

**Morin's Complex Thinking and Besse's Landscape as strategies for a new vision on the planning of green areas and multifunctional urban ecological corridors**

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## SUMMARY

The Cartesian world view established a model of development for western cities that led to a number of environmental, social, and economic consequences. In order to overcome these challenges, a reform in current thinking is necessary. Thus, this article aims to intertwine the concepts of complexity of Edgard Morin and the concepts of landscape proposed by Jean Marc-Besse in order to better understand how the interaction of these two authors can help guide city planning with a focus on sustainability. As a case study, we used the municipality of Rio Claro-SP. The method used was a comparative study of the main works by the authors, as well as an analysis of the process of planning ecological corridors in the chosen municipality, following the steps proposed by Besse. As a result, it was observed that the interaction between landscape and complex thinking is fundamental for creating a far-reaching knowledge network. In the search for sustainability, the dialogic method can be an important tool for creating strategies to solve contemporary challenges of urban planning.

**KEYWORDS:** complex thinking, Cartesian vision, urban project, dialogue, sustainability

## INTRODUCTION

The Cartesian world view arose during the Scientific Revolution, at the end of the Middle Ages, with the advent of the Age of Enlightenment, which emphasized the use of reason, and anthropocentrism, which places mankind as the center of everything. Thus the rationalist method of Descartes was born, a mathematician whose thinking went on to influence the development of societies for centuries (GAIA, 2017). He formulated the paradigm of simplification, in which the thinking subject (*ego cogitans*) and the understood thing (*res extensa*) are seen separately and advocated the idea of human beings as being separate from nature (MORIN, 2007). In these midsts, the physicist Isaac Newton developed methods and physical laws of motion that would become the foundation for the mechanistic view, in which the universe can be described and explained just as one would describe a mechanical clock. Such a vision conceives the universe as a machine, whose processes are divided into smaller parts to be analyzed separately in order to understand the functioning of the whole (GAIA, 2017).

These ideas were the basis for the Industrial Revolution and the advancement of science and technology. In the context of the Scientific Revolution, the thinkers of the period established the notion of man and nature as separate elements, in disconnection. Nature became a mere resource to be exploited and the notion of civilization was seen as the sum of all inventions that demonstrated mankind's ability to conquer nature (THOMAS, 1989). This greatly influenced the way in which society subsequently developed and how the beginning of the Industrial Revolution took place. Urbanization was also influenced by this thinking, following Cartesian logic, paving the way to the occupation of new areas quickly and regularly, without any consideration to the social and environmental consequences (ROSA, 2017).

At the end of the nineteenth century, steel used in the manufacture of machinery caused a rapid transformation in urban landscapes, leading to the verticalization of cities. From the 1950s, in the post-war period, industrialization was on the rise, which prioritized means of transport on wheels, powered by fossil fuels (HERZOG, 2013). In the mid-twentieth century, the predominant urbanization model consisted of large interventions with complete disregard for the entire lithological, hydrographic and geomorphological structure of cities. Actions such as leveling hillsides, channeling rivers and landfills of wetlands, mangroves and coastal areas were present in almost all examples of urban planning in cities. The deforestation of native vegetation and the implantation of exotic plant species were carried out in most cities (HERZOG, 2013).

This manner of urban development, however, has triggered a series of consequences such as air and water pollution, disordered expansion, and the blocking of river flows, which contribute to floods (ISA,2007). It has also been responsible for the loss and fragmentation of habitats, the intensification of land use, and the homogenization of national territories. As a result, the mobility of plants and animals around and within cities has been restricted, causing increasingly reduced levels of biodiversity (FISCHER; LINDENMAYER, 2007).

Converse to this viewpoint, since the 60s, criticism against the status quo has become frequent and a new paradigm based on holistic science emerged with an approach more focused on quality, and which takes into account that everything is connected and interconnected. The holistic view does not privilege only certain areas, but has interdisciplinarity as its central theme: it is characterized as a way to see the world as an interconnected network, where all the small parts are important for understanding the whole; it is a way to view the world from various angles, taking into account various aspects, with the awareness that all the smaller areas of knowledge and ways of learning are important for the understanding of the whole (GAIA,2017). It also considers humankind to be an integral part of nature. Therefore, we as research subjects cannot analyze any phenomenon without considering ourselves as part of this whole that influences and is influenced by nature.

Similar to holistic science, complex thinking, as proposed by Morin, also proposes to weave together the various fields of knowledge, however with some differences: while holism considers the sum of the parts for the understanding of the whole (ESTRADA, 2009), complexity says that “the whole is simultaneously more and less than the sum of the parts” (MORIN, 2007, p.86). This is because knowledge of the parts does not aid in knowing the properties when analyzing them as a whole. Similarly, when the parts are analyzed considering only the set as a whole, many qualities and knowledge of each of them are inhibited. Moreover, Morin states that the acceptance of the notions of disorder and emptiness are fundamental for the development of complex thinking.

Regarding the issue of urban planning, the logic of complexity proposed by Morin is fundamental for reform in the line of thinking and approach of city planners, as it encompasses different issues that had been so far ignored by Cartesian logic. Hence, complex thinking can help overcome and face contemporary challenges. Following this rationale, we have the concept of landscape, which has emerged with a new perspective on issues related to urban planning and the conception of cities. Throughout many decades, the definition of a landscape was regarded as a natural panorama generally seen from high ground. Jean-Marc Besse (2018, P.11) argues that the essential character of the landscape is its relational dynamics, and the landscape is a living medium of unstable compositions, in which men are inserted and of which they are participants. The author is a philosopher and director of the Centre National de la Recherche Scientifique (CNRS) in Paris. His expertise is focused on the history and epistemology of geography, as well as issues relating to landscapes and the environments of contemporary culture.

Thus, the present article aims to understand how the interrelationship of the concepts worked out by these two authors can better guide the planning of urban multifunctional green areas that add aesthetic value, social well-being, and improved connectivity between these important green spots located in the urban mesh. The specific objectives are: 1) to intertwine

Morin's vision of complexity and the synthesis of landscape concepts proposed by Besse and 2) to analyze a case study that elaborated the project of urban green areas, while integrating some principles from this school of thought.

## **METHOD**

In the present study, textual sources were used from articles and books focused on the works of authors Jean-Marc Besse and Edgar Morin. The approach method used was dialogic, which means intertwining knowledge that is apparently separate (MORIN, 2007). Regarding the procedure, the comparative method was used (Marconi; LAKATOS, 2003) between Morin's complex thinking (2007) and Besse's ideas on landscape (2014). Through this union, we analyzed how the ideas of both can be useful in guiding the planning of multifunctional green areas.

As a case study, we used the municipality of Rio Claro, a medium-sized city, located in the central-eastern portion of the state of São Paulo, which has an area of 498.7 km<sup>2</sup> with a population of 201,212, and a population density of 403.7 inhabitants/km<sup>2</sup> (SEADE, 2020). To analyze the socio-environmental context of the city, research was done on sites such as that of The Brazilian Institute of Geography and Statistics (IBGE), as well as articles and studies conducted in the city. To analyze the coverage and land use of the municipality, a map of Rio Claro was developed to identify which types of buildings are present among the trees in the city. To that end, two main existing maps were superimposed: one of manual classification of buildings and another of supervised classification of soil and vegetation uses. All maps were made using ArcGIS 10.4 software.

For the first ground cover map, two RapidEye satellite images detailing Rio Claro were used, from the year 2010, in Raster format. These images were acquired from the online geocatalogue of the Brazilian Ministry of Environment (<http://geocatalogo.mma.gov.br/>). Based on these images, an automatic supervised classification was performed generated by ArcGIS, through the Maximum Likelihood Classifier tool, where all other pixels in the image are classified based on the similarity of their spectral firms with those of the training pixels indicated for the main types of vegetation cover and land use of the region of interest. In the present study, the training sites were: urban area, water, tree vegetation, and herbaceous vegetation (including agriculture) generating a map containing these four categories. Then, files in Shape.file format were obtained with the City Hall of Rio Claro containing information on the use and occupation of the lots. At this stage, the conference and reclassification procedures of the buildings of Rio Claro were conducted. The categories used were: residences, industries, buildings, business and services (including schools, churches, universities and hospitals), and empty lots.

## **A SYNTHESIS OF COMPLEX THINKING**

Edgar Morin is a French historian and philosopher who, among his numerous contributions, addresses the notion of complexity. According to the author, complexity is “a fabric (*complexus*: that which is woven together) of heterogeneous constituents inseparably associated (...). It is effectively the fabric of events, actions, interactions, feedback, determinations, and happenings that constitute our phenomenal world” (MORIN, 2007, p.13).

Therefore, the knowledge of complex thinking is not limited simply to the analysis of science, but also includes the knowledge that exists in philosophy, the arts, literature, myths, and human nature.

There are three principles that lead to complexity: 1st dialogic, 2nd recursive and 3rd hologramatic. The first principle is based on dialogue and aims to intertwine that which is apparently separate along with the acceptance that both-order and disorder can collaborate with each other: "the dialogic principle allows us to maintain duality within unity". It associates two simultaneously complementary and antagonistic terms" (MORIN, 2007, p. 74) to produce organization and complexity. The second principle is that of organizational recursion, in which the cause produces the effect that produces the cause. In other words, "products and effects are producers and causers of that which produces them," (MORIN, 2007,p.74). An example to better understand this idea is the notion of society and individual:

*Society, for example, is produced by the interactions of the individuals who constitute it. Society itself, the organized and organizer as a whole, retroacts to produce individuals through education, language, and school. Thus individuals, in their interactions, produce society, which in turn produces the individuals who produce it (MORIN, 2007, p. 87)*

The third principle is the hologramatic, which considers that not only the part is in the whole, but also the whole is in the part. One way to understand this is the example of DNA: every being is encoded by its DNA, which is present in each individual cell. Therefore, although an individual is composed of millions of cells, by looking only at the cellular unit one can find the totality of the genetic heritage of any one being. From a social point of view, the individual is part of society, but society is present in each individual in the form of language, culture and norms. Thus, "the hologramatic idea itself is linked to the recursive idea, which is linked, in part, to the dialogic idea" (MORIN, 2007, p.75). The notion of totality, therefore, is constituted from these three principles. However, it is important to note that the totality will never be equal to the sum of its parts. This is because, according to Morin (2007, p. 86), "the whole is simultaneously more and less than the sum of its parts" since certain knowledge of the parts that make up the whole does not help us to know the properties of the set of parts. Likewise, when analyzing the set, many qualities and specific knowledge of each of the parts are inhibited or lost.

In addition to these principles, Morin proposes seven lessons necessary for the application of complex thinking: (i) detect error and illusion, (ii) grasp principles of pertinent knowledge, (iii) teach the human condition, (iv) work for an Earth identity, (v) confront uncertainties, (vi) understand each other, and (vii) take responsibility for ethics for the human genre. (FERREIRA,2020). The first one to learn he argues relates to the necessity to include all the errors in the concepts so that the knowledge can advance. The second states that relevant knowledge requires an understanding of the whole for the development of specific knowledge, which is quite contrary to the concept of fragmentation. The third states that human nature is organic and rational, but it's also cultural, psychological, and mystical. The fourth relates to the concept of sustainability in such a way that human individuals must understand their identity in life, and reflect on their actions, so as to bequeath a healthy planet for future generations. The fifth states that uncertainty is at the forefront of the progress of knowledge, as doubt is the

driving factor that makes human beings contemplate themselves and the universe. The sixth places understanding as the means and purpose of human communication. The last speaks of ethics, which synthetically refers to the principle of not doing unto others what you do not wish done to yourself. All this knowledge can guide important achievements in the planning of cities (FERREIRA,2020).

## **THE MULTIPLE VIEWS ON LANDSCAPE**

Landscape is a word with multiple meanings, concepts and uses. For Jean-Marc Besse (2014, P.12) we can perceive five possible entrances (doors), “five landscape problems that coexist in contemporary thinking”, which can be articulated among each other. Landscape can be seen as: 1) a cultural and social representation, 2) territory produced by societies throughout history, 3) a systemic complex, 4) a space of phenomenological experience and 5) a project. In the first door, Besse (2014) shows the landscape as a mental perspective, consisting of a point of view, a way of thinking and perceiving in the mental dimension of human beings, and also as an artistic representation, a pictorial invention. The second door opens us to the concept that “the landscape can be defined as a territory manufactured and inhabited by human societies” (BESSE,2014, p.27). The third door has an ecological approach much used in ecology, in which the landscape is seen as a complex system of biotic and abiotic relationships. The fourth door is the landscape seen as a space for a phenomenological experience. Finally, there is the fifth door, mainly used by architects, urban planners and landscapers in order to project the landscape. The present case study is based on ports 3, 4 and 5.

### **Third Door: landscape as a systemic complex**

The Third Door involves an ecological approach much used in Ecology and other natural sciences (geology, pedology, biology, climatology, etc.), in which the landscape is seen as a systemic complex of biotic and abiotic relationships. Ecology shares the concept of the ecosystem as the basic unit of reference, in which occur interactions between organisms. In this perspective, the landscape is considered a portion, or a frame, of the ecosystem. It is a fragment of an environment that presents “a dynamic, evolutionary totality, crossed by fluxes of variable natures, intensities and directions” (BESSE, 2014, p.43).

One of the ramifications of ecology is the landscape ecology, which first appeared in 1939, founded by the scientist Carl Troll, as a study of the interrelationships of the physical elements of the landscape as a means of life (SIQUEIRA et.al., 2013). Landscape Ecology is born from the union of geographers and ecologists, with two approaches: geographical and ecological. Metzger (2001) states that while the geographical approach favors the study of the influence of man on the landscape, the ecological one emphasizes the importance of the spatial context on ecological processes and its importance for biological conservation. In the ecological approach to landscape ecology, the landscape is classified as: a heterogeneous area composed of groups of interactive ecosystems (FORMAN; GODRON,1986), “a mosaic of heterogeneous forms of land, vegetation types and land uses” (URBAN et al., 1987, p.119), or as “an area that is spatially heterogeneous in at least one factor of interest” (TURNER, 2001, p. 7). In this case,

the landscape ecology encompasses the knowledge of how this mosaic of different landscapes uses influence species over time and space, while taking into account multiple aspects.

#### **Fourth door: a space of phenomenological experience.**

The fourth door is the landscape seen as a space for a phenomenological experience. Phenomenology is the study of essences (essence of perception, essence of consciousness). It is a philosophy that seeks to describe our experience as it is, without the casual explanations that scientists, psychologists and historians can provide. It has the task of revealing the mystery of the world and the mystery of reason (MERLEAU-PONTY, 1996). Phenomenology was conceived as "a return to things", a systematic investigation of consciousness and its objects (NORBERG-SCHULZ, 2006).

The phenomenological approach is linked to the perception of the individual. It deals with the apprehension of bodily senses, from the experience of the individual who looks, feels and recognizes the space as expressive and symbolic (MERLEAU-PONTY, 1996). It is also able to articulate the socio-historical, subjective and cognitive conditions for gaining knowledge (NÓBREGA, 2008). Considering our context, the fourth door would therefore be the act of seeing the landscape as a sensorial experience between the internal and the external, an opening to the sensitive qualities of the world; an encounter between man and the world around him (BESSE, 2014).

The landscape is a bodily experience that corresponds to a sensorial experience gained through the exposure of the body to the whole. It is about connecting with our sensitivity to the world and to others: "the landscape articulates the space and time of our existences and inserts them into their rhythms. It is the primary form, in the mode of bodily sensitivity, of our experiences with the earthly world" (BESSE, 2018, p.106). Therefore, even the act of observing a landscape would imply bodily interaction of the senses with it. It is like an encounter, in which human beings project their emotions and feelings as the landscape impresses its forms and aura back at us (BESSE, 2018).

#### **Fifth Door: Project**

The fifth door is mainly used by architects, urban planners and landscape designers. These professionals base themselves in logical action onto the world. A project is intended to convey a message in a determined historical moment where specific political, economic and cultural events and relationships have manifested. It is to manufacture the symbolic while allowing the a given place to be identified within the landscape and the landscape within nature (LEITE, 1996). A project can also be a "response" to a "problem" (spatial, social, ecological, etc.) and which offers an interpretation, a reformulation, a resolution (LEITE, 1996).

Landscape projects have the ability to transform a space into a place. A place is a concrete and symbolic construction of the space. It creates relational, historical, and identity foundations (AUGÉ, 1994). Places are qualitative phenomena, which go beyond the concept of location, because they bring with them symbolism, character and identity of a given place (NORBERG-SCHULZ, 2006). "The design gives the place a meaning and a structure. The meaning

comes from the relationship it establishes with the surroundings. (...) The structure, in turn, stems from the formal properties that the design has within a system of relations" (LEITE, 1996, p.8).

#### **APPLYING THE THEORIES OF MORIN AND BESSE IN THE CASE STUDY OF GREEN AREA PLANNING IN RIO CLARO.**

When we want to design, think and act with the landscape, Besse (2018) says that we must first be attentive to it, observe it, and put into action a system of rules that guides the vision. It is defined as a movement between "seeing" and "building", because we must first know how to see to be able to build, and know how to see what we want to build. It is also necessary to understand the territory and the place where it will be designed, because all places have memory and are not like a blank page: "the soil is the effect of a historical construction, which brings a whole superposition of the past and which is, simultaneously, a reserve for future energies" (BESSE, 2014, p.58). Thus, it is necessary to consider the urban space within the complexity of how it fits into the organization of the space that surrounds it: temporalities, functions, the road network, rural environment and the natural environment (BESSE, 2014). Such complexity is possible only when considering the three principles described by Morin (2007): dialogic, recursive and hologramatic.

Designing with the landscape requires description and invention, proposition and revelation in a form that already exists, potentially already roughcast in the space (BESSE, 2018). The author mentions four topics that one must have to work with the landscape: 1) situation, 2) knowledge, 3) references and 4) idea. The first topic covers the importance of understanding the context of the area, for the design: its history, politics, and laws, but also its irregularities, climate, topography and geology. The second requires the designer to have certain amount of technical knowledge, through the medium of photography, for example, or mapping, and writing, but mostly from the point of view of experience, by the means of a site visit in order to "feel the ground". The third refers not only to the search for examples in designs, but it also have scientific and political references, among others. Lastly, the idea is about being inventive and create, but also discover what is already there (BESSE, 2018). Landscape design can therefore be understood as: creating something that is already there (BESSE, 2014, P.61).

To design the landscape would be, simultaneously, to put it in image or represent it (projection) and imagine what it could be or come to be (projection). This ambiguity, or this circularity, is constitutive of the very notion of design in landscape philosophy. It emphasizes the two dimensions contained in the act of the design: to observe, on the one hand, and to modify, on the other (BESSE, 2014, p.60). Considering this vision of design, we used the steps suggested by Besse (2018) on designing and working with the landscape to propose a new vision of urban planning, based on studies previously carried out in the municipality of Rio Claro and analyses of the territory.

#### **Step 1 - situation: understanding the socio-environmental context of the municipality**

Rio Claro was founded on June 10, 1827, becoming a municipality only in 1845. The



city originated from an old village that served as a stopover between the capital of São Paulo and Cuiabá in the colonization period by the trailblazers and adventurers who settled in the area, building the first houses on their properties on the banks of the Ribeirão Claro (PMRC, 2020). In 1817, Manoel de Barros Ferraz and the Galvão family from Itu acquired the first land grant in the hinterlands of Morro Azul. In the following year the second land grant was granted to the Goes Maciel family and so on successively. From the concessions of land grant to various families, many farmers began to arrive bringing enslaved Africans. Later, Swiss and German immigrants arrived (PMRC, 2020). In 1845, it gained its administrative autonomy, with the denomination of São João do Rio Claro, having its name simplified to Rio Claro in 1905. In 1876, the railway connection between Campinas and Rio Claro was inaugurated, carried out by the Companhia Paulista de Estrada de Ferro. A new railway, linking Rio Claro to São Carlos and Araraquara, was built between 1881 and 1885, also by the Companhia de Estradas de Ferro do Rio Claro, later acquired by the Companhia Paulista, now FEPASA (GIESBRECHT, 2017).

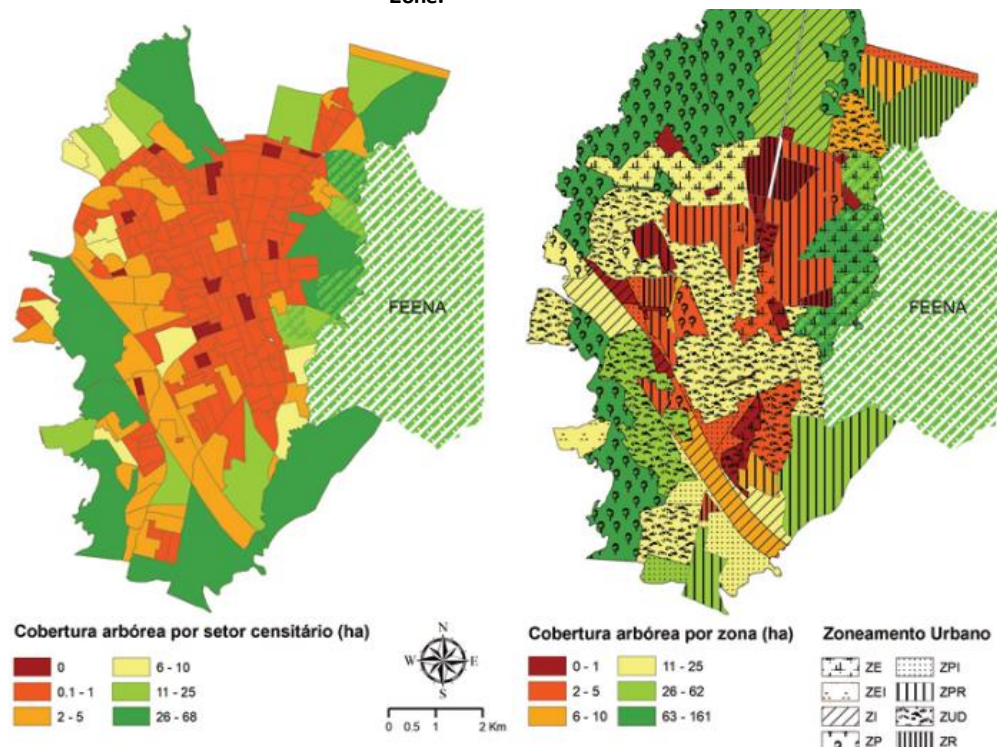
Located in the region of Campinas (second largest industrial pole of the state), it is part of a highly developed micro-region and in constant economic expansion. The municipality is located in the southern portion of the transition between the Brazilian tropical savanna and the semi-deciduous seasonal forest. The climate is tropical with two seasons: cold and dry winters and hot summers with high air humidity. The average annual temperatures of the city range from 18.1 °C to 20.9 °C. The urban perimeter has 58.01 m<sup>2</sup> of woody vegetation per inhabitant and one of the largest eucalyptus reserves in the state of São Paulo, the Navarro de Andrade State Forest (FEENA), which despite presenting mostly exotic species—mainly plantations of *Eucalyptus* spp.—it is considered a conservation unit for its historical character and scenic beauty. However, both urban vegetation and green spaces are poorly distributed around the urban perimeter (PENA et al. 2020).

In 2014, the Rio Claro City Council, with support from the Secretariat of Planning, Development and Environment, hired an environmental diagnosis of the municipality, with emphasis on the assessment of soil, water quality and vegetation cover status (PMRC, 2014). From the diagnosis, it was found that the municipality presents serious environmental problems as a consequence of reduced planning and supervision in the development of its main economic activities: clay and sand extraction, sugar cane monoculture and livestock (PMRC, 2014). Rio Claro is part of the Santa Gertrudes ceramic pole, the most important in the country, and consequently has the third worst levels of particulate matter in suspension (PM<sub>10</sub> and PM<sub>2.5</sub>) in Brazil (WHO, 2016), falling behind only Santa Gertrudes (neighboring municipality) and Cubatão (also in the state of São Paulo). The high rates of air pollution stem mainly from the processes of transportation and drying of clay, largely carried out in open courtyards rather than through industrial drying methods.

In addition, the evaluation of afforestation in the city carried out in the study developed by Pena et. al. (2020) showed a large deficiency of trees in the streets. The study used information on the composition of species and the number of arboreal individuals (with height greater than 1m and diameter at chest height greater than 10 cm) in 35 green areas distributed across different regions of the municipality to evaluate the influences of characteristics of the urban environment on different groups of organisms, such as birds and ants. The results show that while the census sectors located in peripheral regions can host up to 68 ha of tree

vegetation, practically all sectors of the central region have between 0 and 1ha (PENA et al. 2020; Figure 1), a situation also seen in many other medium-sized cities in Brazil (PENA et al. 2020).

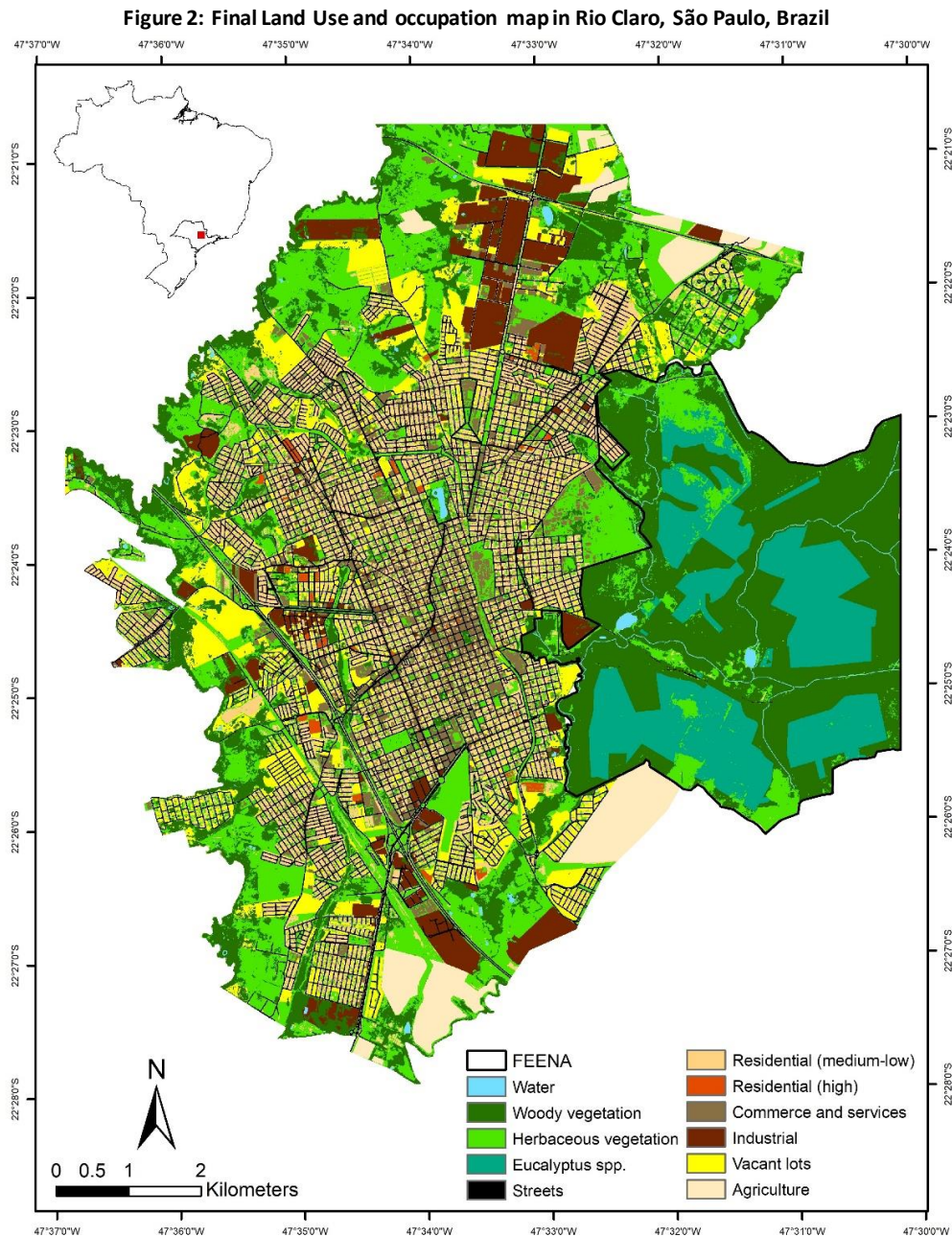
**Figure 1: distribution of tree cover in the urban perimeter of Rio Claro according to census sectors (left.) and urban areas (right). FEENA: Edmundo Navarro de Andrade State Forest, ZP: Protection Zone, ZE: Special Use Zone (Cultural Preservation/Water Resources), ZEI: Special Zone of Social Interest, ZR: Residential zone, ZPR: Predominantly residential zone, ZUD: Diversified Use Zone, ZPI: Predominantly Industrial zone, ZI: Industrial Zone.**



Source: PENA et al., 2020

## Step 2 – Knowledge: mapping and simulations of multiple least cost corridors (*MLCC*)

The analysis carried out from the land use maps of Rio Claro also showed the same deficiency in relation to the urban afforestation of the municipality. Urban area represents 38.9% of the total mapped territory. Within this urban area, it can be seen that the arboreal vegetation represents only 4.8% of the landscape, while the built-up area represents 69.2%. Considering only the streets and avenues of the city, those wooded represent only 4.1% of the total avenues and streets in the urban network and only 0.5% of the total landscape. In the municipality, the cemented area is 14 times larger than wooded area.



Source: GRAVIOLA et al., 2017

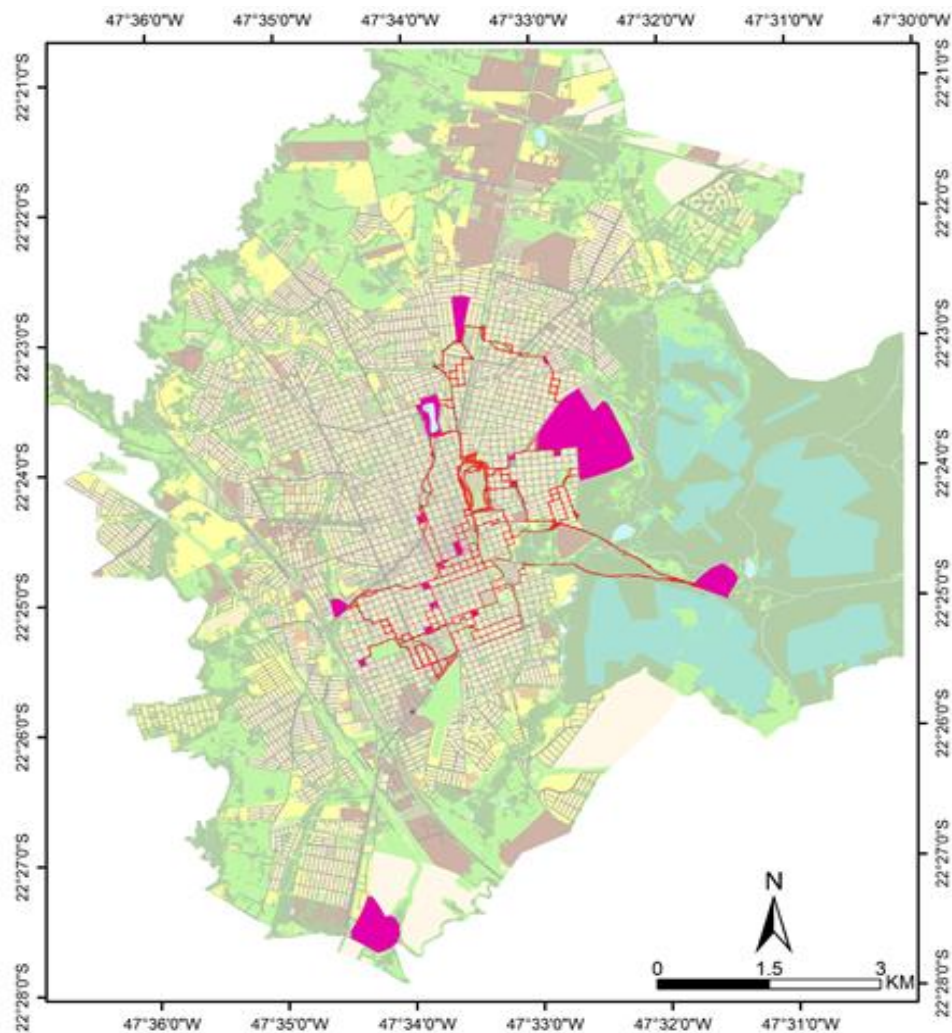
From the mapping, analyses related to landscape connectivity were conducted for the two study groups: birds and humans. In dealing with the planning of multifunctional corridors, which aims to bring benefits to the fauna and the population and simultaneously integrate the urban landscape in no varied meanings, resistance<sup>1</sup> maps were created for both groups (GRAVIOLA et.al. 2021). The establishment of the values assigned for each land use to people was defined under the guidance of the architect and urban planner Patrícia Sanches, who assisted in the establishment of the important criteria to be considered, such as recreation,

<sup>1</sup> Resistance maps are maps in *raster* format, whose pixels receive resistance values--meaning, they receive a value according to the level of facility and/or difficulty that the analyzed individual has in crossing the landscape. These values are defined in the discussion section with several experts from the analyzed group.

leisure, sports practices, contemplation of nature, sociocultural inclusion, mobility and movement of people (SANCHES, 2011). For the creation of the bird resistance map, a table was elaborated of the characteristics of the species, such as their ability to cross urban centers, sensitivity to urbanization and dependence on forest environment (GRAVIOLA et.al. 2021).

Finally, from the resistance maps, the paths of lower cost were modeled using the software LSCORR (Landscape Corridor), developed by Ribeiro et al. (2017), in which multiple possible routes were simulated, based on the distance and resistance of each region, i.e. the cost of displacement and the spatial congruence between the different solutions. Multiple least-cost corridors (MLCC) and LSCORR software are reliable tools that can be very useful in planning urban parks and gardens. Both enabled us to estimate the probable routes of movement of birds and people within the urban landscape. With the result of the simulations, the maps were superimposed to identify the priority streets for urban afforestation and the areas chosen as routes by the software, but which are currently urban voids or abandoned areas, which present great potential as sites for future urban parks (GRAVIOLA et.al. 2021).

**Figure 3: result of simulations of the lowest cost paths (MLCC) common among people and birds in the urban landscape of Rio Claro (São Paulo, Brazil).**



Source: adapted from GRAVIOLA et. al, 2021

### **Step 3-References: approaches for a more complex vision of planning cities**

There are many examples in today's world of cities for which the planning considers connectivity and the quality of the environment for all living beings. By considering the context of the street, road afforestation provides thermal comfort, in reducing energy consumption with air conditioning and provides habitat and resources for urban biodiversity (LIVESLEY; MCPHERSON; CALFAPIETRA, 2016).

In Brazil, some cities in Northern Paraná were planned and inspired by Howard's urban ideas (SZMRECSÁNYI, 2000). Considering the Brazilian capitals, Curitiba and Belo Horizonte stand out as examples of urban planning that take into account landscape and environmental issues (SCBD, 2012). Particularly Curitiba is internationally recognized for its urban park designs that associate leisure equipment with urban intervention designs and present concrete measures in relation to environmental preservation (OLIVEIRA & RECHIA, 2009). In addition, most of its parks establish direct contact with water, where users can interact and enjoy rivers and lakes.

These examples show that it is possible to plan cities that congregate the communion between culture, society and nature. Analyzing the history, landscape and socio-environmental context to guide the creation of ecological corridors is one of the possible paths to achieving this goal. In both Portugal and Brazil, there are several examples of corridors created from prior landscape studies (FRISCHENBRUDER; PELLEGRINO, 2018; SILVA et al. 2006; RIBEIRO; BARÃO, 2006). The creation of ecological corridors comes as a challenge for landscape architecture, which

*[...] works in the field and often seeks to re-naturalize, to return to impoverished and degraded landscapes the ability to regenerate and resume the processes of growth and immanent self-regeneration of which they were deprived (SERRÃO, 2013, p.24).*

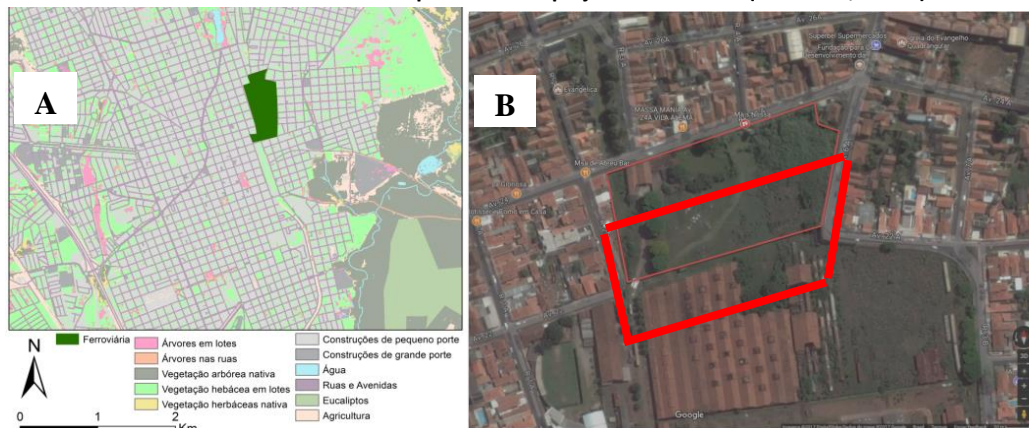
The Five case studies in Portugal, analyzed by Ribeiro and Barão (2006) showed the significance of ecological corridors as a planning strategy to achieve the political objectives for the creation of a more sustainable city at the municipal level. But what can be seen as an expansion in the creation of these spaces does not necessarily mean that ecological corridors bring with them all their potential effect on environmental quality (FRISCHENBRUDER; PELLEGRINO, 2018). In the case of cities, the success of the corridors in the environmental and social aspects depends on whether the guidelines are based on examples of successful implementation of the same; hence, in order to reach the full potential of corridors, it is necessary to produce accurate information, and to apply it as a tool for planning. It also involves training planners and designers at every level so that they take into account such studies, in addition to sharing scientific information on all areas of society (FRISCHENBRUDER; PELLEGRINO, 2018).

### **Step 4 – Project idea**

From statistical and urbanistic Analyses developed throughout Stage 2, the area of the former railway station (figures 4A and 4B) was chosen for the construction of the multifunctional corridor project, since it is a central area in the downtown area of the city and is a point of confluence of routes from the simulated movement preferences for both bird species and

people (GRAVIOLA et al. 2021). The railway was opened in 1876 and operated for 100 years until, in 1986, it began its abandonment, being officially decommissioned in 2001 when the passenger trains were decommissioned (GIESBRECHT, 2017). The area used to prepare the design was indicated in Figure 4B, because there is no rail or train and is currently abandoned and unused.

**Figure 4: Photo A – the railway station area highlighted in green. Photo B – Red delineates the railway station area to be used for the development of the project in Rio Claro (São Paulo, Brazil)**



Source: own authorship, 2017

Currently, some lines still function as freight transport, but most of the station is in total abandonment and many buildings dilapidated (figure 5A), making it an unused and neglected part of town, which makes it dangerous to walk through at night, not to mention the occasional muggings. In addition, this area is overrun by exotic herbaceous species, and generally neglected of landscape maintenance (figure 5B).

**Figure 5: abandoned area of Rio Claro Railway Station (São Paulo, Brazil), which presents (5A) dilapidated buildings and (5B) terrain overrun by herbaceous vegetation (*Brazhiaria* sp)**



Source: own authorship, 2017

As a proposal, the project proposes that the abandoned buildings (figure 5A) should be restored and re-signified in the urban landscape, due to the historical value represent as important cultural heritage to the city. These locations have the potential to become the art and History Museums of Rio Claro. In the outdoor area, the concept was to create a forest with native plant species from the region with a walking trail 500m long, in addition to a garden of conventional edible plants (PANC) and a labyrinth containing several vine species intended for

children. The aforementioned labyrinth was conceived as a spaces for promoting environmental education to the citizens of Rio Claro (ROSA et al. 2017).

The project also has a pavilion for cultural and circus activities. The pavilion could be used for teaching an array of cultural modalities and various sports. In addition, it could be a space dedicated to shows, temporary exhibitions, lectures on the environment and even a space for town meetings where the population could be invited. In the background, on the right side, considering the front view, is a parking lot for 100 cars and 120 bicycles, surrounded by ipê trees of different species (ROSA et al. 2017). For its implementation and maintenance, this project could be financed by the mining companies hosted by the city that for years have not complied with their environmental responsibilities (MPSP, 2019) provided for by Article 36 of Federal Law No. 9,985/2000, of SNUC.

**Figure 6: experimental design of the project. Aerial view of the multifunctional park with the presence of: 1) the forest of native species, 2) cultural pavilion, 3) flowerbed of PANC, 4) labyrinth of creepers and vines, and 5) museum for the municipality of Rio Claro (São Paulo, Brazil).**



Source: own authorship, 2017

## FINAL CONSIDERATIONS

Complex thinking conceives *complexus*, which means that which is woven together. In this case study, we analyze a green area planning model contemplating multiple aspects that aim to align human well-being with environmental preservation. It is important to note that the process of drawing up the project is more important than the project itself. This is because the objective of this article is to implement a new world view that aggregates multiple aspects of this particular knowledge base. In this project, we consider different aspects of this knowledge base and are guided by some of the knowledge proposed by Morin's complex thinking: such as the 2nd topic, which refers to knowing which knowledge is pertinent, and which goes against fragmentation, revealing the need to aggregate various aspects of knowledge. And the 4th, which relates to teaching our earthly identity, so that human beings can understand themselves as an integral creature of Planet Earth, responsible for leaving behind a healthy and biodiverse planet for future generations (FERREIRA, 2020).

The theory of complexity considers the various areas of knowledge and diverse philosophies for the planning of cities in order to integrate socio-ecological functions and to stimulate the internal perception of humans with their multiple senses. This intertwining of areas of expertise and knowledge is what is proposed to the dialogic method of Morin's theory, which seeks to gather, contextualize, and globalize knowledge, while recognizing that which is singular, the individual and the concrete. Both in Morin's complex thinking and in Besse's landscape, the natural environment is no longer part of "that part" of town, or in the "sticks". Nature is part of the core of urban life and proper planning must consider it and act out of concern for water and air quality by way of park and garden projects and the installation of sustainable infrastructure (BESSE, 2014).

Landscapes are part of our everyday life and are present both on the individual plane (our beings), and on the collective plane (our lives) (BESSE, 2013). Landscapes are not just a view, but comprise a world that is lived, manufactured, or inhabited by ever-changing human societies (BESSE, 2014). In this sense, it is possible to perceive a landscape as the conjunction of all this, reconciling physical, social and historical aspects, as well as the ideological and psychological. Meinig (1979) summarizes this idea, saying that "any landscape is composed not only of what is before our eyes, but also of what is inside our heads".

Considering the challenges and consequences arising from the Cartesian vision in the process of urbanization, a thought reform is called for, aimed at the transdisciplinarity of knowledge and which includes the principles and lessons of complex thinking in urban planning. It is also essential to consider landscapes in the context of their multiple meanings. Therefore, the interaction between complex thinking and landscapes is fundamental for the planning of more sustainable cities. This is an interesting relationship to consider, as it is able to create a vast network of knowledge focused on seeking solutions to social, environmental and economic problems. With regards to the search for sustainability, the dialogic method of complex thinking can be an important tool to create strategies that seek to make urban landscapes healthier ecologically and more socially just.

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