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REVIEW ARTICLE

Urban ecology and planning: A necessary convergence

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ABSTRACT

The global large-scale urbanization of the territory is one of the most important ecological phenomena today. The standards used in urban growth are crucial to the protection of biodiversity and affect the provision of a reasonable quality of life for the urban population. Contrary to the views of many biologists and other scholars, cities are barren environments. Contrary to nature, urban ecology, as a necessary interdisciplinary science, recent developments show that cities are heterotrophic ecosystems, which need to be planned in a way to reduce their impact on the biosphere and improve their ability to maintain biodiversity.

Keywords: urban ecology; urban ecosystem; urban biodiversity; city planning

1. Overview of world urbanization

Today, more than half of human beings live in cities, which is why we have seen unprecedented urban landscape expansion. For example, cities account for about 10.2% of the earth's coastal areas[1]. This is undoubtedly the most important human ecological phenomenon in the 20th and 21st centuries, reflecting the biosphere and mankind, but it has not been fully quantified and understood.

In Brazil, the process of urbanization has led to the displacement of millions of people from rural areas to cities. In 1890, Brazil's urban population was about 10%, which has been the opposite for decades: Today 83% of Brazilians live in cities[2]. In the first cycle, immigrants have moved to big cities. Since the mid 1990s, Brazil has begun an urbanization cycle divided by urbanization cycle, with a significant increase in the number of average cities (cities with a population of 100,000 to 500,000), people living in these cities and areas living in these cities. It can be clearly seen that the area occupied by metropolises has decreased (from 28.23% to 16.23%), while the area occupied by average cities has decreased from 11.77% to 27.23% of the total urban area of Brazil from 1970 to 2000. During this period, the average number of cities also increased significantly, from 40 in 1970 to 194 in 2000[2,3].

Of the 5,570 municipalities, Brazil currently has 258 medium-sized cities. About 25% of the Brazilian

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population lives there. In addition, these cities continue to grow faster than large and small cities[4]. The current urbanization trend in Brazil reflects a global phenomenon. Contrary to popular belief, most of the world's urban population growth occurs in small and medium-sized cities, which often have very weak planning and implementation capacity[5]. At the beginning of the 21st century, 52% of the 3.3 billion urban residents lived in cities with a population of less than 500,000. By 2025, these cities will absorb about half of the expected growth of the global urban population. In addition, the poor will account for a large proportion of the world's urban population growth in the future[6].

2. The planning and management standards of two medium-sized cities in Brazil are low

Angoletto et al., respecting the effectiveness of urban environmental management in medium-sized cities in Brazil, divides these cities into two categories. Poor medium-sized cities[4]. The most notable features are high illiteracy rate, young population, low wages and less municipal environmental management action. This group of poor cities is completely concentrated in northern or northeastern Brazil.

On the other hand, in contrast to the poor cities in northern and northeastern Brazil, the affluent city of predo is exploiting the adult population with low birth rate, high education and high wages. Therefore, consumption standards are more complex than poor cities. Cars and other vehicles are a good illustration of the differences in consumption between Brazil's rich and poor medium-sized cities. The per capita vehicle ratio of cities in southern and southeastern Brazil is very similar to that of cities in first world countries. For example, in Malinga city (Parana), there is one private car for every 2.08 residents, while kamita (Pala) has one car for every 55.1 residents.

The study of angoletto et al. pointed out that in the most prosperous medium-sized cities, the citizen/vehicle ratio is low[4]. They pose a major public health problem due to the pollution emitted by vehicles (and too many other effects related to the use of vehicles). In addition, these data clearly show that measures need to be taken to reduce the role of cars, which is dominant not only in transportation, but also in shaping Brazil's urban form. In fact, to some extent, this is a dilemma for all Brazilian cities because of the rapid and continuous expansion of the national fleet, which can be explained by various factors, including economic stability, lack of urban land use planning, adoption of transportation modes that give priority to private vehicle travel, and insufficient investment in public mass transportation[7]. In addition, in response to the economic crisis in 2008, the government also encouraged the purchase of vehicles by reducing the IPI (tax on industrialized products) for the sale of cars and motorcycles[2].

The average number of staff of the municipal environment secretariat (or similar institutions) is 13 per 100,000 people, of which only two have university degrees. Despite more action on environmental management in wealthy medium-sized cities in southern and southeastern Brazil, there are three types of control measures with low incidence, regardless of city type. The lack of specialized environmental officials and relatively weak environmental management equipment and actions in central Brazilian cities indicate that the effectiveness of environmental problems and impacts that need to be corrected or avoided in these cities is very low[6].

Many urban environmental problems are due to administrative inefficiency and lack of coherent urban planning and policies, rather than the urbanization process itself. In Brazilian cities, management and planning have not yet become environmentally effective tools[8]. It is clear that although environmental issues have become important in civil society, environmental issues at the urban level in Brazil have not received high attention. In medium-sized cities, we do not even meet the soft sustainability standards of cities in developed countries. The sustainability of some parameters, such as those related to the air quality of urban ecosystems. There are few staff to develop public

environmental policies that effectively address the huge environmental challenges of Brazilian cities[4].

3. Urban ecology: Inevitable interdisciplinary science

According to Angeletto[2] and camps Calvet et al.[9] urban ecology is a science that integrates the theories and methods of natural science and social science to study the standards and processes of urban ecological theme system. The intersection of natural science and social science is the core paradigm of urban ecology. Urban ecosystem research is a relatively new field of ecology. Until recently, the western knowledge tradition has failed to organically combine nature and society, resulting in the lack of theory on the relationship between ecology and city. The separation between ecology and sociology hinders a broader understanding of urban ecosystems[5].

Barcelona ecologist Jaume Terradas described cities as heterotrophic ecosystems organized by increasing entropy around the earth[10]. Unlike autotrophic ecosystems, which are mainly composed of a food chain composed of photosynthetic organisms that convert solar energy into chemical energy, and chemical energy provides food for a group of heterotrophic organisms, heterotrophic ecosystems rely on areas outside them to obtain energy, food, fiber and other materials, and deposit waste and pollutants.

Streams and oyster reefs are also examples of heterotrophic ecosystems. However, there are three main differences between different cities. The technology metabolism per unit area is much stronger, which requires more intensive energy flow, partly supported by fossil fuels. In order to produce consumer goods that are not necessarily related to human survival, a large number of materials such as metals are needed. Waste emissions are much larger and more polluting[11].

Although they occupy a small part of the biosphere (about 1% to 5% of the earth's land area), cities affect the whole biosphere through their huge inflow and outflow. In short, a city is an ecosystem whose input environment (the area where diving raw materials are collected) and output environment (the point in the biosphere where urban metabolic waste is received) are much larger than other heterotrophic ecosystems. Therefore, it can be said that cities and their ecological processes are not subject to administrative, geographical or political restrictions[5].

For historical reasons, conservation biology divides the world into primitive and degraded habitats. However, a change of mindset is needed: conservation biology must return to human habitats and generate knowledge on how to separate these man-made habitats from wild species[12]. In fact, although the percentage of protected areas worldwide has been increasing since 1990, the number of threatened species continues to increase highlighting the urgent need to develop more biological protection mechanisms.

4. Biodiversity and environmental services in urban ecosystem

From a social perspective (agricultural soils) or an environmental perspective (forests, mangroves and other ecosystems), the transformation of relevant soils is undoubtedly the most harmful impact of urbanization. Lambin and meyfroidt estimated that by 2030, the original or agricultural soil of urbanization will increase by 516 million hectares[13]. In terms of biodiversity, urbanization has generally reduced the species richness of most biological communities, although the biomass of birds and arthropods has increased. There is an obvious exception to this standard: in cities, the richness of plant species tends to increase. The richness (number) of plant species in urban ecosystems is usually higher than that in rural areas, even forest debris[2,12,14,15]. However, it is certain that in urban ecosystems, primitive and alien species dominate, and the latter exist in these environments through intentional introduction (e.g. in public space or landscaping) or accidental introduction (intruder and naturalization). For example, many ornamental plants grown around the

world are not native to these areas[16], but the cultivation of native species is still very limited.

In the biosphere ecosystem, the degree of human orientation of cities is unique. They reflect the unique vegetation group composed of economic, social, environmental and technological factors. In addition, key social resources such as political power, income, reputation and knowledge have produced significant social differences in cities. The spatial standards of these social resources are also important factors affecting the distribution of biophysical and natural resources in urban ecosystems, such as vegetation[17–19].

With the development of urbanization, alien species, animals and plants seem to have a dominant trend. Native and alien species are combined in a unique way in the city, creating writers like Dunn and others and mcpherson et al.[5,6]. We are just beginning to understand the impact of the call for a new ecosystem on biodiversity. In these ecosystems, the impact of alien vegetation on the highest nutritional level is still an open issue. Some studies have shown a significant increase in the number of birds and butterflies in gardens dominated by native vegetation, while others have shown that the diversity of invertebrates and vertebrates is not necessarily related to protozoan species[20].

Many benefits are provided by urban flora, mainly by tree and shrub species. Urban trees alleviate the heat island, and their leaves absorb rich air pollutants and fix carbon dioxide. In areas with rich urban forest vegetation, people are less exposed to ultraviolet radiation. The protection of urban soils and water bodies can also be mentioned. In addition, trees are an important habitat for urban biodiversity, and urban vegetation points (residential gardens, squares, parks and indigenous vegetation fragments) can be used as ecological corridors or steps connecting urban and forest landscapes[9,21].

Some epidemiological studies have shown that it is positive to enter the green space for a longer time, because areas with abundant vegetation, including Kuntai area, are more capable of reducing air pollution and urban heat island. Heat island increases the incidence of myocardial infarction due to the excessive demand of the cardiovascular system for blood and the need for thermoregulatory mechanisms. In addition, green areas encourage physical exercise such as walking and gardening[22].

Economic benefits include assessing well vegetated housing in residential areas, reducing heating and cooling costs, and making it easier to attract capital, business and employment opportunities. Associated with more abundant tree coverage around, residential electricity costs can be reduced by up to 30%[9,15].

Urban ecosystems with larger and better green spaces are more resilient, attract more biodiversity and provide more ecosystem services. However, although people's understanding of the multiple functions and benefits of urban green space has been well developed, it has not been fully integrated into the design, planning and management process. In addition, methods to assess these areas to effectively support decision-making often do not exist[15].

The richness of plant species in urban ecosystem is usually high, but it is unevenly distributed among communities, which is an environmental injustice, that is, the inequality of access to environmental resources defined by Alexo et al[23]. Communities with higher socio-economic status usually show greater plant diversity in their public spaces, such as parks and squares (usually not present in poor communities) or residential gardens (quintais, a common land use in cities)[2,15].

A comparative study of plant diversity between poor and middle-class communities illustrates these inequalities well. For example, in Malinga city (Parana, Brazil), quintais in opera Rio Jardim Das Torres district has 165 species of plants, while in zona 02. District, quintais district has 381 species of plant species[24]. His is a common phenomenon in Brazilian cities[2]. Similarly, in other unequal aceh countries, such as South Africa, urban inequality in access to vegetation is also characteristic[14]. In Brazilian cities, the democratization of urban plant benefits can be

achieved by planting plants in the courtyards of slums. As Duarte and Beltrame suggested, these plants will achieve greater success before taking environmental education actions and planting trees, so as to achieve the dual goals of increasing tree coverage and restoring biodiversity landscape[25,26].

5. Role of Brazilian postgraduate courses in the protection of urban biodiversity

As the Chinese often say, it is better to do good deeds in your own home than to burn incense in a distant temple. Due to its huge impact on the biosphere, urban growth planning has become one of the most important challenges in the 21st century[27]. However, the decentralization process is under way, resulting in increased responsibilities for small and medium-sized cities. Therefore, new ways need to be found to equip these cities in order to plan future expansion, make sustainable use of their resources and provide basic services. One approach is to implement extension projects that combine the technical capabilities of university graduate courses with the human, political and financial resources of the municipal government[2].

Urban populations depend on a wide range of ecosystem services, such as pollination, climate regulation and carbon absorption. In addition, the maintenance of these services, whether at the local level, or at the regional and global levels, is increasingly dependent on the embodiment of urban development standards[28]. Usually, cities are located near rivers, estuaries, mangroves and forests. As a result, cities tend to develop when they are vital to biological protection, a fact that highlights the importance of planning cities that are more wildlife friendly.

The assertion that proper planning of urban ecosystems is as important to the protection of biodiversity as the establishment of legal nature reserves[29] confirms the terrible progress of unplanned or unplanned urbanization. Globally, the total area of urban areas exceeds the total area of legal biological reserves, even in countries with small populations. In the United States, for example, this has been a reality since the 1990s[1].

There is a sharper argument for understanding the characteristics of urban ecosystems. Today, most people live in cities and rely on appropriate environmental management to maintain an acceptable quality of life. The importance of social, environmental and planning and management of urban ecology research highlights the urgent need to train professional cadres through graduate courses at Brazilian universities[25]. In fact, in the development of established communities and new residential areas, a better understanding of urban ecosystems, especially urban biodiversity, and how to protect and further strengthen urban biodiversity can improve the health, quality of life and well-being of communities[12,25].

By 2030, about 60 percent of global urban growth is expected to remain to be achieved[30], so we have a unique opportunity in Brazil and globally to qualify researchers in graduate courses and enable them to generate knowledge and enable them to develop smarter forms of urbanization. Dialogue between academia and managers is a key challenge in urban environmental planning, as local governments often know little about how to maintain biodiversity in urban ecosystems[15,22].

Of course, to understand the huge complexity of urban ecosystem, it is not only affected by environmental fact ors, but also by social, economic, political and cultural dynamics. It is necessary to constantly develop interdisciplinary methods. Brazil has a significant shortage of researchers (biologists, architects, geologists, sociologists and others) qualified for urban ecology research[12]. Nearly 90% of urban ecology research is conducted in cities in developed countries[30]. In fact, there are few studies on urban ecology in Brazil. At a historic moment, as we said, the impact of cities on the biosphere has expanded so much that it is impossible to analyze environmental and urban problems alone. The challenge of protecting biodiversity and its environmental services vital to mankind. It can only be overcome by developing more plant and animal friendly urban policies, which, importantly, have not

yet been developed for Brazilian cities[25].

From a legal perspective, Brazilian law is full of legal principles requiring environmentally sustainable planning, mainly to meet the needs of large and medium-sized cities. In this regard, the 1988 federal constitution of Brazil guarantees the right of all Brazilians and foreigners living in the country to an environmental balance, stipulates the obligation of the government and society to protect the environment and retain it for future generations, and recognizes this right as an undeveloped right, whether Brazilians or non Brazilians art. In addition, the Constitution provides for an urban development policy aimed at organizing the full social function of cities and ensuring the well-being of their residents (Article 182).

Brazilian cities with 20,000 or more inhabitants need specific laws to regulate their development policies and urban expansion, which must include space for the protection of biodiversity. For example, in Mato Grosso, Brazil, the law requires urban green space to account for at least 10% of the total urban area. Other instruments relate to road greening, protection of springs and riparian areas.

Unfortunately, among other reasons, these tools are still rarely used in the planning process because urban ecology has not been integrated into urban planning and ges-ion standards[2,10]. These data and arguments clearly show that there is an urgent need for graduate courses in urban ecology, or at least a research line in urban ecology in graduate courses in ecology, architecture and urban design, geography and environmental sciences. Brazilian universities need to train well-trained professionals to meet the numerous environmental challenges posed by urbanization.

6. The future of Brazilian cities: Blade killer or green hot spot?

In 1969, Roger Waters and his rock band member Pink Floyd wrote cirrus minor. The lyrics tell us that in the herdsman's climate, when the melody is mixed with the singing of nightingales, it is a biological enjoyment. But this is not nostalgia for lost nature:

In the church by the river
Wandering in the fog,
Laugh on the grass and grass.
Yellow bird, you are not alone
In singing and flying,
Leave with a smile.
Willows in the water
Wake up the daughter of the river,
Swaying in ripples and reeds.
Let's go to little cirrus cloud,
See the crater on the sun
After a thousand miles of moonlight.

Gazing quietly at such expensive natural elements from the yard is not an 18th century scene. Soon, the poet told us about a space trip and put us in the future. An attractive urban future, where countless colorful creatures coexist with rich technological progress, enabling us to realize all the dreams generated by our primate brain. What kind of urban future do we have? Like the gray metropolis depicted in the movie "cult blade killer"? Cities are bound to multiply and become nightmares of concrete and smoke or hotspots of biodiversity. Is there an effective agenda for urban environmental issues? Does Brazil have the technological capacity to achieve more elegant and intelligent urban growth?

Conflict of interest

The authors declare no conflict of interest.

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