Biophilia and sustainability in urban planning: *conceptual interfaces and parameters of analysis*

Biofilia e sustentabilidade no planejamento urbano: interfaces conceituais e parâmetros de análise

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Abstract

The way in which human societies relate to nature gains relevance in the face of the global challenge of population growth in urban areas and the effects of climate change. In this context, it seems appropriate to relate the concept of biophilia and biophilic design to the issue of sustainability. The purpose of the article is to bring notes and verify sustainability indicators related to biophilia. With a non-systematic bibliographic review methodology on biophilia and urban sustainability, this article discusses conceptual interfaces of ecological urban planning, sustainable cities and biophilic cities. The results show that the adoption of the biophilic vision in urban planning, which permeates projects, urban techniques, public policies and initiatives for preservation and environmental education, can contribute to the sustainability and resilience of cities and collaborate to the fulfillment of the Sustainable Development Goals proposed by United Nations.

Keywords: *Green areas. Biophilic cities. Sustainable development goals. Urban sustainability.*

Resumo

A maneira como as sociedades humanas se relacionam com a natureza ganha relevância diante do desafio global de crescimento populacional nas áreas urbanas e os efeitos da mudança climática. Nesse contexto, mostra-se oportuno relacionar os conceitos de biofilia e design biofílico à questão da sustentabilidade. O objetivo do artigo é trazer apontamentos e verificar indicativos de sustentabilidade relacionados à biofilia. Com metodologia de revisão bibliográfica não sistematizada sobre a temática biofilia e sustentabilidade urbana, discute-se neste artigo interfaces conceituais do planejamento urbano ecológico, cidades sustentáveis e cidades biofílicas. Entende-se que a adoção da visão biofílica no planejamento das cidades, que permeia projetos, técnicas urbanas, políticas públicas e iniciativas de preservação e educação ambiental, pode contribuir para a sustentabilidade e resiliência das cidades e colaborar com o alcance dos Objetivos de Desenvolvimento Sustentável proposto pela Organização das Nações Unidas.

Palavras-chave: Áreas verdes. Cidades biofílicas. Objetivos de desenvolvimento sustentável. Sustentabilidade urbana.

Introduction

The effects of human actions on nature are a matter of global concern in the face of

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the two main challenges for human societies in the 21st century: the exponential growth of the population in urban centers and the loss of biodiversity with serious impacts on climate change.

It is predicted that in 2050 68% of the world population will live in urban areas and, in Brazil, this index will reach 92.4% (United Nations Organization, 2018). On the other hand, according to the World Scientists' Warning of a Climate Emergency report, human actions against the environment and against biodiversity are causes for the planetary emergency. In this sense, it is necessary to restore ecosystems and to change the way in which global society interacts with natural ecosystems to mitigate the effects and adapt to climate change (Ripple *et al*., 2020).

In a world where human connections with nature take second place in relation to the prevailing interests that compete for social good and economic gain, the ethics of the Earth, defended by Aldo Leopold, is again evoked (Steiner; Thompson; Carbonell, 2016). In addition, old concepts are being revisited, such as the Biophilia theory (Wilson, 1984), which admits the existence of a human inclination inherent to the affiliation with nature and that such relationship, throughout evolutionary history, contributed to the collective aptitude and the survival of the human species (Kellert, 2018).

Nature preservation, including in the urban environment, is defended in international treaties, such as the Seventeen Sustainable Development Goals (SDG) signed at the United Nations Summit on Sustainable Development, which identified targets such as integrating ecosystem values and biodiversity with nationals and local planning and mobilize financial resources for the conservation and sustainable use of biodiversity and ecosystems (Organização das Nações Unidas, 2015).

Issues related to the financing of environmental programs in developing countries, governance and general responsibilities led the debate organized by the United Nations (UN) in 2015. However, the main concern was in measuring the indicators to assess the achievement of the proposed goals for each SDG, because the UN does not have enough data for such quantification (Koch; Krellenberg, 2018). The SDG 11 (Sustainable Communities and Cities) aims to make cities and human settlements inclusive, safe, resilient and sustainable.

It should be noted that the New Urban Agenda which was signed in 2016 during the United Nations Conference on Housing and Sustainable Urban Development, also advocates the “adoption of healthy lifestyles in harmony with nature” and the use of Nature-based solutions for mitigation and adaptation to climate change (Organização das Nações Unidas, 2016, p. 8).

All these guidelines converge to the necessary change of vision in relation to city planning, in contrast to the model adopted throughout the 20th century in the so-called modern cities. Under the allegation of promoting development, in these cities, there was a gradual

disappearance of forests, alteration of river courses, disregard of the biophysical basis and the natural processes of city landscapes (Queiroz; Somekh, 2013).

In this sense, the concept of “biophilic cities”, still under construction, but increasingly used by the scientific community and public management, emerges as an indispensable urban planning instrument to achieve the UN proposal for cities and communities around the world. Biophilia, a term etymologically derived from the Greek (*bio* = life; *philia* = love) has essentially the meaning of love for life. Although urban areas bring numerous benefits to life in society, such as the great offer of services and products, they also alienate human beings from nature, due to the way they were built, specially, in Brazil. In this sense, public environmental managers have the great challenge of promoting the transformation of cities, so that they can leave an almost entirely artificial environment and become a mosaic of gray, green and blue infrastructures.

Based on this, this work has as main objective to bring some notes of conceptual interfaces and parameters of analysis of Biophilic Design in built environments. This information will serve environmental managers in promoting projects that seek the environmental sustainability of cities using nature.

Materials and Methods

This work was carried out through a non-systematic bibliographic review. In order to collect the information, it was used the crossing of keywords related to the investigated theme: “biophilia”, “urban sustainability”, “green areas”, “biophilia AND urban sustainability”, “biophilia AND green areas”, “urban sustainability AND green areas”, both in Portuguese and in English. The keywords were searched in databases such as SciELO, Scopus and Google Scholar. Using different bases facilitates the publication of literature in Portuguese and a theoretical framework widely cited in scientific articles, thus demonstrating greater current and scientific.

Only works focusing on biophilic design of cities and environmental sustainability related to urban green areas were included in the research. There was no restriction on the date of publication, only in relation to the language in which the works were published, including only those available in English, Portuguese or Spanish.

In addition, several books and handouts on the subject were consulted without concern for the year of publication of the works, so that it was possible to obtain a good theoretical framework for discussing the concept of "Biophilia" and "Biophilic Design".

The selection procedure was initiated by an exploratory reading, followed by an analytical reading. After this moment, the content and ideas were hierarchized and written.

Results and Discussion

Considering nature and biodiversity as an aesthetic convenience or an obstacle that

needs to be overcome through science and technology, leads to a disconnection between human beings and the natural environment. This fact is verified in projects of the built environment and in the orientation of society towards technology and indoor environments (Kellert, 2018).

The belief that progress and development depend on the ability to control and change nature still lingers in the 21st century. However, the emblematic urban project Emerald Necklake, built between 1878 and 1895, is currently considered a reference for its ecological and systemic vision, which contradicts the logic of subjugating nature.

The project is by Frederich Law Olmstead who is considered the father of Landscape Architecture. Olmstead believed that human well-being depended directly on human contact with nature (Laurie, 1983; Herzog, 2013; Bonzi, 2017). His thinking showed alignment with the biophilic theory.

In addition to connecting urban parks through green paths and by the river, Emerald Necklake implemented ecological and sustainable solutions, such as wetlands to purify as polluted waters and industrial waste. For this reason, the project can be classified as NbS (Nature-based Solutions), which involves “actions to protect, sustainably manage and restore natural or modified ecosystems that respond to social challenges in an effective and adaptable manner, while ensuring well-being and benefits to biodiversity” (International Union for Conservation of Nature, 2016, online).

Emerald Necklake can also be classified as Ecosystem Based Adaptation because it practices “use of biodiversity and ecosystem services as part of the broad adaptation strategy or to help people adapt to the effects of climate change” (Lhumeau; Cordero, 2012, p. 1).

The application of ecological values in city planning was advocated by Ian McHarg, in the late 1960s, with the concept of ecological urban planning. He used to criticize the tendency to transform nature into a decorative object and also defended the need to sustain nature “as a source of life, environment, teacher, sanctuary, challenge and, above all, to rediscover the corollary of the nature of the unknown in the self, the source of meaning” (McHarg, 1995, p. 6).

A more recent approach that incorporates an ecological vision in urban planning is Green Infrastructure, which corresponds to networks of permeable and vegetated fragments, with multiple and interconnected functions that “[…] restructure the landscape mosaic, offer ecosystem services and mimic natural functions of the landscape” (Herzog, 2010, p. 97).

The interconnectivity of these infrastructures can occur through tree-lined streets that integrate rainwater management (Herzog, 2013; Bonzi, 2017) or through “complete streets”, which combine multiple uses of vehicles, pedestrians, cycle paths and urban furniture, making processes compatible natural rainwater drainage, biodiversity and shade for pedestrians (Afinal..., 2017).

The biophilic aspect of green infrastructures lies in the possibility of combining environmental conservation in public spaces with nature experimentation activities, optimizing land use and reconciling the needs of people and nature (Benedict and McMahon, 2006). Considering its multiple functions (*Chart 1*), green infrastructures have aspects of sustainability and contribute to the urban resilience.

Chart 1. Functions of urban Green Infrastructure.

Functions	Contributions
Biotics	Habitat for species; species movement; biomass production; support in flora-and-fauna interaction.
Abiotics	Interaction between surface and groundwater; soil and nutrient production; maintenance of the hydrological regime; sequestration of carbon and greenhouse gases.
Cultural	Experiences with natural ecosystems; physical activity; experimentation with cultural history; sense of isolation and inspiration; healthy social interactions; and encouraging environmental education.

Source: Bonzi (2017, p. 20).

The perception that environmental protection in the urban context brings innovation to the city and quality of life for the inhabitants is somewhat recent discussion (Gauzin-Müller, 2011; Bonzi, 2017). The concept of sustainable development, defended in the UN's Our Common Future Report, like as development that meets the needs of the present without compromising the ability of future generations to meet their own needs, is evoked in general (Comissão Mundial sobre Meio Ambiente e Desenvolvimento, 1991). However, even though the concept of sustainable development is anchored to triple bottom line – social, environmental and economic –, some authors, when operationalizing the concept, consider each of these aspects separately (Souza, 2016).

The concept of sustainability was considered in city planning in the late 1980s by Ehkart Hahn. In his book – Ecological Urban Reformulation, Theory and Concept – Hahn establishes the necessary measures for sustainable urban planning (*Chart 2*), combining the protection of natural resources with urban design, architecture, social participation and the economy (Gauzin-Müller, 2011).

Chart 2. Measures for ecological urban planning by intervention sector.

Sector	Measures
Architecture and Urban Techniques	Ecology in the Architecture and Construction sectors; power generation; water management; transport management; waste reduction; protection of green areas and nature; climate and air quality; soil and water protection; noise protection; health and food.
Ecology and Local Democracy	Participation of interested people; information and advice on the environment; decentralization of management and decision making; education for the environment; new models of cooperative and real estate promotion; creation of eco stations (decentralized spaces for the dissemination of ecological and cultural themes); creation of an agency for energy, water and waste; new housing and neighborhood models.
Economy and Ecology	Energy tax; tax on emission of pollutants; consumption charge; ecological accounting for companies; adaptation of building planning and standardization tools; creation of centers for trade services and ecological activities; job creation in the ecology sector.

Source: Gauzin-Müller (2011, p. 49).

Inspired by this thought, the Ecological Urban Restructuring report, in the early 1990s, offered eight guidelines which were incorporated into urban policies and projects in several European countries later: (i) ethics and respect for human beings; (ii) participation and democratization; (iii) organization in networks; (iv) return to nature and sensory experiences; (v) mixed use and controlled urban density; (vi) respect for the *genius loci* (the spirit of the place); (vii) ecology and economics; viii) international cooperation.

The integration of social, ecological and economic objectives is the basis of the Sustainable Urbanism and Biophilic Urbanism approaches, whose interface is presented below.

Sustainable urbanism, in addition to combining social, environmental, political and cultural objectives with the economic and physical of citizens, considers environmental protection as a factor of innovation and citizenship (Rogers; Gumuchjan, 2001; Leite, 2012; Farr, 2013). In this context, social participation is relevant to sustainable urbanism, as Romero (2007, p. 51) said: "[...] (the sustainable city) is constituted by a society aware of its role as a transforming spaces agent and whose relationship is not due to the nature-object reason, but to a synergistic action between ecological prudence, energy efficiency and socio-spatial equity".

The urban ecosystems – aquatic environments, conservation areas, forest fragments, afforestation, among others – play fundamental roles for the quality of the urban environment and, for this reason, they are highlighted in the strategies and practices for conservation and sustainability (Galdino; Andrade, 2008).

Farr (2013) lists other aspects for the realization of sustainable urbanism, such as urban density (which supports public transport); the sustainability corridors (public transport corridors and green paths); sustainable neighborhoods; high-performance buildings and infrastructure; biophilia which means people have more contact with nature. This necessary interaction of people with natural systems can be done even in dense urban environments (Farr, 2013).

Following the vision of sustainable urbanism, Gehl (2018) argues that the city should be designed for people, with incentives for citizens to remain in public spaces, for active mobility (by bicycle or on foot), accessible public transport and, also, stimuli for healthy habits such as physical activity and sociability.

Sustainable urbanism converges with the vision of biophilic urbanism when it defends the viability of a synergistic relationship between human society and nature. Biophilic urbanism concerns the planning of cities that, in addition to sustainable aspects, present "dense urban life and rich in contact with nature", as stated by Timothy Beatley in an interview with Greg Hanscom (Opera Mundi, 2014).

The expression derives from the theory of Biophilia (Wilson, 1984), whose application in Architecture and Design was proposed by the emeritus professor of Social Ecology at Yale

University, Stephen Kellert, and summarized in the Biophilic Design concept. For Kellert (2018), bringing nature to the built environment impacts people's quality of life, with direct benefits to physical and mental health.

Biophilic Design, according to Kellert (2018), takes effect through four parameters (*Figure 1*): biophilic elements, biophilic values, biophilic principles and biophilic scale.

Biophilic elements are the aspects that evoke the feeling of being in contact with nature, whether through direct experiences – such as visualizing vegetation, animals, lakes, elements of the climate (snow, sun, rain) – or through indirect experiences, as images or representations of nature, such as textures, natural geometries, simulation of air and light, the passage of time and biomimetics.

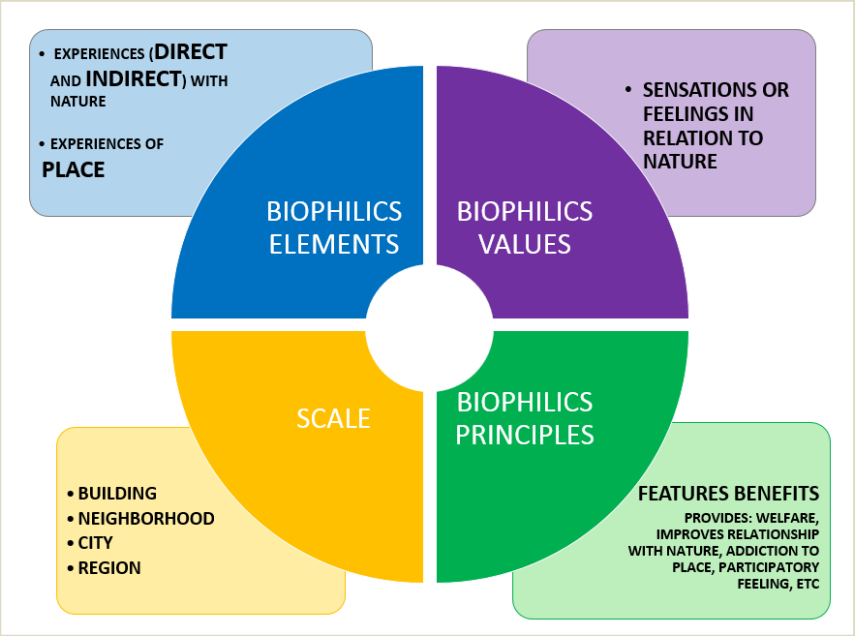

Figure 1. Synthesis of Biophilic Design Parameters.
Source: Elaborated by the author Dulce Ferreira de Moraes (2019).

Aspects of ecological and environmental context are also classified as biophilic, such as the sense of perspective and refuge, the transition spaces, the local ecological and cultural connections and sense of being part of the whole.

Biophilic values (*Chart 3*) are the sensations or feelings towards nature. These values can be positive, such as the attraction to a natural landscape, or negative, such as the feeling of control and exploration of natural elements. Nature can awaken other values such as spirituality, desire to learn or symbolic expression.

Biophilic design is also characterized by “universal principles”, such as: it focuses on adapting to nature that promotes physical and mental health; creates interrelated and integrated configurations in the ecological whole; encourages engagement and immersion in natural processes; it is strengthened by the satisfaction of positive values about nature; it results in emotional attachments to structures, landscapes and places; it promotes feelings of

community participation; it occurs in a multiplicity of configurations (indoor, exterior and transition spaces); it involves an authentic experience of nature, instead of an artificial experience; and it implies human relationship with natural systems; and it avoids adverse environmental impacts.

Chart 3. Biophilic values and their respective expressions.

Value	Expression way
Affection	Love or positive emotions directed towards the natural world.
Atraction	Aesthetic attraction or perception of beauty in nature.
Control	Tendency to control, dominate and sometimes subdue nature.
Exploitation	Tendency to use the natural world as a source of material and resources.
Intellect	Uso da natureza como aprendizado e desenvolvimento intelectual.
Symbolism	Uso da imagem da natureza para promover pensamento abstrato.
Spirituality	Uso da natureza para alcançar um senso de significado, propósito.

Source: Elaborated by the author Dulce Ferreira de Moraes (2019), based on Kellert (2018).

The last parameter of biophilic design is scalability (*Chart 4*). In urban scale, biophilic projects interfere with urban ecology and climate and, cumulatively, result in so-called Biophilic cities which are characterized by restoring and recovering existing nature, creating new ways of inserting nature in the streets, in buildings, and by becoming “places of urban coexistence” (Beatley, 2018).

Chart 4. Biophilic design scales.

Scales	Applications
Building	Green roofs and atriums, roof gardens, green walls and interior spaces with natural lighting.
Block	Green patios, green areas around the house and areas with native species.
Street	Green streets, urban afforestation, low impact urban development, vegetated valleys and narrow streets, edible landscaping and a high degree of permeability.
Neighborhood	Flow of natural light, restoration of rivers, urban forests, ecological parks, community gardens, neighborhood parks and pocket parks, ecological fields
City	Urban streams and riverside areas, urban ecological networks, green schools, city tree canopy, community forest and orchards, green public service corridors.
Region	Fluvial and floodplain systems, riverside systems, regional green space systems, main green transport corridors.

Source: Elaborated by the author Dulce Ferreira de Moraes (2019), based on Kellert (2018).

Following the criteria established by Beatley (2011), a city is biophilic if: (i) it has public infrastructure programs for green areas; (ii) allocates a percentage of its budget to finance these projects; (iii) have programs that promote affinity between citizens, flora and fauna; (iv) connects urban parks and offer paths for experimenting with nature; (v) have natural spaces and ecological corridors for multisensory sensations of nature; (vi) values and supports education initiatives on nature; (vii) invests and supports the creation of green infrastructure; (viii) takes measures to actively support nature conservation.

A synergistic relationship is observed between the measures of ecological urban planning, principles of biophilic design and the criteria of biophilic cities (*Figure 2*).

The bibliographic review by Batley and Newman (2013) points out the contribution of biophilia and biophilic cities to urban sustainability and resilience. There is evidence that when cities become greener and more natural can become more ecologically, economically and socially resilient in the long run.

Observing the application of biophilia in urban planning makes it possible to verify indicative factors of sustainability.

Environmental benefits are the easiest to identify. Green areas (parks, squares, gardens and afforestation) directly influence urban microclimates. Trees contribute to the humidity levels of the air through the evapotranspiration process; they regulate the temperature and can reduce the temperature from 1°C to 4°C on hot days; contribute to feeding groundwater; reduce air pollution and noise pollution acting as an acoustic barrier; soften solar radiation; modify the speed and direction of the winds; they provide shading and, therefore, cooling the street (Mascaró; Mascaró, 2002; Gauzin-Müller, 2011).

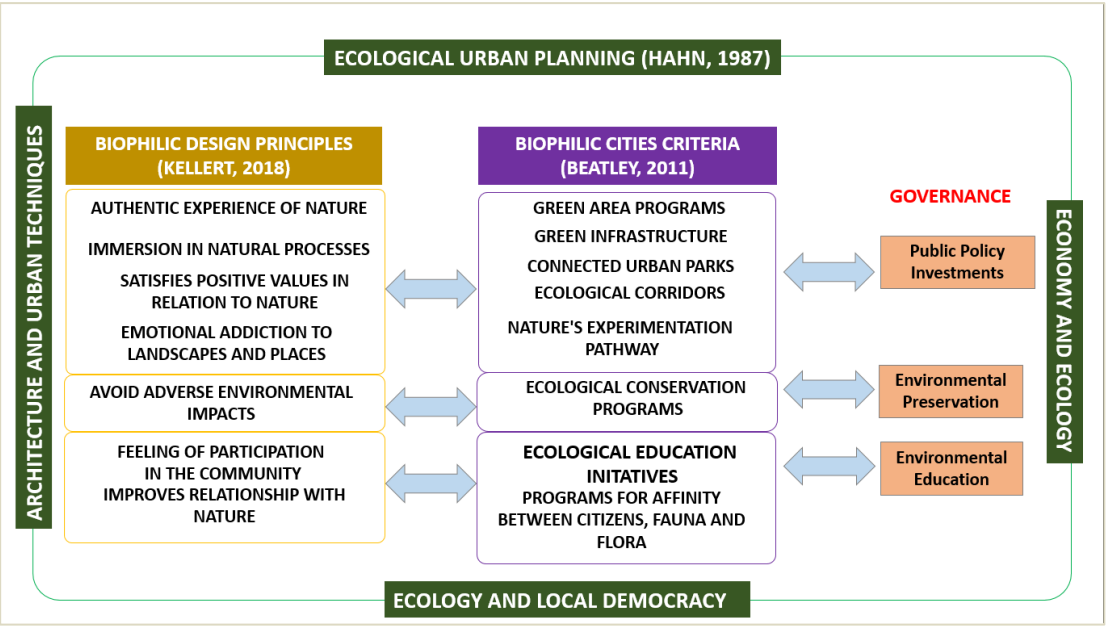

Figura 2. Synthesis of conceptual interfaces
Source: Elaborated by the author Dulce Ferreira de Moraes (2019), based on Beatley (2011), Gauzin-Müller (2011) e Kellert (2018).

In the social aspect, the benefits to human health are the most relevant. Although there is scientific literature (Lee; Maheswaran, 2010; Kondo *et al.*, 2018) that questions the evidence of benefits of urban green areas to human health, several studies relate the presence of vegetation in public space with health-inducing behaviors, such as walking and empowering people to deal with future tensions (Beatley; Newman, 2013).

A study in a city in the United States indicated that the probability of commuting on foot is three times higher on wooded pedestrian routes, because the shade of adult trees stimulates outdoor activities and reduces summer temperatures by three to six degrees Celsius (Farr, 2013).

More than three thousand scientific articles and technical reports which are registered in the scientific database “Green Cities: Good Health”, coordinated by researcher Kathleen Wolf, from the University of Washington, and the United States Forest Service, attest to the social and health benefits for people who live in urban environments with greater contact with nature (Kellert, 2018).

In Brazil, a survey carried out in 2016 presented data from epidemiological and experimental studies that relate the existence of green areas to beneficial effects to the mental and physical health of the population, such as the reduction of psychiatric morbidities (including depression and anxiety); reduction of overweight and obesity; reduction of mortality from all causes; reduction of cardiovascular diseases and outcomes in pregnancy (Amato-Lourenço *et al*., 2016).

On the other hand, the absence of green areas in cities can be related to the appearance of several pathologies. Some studies indicate that living close to green areas can decrease the risk of diseases, such as hypertension (Labib; Lindley; Huck, 2020, Moreira *et al*., 2020), and can also be related to mental health benefits (Astell-Burt; Feng, 2019; Lee; Lee, 2019).

It should be noted that the economic gains of a city with a large presence of green are beyond the reduction of spending on public health. A study carried out in the city of Austin (USA) measured in monetary terms the benefits from the preservation of green areas. For example, with 33.8 million trees, the city generated a total of US $ 2.8 million per year by removing pollution (1,300 tons/year); US $ 11.6 million, with carbon sequestration (92 thousand tons/year); US $ 18.9 million with the reduction of energy consumption in buildings; US $ 4.9 million with the reduction of carbon emissions. The study also points out a value of US $ 242 million related to carbon stock (1.9 million tons) and a compensatory value of $ 16 billion (United States,2016).

These factors justify the criteria for biophilic cities considered by Beatley (2011), related to allocating a percentage of the budget to finance green infrastructure projects and programs that promote affinity between citizens, flora and fauna.

The cities of Tirana and Singapore illustrate examples of incorporating biophilic principles into urban projects.

The Albanian capital city developed the Tirana 2030 program, which provides for the implementation of sustainable corridors with mobility axes – new high-speed rail lines connecting the city centre to the airport and the maritime terminal – and biodiversity corridors, such as the two rivers that cross the city and new green corridors being created. The program intends to triple the amount of green spaces in the central area with two green road rings for use by pedestrians and cyclists; and create an oasis around Lake Farka and an orbital forest to contain urban sprawl (Walsh, 2017). The city also intends to expand the green areas through living architecture. Vertical Forest Tower building, in the city centre, will receive 3,200 shrub plants and 145 medium-sized trees. This type of building is like as the *Bosco Verticali* buildings in Milan, Italy, and has been presented as an architectural solution to increase urban afforestation.

Another example of the application of biophilic urbanism is Singapore, the Asian city-

state that, since the 1960s, has undertaken to expand its vegetation coverage, through various public policies. This proves that biophilic urbanism occurs with governmental articulation and society participation. In 2012, during the World Cities Summit, the government launched the 2012 Singapore Green Plan which had showed some integrated strategies that incorporate science and technology, social participation, ecological landscaping and green infrastructure. The main objectives of the plan are the improvement of biodiversity and thermal comfort in the open air, reduction of the urban heat island effect, water management with reduction of rainwater peaks and also the reduction of energy consumption in buildings (Yok *et al*., 2009).

Among the strategies adopted in Singapore are the National Parks (NParks), which are interconnected in a network of corridors and green trails. They became centers for teaching and research on biodiversity. For example, in Gardens by the Bay are installed Super Trees which are model of innovation and energy efficiency associated with biophilic stimulus to bring people closer to nature. The gigantic tree-shaped structures, 25 to 50 meters high, are connected by trails which where visitors can have a panoramic view of the gardens and the bay's horizon. The garden is also used for evening cultural events (Gardens by the Bay, 2019).

Other biophilic strategies in Singapore are: incentive programs for the creation of community vegetable gardens and roof gardens; research structure for the improvement of vertical garden techniques in the *Hort Park* horticulture center; regulations for projects that require vegetation in (and over) buildings; programs, such as *Skyery Rise Greenery*, which subsidize biophilic urbanism and assess the sustainability of new buildings. Water management is being marked by naturalization of the canals, implemented with demolition of the concrete edges and planting of trees in the adjacent ground to filter rainwater (Newman, 2014).

As seen in the examples above, in addition to public projects and policies, the participation and involvement of society is a fundamental factor to appliance of biophilia, whether in the design of the project or in the use of spaces for experimenting with nature. This social participation must be based on environmental education or on “ecological literacy”, as advocated by David Orr, which is a deeper transformation in the content with the understanding that “ecosystem imbalance reflects a previous imbalance of the mind, making it an issue fundamental in institutions aimed at improving the mind” (Orr, 2006, p. 11).

According to Orr (2006), all education can be considered environmental education, because, by inclusion or exclusion, it transmits the perception of being or not to be an integral and integrated part of nature. In the process of ecological literacy, “the goal is not the mere mastery of specific subjects, but the establishment of connections between head, hand, heart and the ability to recognize the different systems” (Orr, 2006, p. 11). Environmental education, in this sense, is “education for a sustainable life”, because it offers a systemic understanding of life (Capra *et al*., 2006, p. 14).

The appliance of biophilia in urban planning and adoption of the Biophilic Cities criteria (Beatley, 2011) can help to meet the UN's Seventeen Sustainable Development Goals for the year 2030, including the SDG 11 – making cities and inclusive, safe, resistant and sustainable human settlements – and contributing to the achievement of the targets of increasing sustainable urbanization, with participatory and integrated planning and management; strengthen efforts to protect and safeguard cultural and natural heritage; reduce the negative environmental impact per capita of cities, especially in relation to air quality; implement integrated policies and plans for mitigating and adapting to climate change and urban resilience.

It also contributes to the achievement of SDG 15, which deals with protecting, recovering and promoting the sustainable use of terrestrial ecosystems and halting the loss of biodiversity. It can directly contribute to the recovery and sustainable use of terrestrial and freshwater ecosystems; ensure the conservation of mountain ecosystems and biodiversity, to improve their ability to provide benefits; integrate the values of ecosystems and biodiversity into local planning; mobilize financial resources for the conservation and sustainable use of biodiversity and ecosystems.

Conclusion

In conclusion, the application of biophilia in urban planning presents several indicative factors of sustainability. However, its effectiveness is possible with the change of vision and way that society relates with nature and the adoption of an ethical stance towards nature and life.

This vision must to consider integrated work of all the actors involved in the design of the city, whether in architectural design, urban techniques, governance, public policies, the perpetuation of ecological knowledge, initiatives associated with environmental preservation and education.

The application of biophilic urbanism, based on the most harmonious relationship between human beings and nature, shows an important contribution to the achievement of the Sustainable Development Goals, as it contributes to the creation of fair, safe, healthy, accessible, resilient people and sustainable human settlements. It is also a contemporary proof of theories of Biophilia and Biophilic Design in the sense that the human inclination to affiliate with nature contributed to physical and mental well-being and leads to the collective aptitude for the survival of the human species.

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