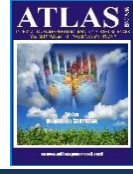




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URBAN BIODIVERSITY; GENERAL SITUATION AND DESIGN APPROACHES ACROSS THE WORLD

KENTSEL BİYOÇEŞİTLİLİK; GENEL DURUM VE DÜNYADAKİ TASARIM YAKLAŞIMLARI

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ABSTRACT

Among the most comprehensive and important topics of the discourses over recent years related to conservation and sustainability is the concept of biodiversity, which appeared in the world agenda after 1992 Rio de Janeiro Conference as a target in the conservation strategies. It is stated in the studies that by 2050 two – third of world population is estimated to inhabit urban areas and therefore, the conservation of biodiversity in rapidly populated cities is also on the agenda as a vitally important issue.

In the present study, various aspects of urban biodiversity, its importance and contributions to city identity and urban landscape, urban areas representing green areas and biodiversity, reasons for the richness of urban flora, design approaches to contribute to urban biodiversity are evaluated by considering recent literature in urban biodiversity, present situation of the topics in the world countries and their design approaches.

It can be seen when analysing worldwide the design approaches to urban biodiversity that European countries, USA, Australia and New Zealand work incessantly on biodiversity designs and sustainable planning, where they open ways in urban landscape works to new and important designs for the sustainability of urban biodiversity such as park and garden designs as well as roof top gardens contributing to urban landscape, green infrastructure systems, green ways, rain gardens and landscape canals. At the end of the study, importance of urban biodiversity and related designs is evaluated and some suggestions are proposed for the present conditions.

Keywords: Biodiversity, Design Approaches, Urban Biodiversity, Urban Landscape

ÖZET

Son yıllarda koruma ve sürdürülebilirliğe dair söylemlerin en önemli ve kapsamlı konuları arasında tüm dünyada 1992’de Rio de Janeiro’daki konferansla birlikte koruma stratejilerine hedef olarak giren “biyoçeşitlilik” kavramı öne çıkmaktadır. Yapılan araştırmalarda, 2050 yılında dünya nüfusunun 2/3’ünün kentlerde yaşayacağı ve bu nedenle hızla nüfusu artan kentlerin biyoçeşitliliğinin korunmasının çok önemli bir konu olarak gündeme geldiği belirtilmektedir.

Bu çalışmada; kentsel biyoçeşitlilik, önemi, kent kimliği ve kentsel peyzaja sağladığı faydalar, kentlerde yeşil alanları ve dolayısıyla biyolojik çeşitliliği temsil eden alanlar, kentsel floranın zengin olmasının nedenleri, kentsel biyoçeşitliliğe katkı sağlama amaçlı yapılmış olan tasarım yaklaşımları ve kentsel biyoçeşitlilik konusundaki literatür incelenerek dünya ülkelerinin ne durumda oldukları ve nasıl bir tasarım yaklaşımı izledikleri analiz edilip değerlendirilmiştir.

Kentsel biyoçeşitliliğe dönük tasarımların küresel analizi yapıldığında Avrupa ülkeleri, ABD, Avustralya ve Yeni Zelanda’nın hızlı bir şekilde biyoçeşitlilik tasarımları ve sürdürülebilir planlamalar üzerine çalıştığı ve

kentsel peyzaj çalışmaları içinde park ve bahçe tasarımlarına ilave olarak kentsel peyzaja katkı sağlayan çatı bahçelerine, yeşil alt yapı sistemlerine, yeşil yollara, yağmur bahçelerine ve peyzaj kanalları gibi kentsel biyoçeşitliliğin sürdürülebilirliği açısından önemli olan tasarımlara yer verdikleri görülmüştür. Çalışmanın sonucunda; kentsel biyoçeşitliliğin ve kentsel biyoçeşitlilik tasarımlarının önemi tartışılmış ve öneriler sunulmuştur.

Anahtar Kelimeler: Biyoçeşitlilik, Kentsel Biyoçeşitlilik, Kentsel Peyzaj, Tasarım Yaklaşımları

1. INTRODUCTION

It is predicted that by 2050, two-third of world population will be living in urban areas. Conservation of biodiversity has come to world agenda as a very important topics in cities where human population increases rapidly (Muller and Werner, 2010).

Cities exhibit considerably different characteristics from other land-uses and landscape types with their habitat types having been shaped by their unique physical and ecological conditions, mixed and small scaled habitat mosaics, native plant and animal species, exotic species and anthropogenic activities (Kattwinkel et al., 2011)

The concept of biodiversity adopted to be a target in conservation strategies with the conference in Rio Janeiro in 1992 all over the world has turned out to be one of the most important and comprehensive discourses related to conservation / sustainability in the last years. Diversity of genes, species and ecosystems started to be accepted as a very big “potential capital richness” related to sustainability in global scale (Avcı, 2008).

Significant negative effects of urbanisation are land use changes, loss of natural vegetation, increase in the prevalence of exotic species, fragmentation and isolation of natural areas, destroying habitats for many living organisms (Uslu and Shakouri, 2013).

Sustainability of urban biodiversity can be provided only by adopting species – based conservation approaches for rare and endemic species, developing approaches with ecological focuses in the determination of urban land uses and setting up green infrastructure systems.

Ecologically dynamic urban environment can offer possibilities to improve biodiversity and enable other ecosystems to sustain diversity. Existence of urban biodiversity can contribute to human quality of life like environmental improvement (Uslu and Shakouri, 2013; Selim et al., 2015).

In the present study, various aspects of urban biodiversity, its importance and contributions to city identity and urban landscape, urban areas representing green areas and biodiversity, reasons for the richness of urban flora, design approaches to contribute to urban biodiversity are evaluated by considering recent literature in urban biodiversity, present situation of the topics in the world countries and their design approaches.

2. URBAN BIODIVERSITY

Concept of biodiversity has come to forefront as an important issue in order to reduce or erase the destructive effects of urbanisation on cities. Within this context, sustainability of biodiversity should absolutely be provided in cities. According to Selim et al. (2015), sustainability of biodiversity can only be provided by adopting and applying new and important species - based design approaches for rare and endemic species, developing ecologically – focused approaches in the determination of urban land use changes and setting up green infrastructure systems.

It is possible to mention about two types of areas in cities for plant cover. The first type includes those which humans have shaped so far through the structures such as buildings, roads etc. while the second one covers the remains belonging to rural geography like forests parts, urban forests, clusters of shrubs. Existence of exotic plants brought to a city

(un)consciously can play significant roles in the plant diversity of cities (Avcı, 2008). Urban biodiversity is composed of manmade green areas having been adapted to cities later and naturally growing plant cover. Figure 1 represents the examples of manmade green areas and part of a grove, naturally growing forest.



Figure 1. Manmade green areas and part of a grove, naturally growing forest

2.1. Benefits of Urban Biodiversity to City Identity and Urban Landscape

Urban biodiversity provides significant contributions to city identity and urban landscape. According to Oliveira et al. (2011), among such benefits are

- ✓ Insulation of noise and voice,
- ✓ Absorption of CO₂ and release of O₂,
- ✓ Reducing the effect of urban heat islands,
- ✓ Forming spaces for social and cultural interaction,
- ✓ Enabling recreational activities,
- ✓ Making aesthetical and economic contributions to spaces,
- ✓ Having positive effects on socio-psychologic well-being,
- ✓ Contributing to interaction between nature and human being,
- ✓ Moderating/controlling microclimatic effects,
- ✓ Urban ecosystem provides suitable media to meet habitat needs of biological organisms.

2.2. Urban Areas Representing Biodiversity

According to Shashua-Bar and Hoffman (2000), Hamada and Ohta (2010), Uslu and Shakouri (2013), Selim et al. (2015) urban areas representing biodiversity are

- ✓ Parks and public gardens, natural and semi natural areas (urban forest, wetlands, coastal areas etc.), green corridors (river-banks as natural corridor, highway plantations as artificial corridor etc.)
- ✓ Green corridors (river-banks as natural corridor, highway plantations as artificial corridor etc.)
- ✓ Sport areas, hobby gardens, urban squares, grave yards, bazaar areas, pedestrian sidewalks (Shashua-Bar and Hoffman, 2000; Hamada and Ohta, 2010; Uslu and Shakouri, 2013; Selim et al., 2015).

2.3. Designs Contributing to the Sustainability of Urban Biodiversity

Species diversity and abundance are larger in green roofs than that in traditional ones. Species diversity and abundance and composition of organisms in green roofs are as rich as those in ground level are. With the use of natural plant cover in green roofs, living organisms become elaborated and diversified, help conserve rare species. Green roofs repeat ecological communities surviving on ground can ease the movement of organisms along urban landscape (Nicholas et al., 2014).

Green roofs have favourable effects on water conservation and mitigation of climate change (Carter and Fowler, 2008) as well as their ecological, economic and aesthetic benefits in cities (Oberndorfer et al. 2007). Modern green roofs are covered by drainage, root barrier, water proof layer systems and plants growing in their growth media (Williams et al. 2010).

Existence of ornamental plants in urban parks affects urban biodiversity positively. Several bird species can feed and nest depending on the presence of native plant species in urban parks however they are affected negatively by the invasion of exotic plants in cities (Hanita and Mohamad, 2013). Ornamental plants used in Nong Nooch Tropical Botanical Garden Bangkok/Thailand (Figure 2) are seen to contribute to urban biodiversity.



Figure 2. Nong Nooch Tropical Botanical Garden, 2016, Bangkok/Thailand

According to several studies, urban green areas are divided into two groups. First is the naturally reserved Informal Urban Green Areas while the second one is Formal Urban Green Areas composed of the areas such as specially designed urban parks and gardens. Contribution of Informal Urban Green Areas to increase urban biodiversity is accepted to be large. Among such informal green areas are natural green spaces along streets, railways and others (Tredici, 2010a; Kowarik, 2011; Kühn, 2006; Rupprecht et al., 2015).

Southern hemisphere approach related to urban biodiversity design is in replantation works to increase biodiversity, local climate features and traditional characteristics should be taken into consideration by being tied with historical past, native plant species should be used to make balance between flora and fauna in harmony with nature, soils in urban environment are banks for exotic plant species (Ignatieva, 2010).

2.4. Approaches towards Urban Biodiversity Designs at Scales Determined by Landscape Architects and Planners

2.4.1. Large scale projects on urban biodiversity designs

Garden city model proposed by Ebenezer Howard in 1898 is one of the most important sources to feed, support and increase urban biodiversity in large scale landscape projects. Garden city model proposed to construct healthy and safe life in cities can enable cities to

shelter public parks covering abundant green areas, green lanes, boulevards, private gardens by allowing and contributing to the sustainability of modern city.

Among large scale urban biodiversity designs are green infrastructure, urban biotope maps and greenway projects. The most popular of these concepts in the USA is the concept of Greenways which are defined to be green corridors planned for recreation and conservation (Ahern et al., 2006; Ignatieva, 2010). One of the aims of greenway projects planned in for various aims like alternative transport, conservation of natural and cultural heritage is to increase biodiversity (Spellerberg, 2005; Ignatieva, 2010).

Green infrastructure is the connection between open spaces and natural areas constituted to provide biodiversity and ecologic, economic, social sustainability. In European approaches at similar scale; green belt and ecological network tie existing natural forests in and around cities and open green spaces (Beatley, 2000; Ignatieva, 2002; Kuznetsov and Ignatieva, 2003).

2.4.2. Middle scale projects on urban biodiversity designs

Such an approach is an important part of applications at neighbourhood level (small districts, sub-regions, and house blocks and complexes). In the USA, Low Impact Development (LID) is the part of all sustainable applications to conserve and develop urban biodiversity by designing with nature; such as green buildings, solar energy, water collection and management, green roofs, water retention pools, rain gardens, canals, recycling and compost facilities (Eason et al., 2003; Weinstein and English, 2008).

Shallow hole areas where rain water is directed without applying any treatments and natural and exotic plants can grow are called “rain garden” or in other words “bioretention” (Demir, 2012). Rain gardens used to direct, slowdown and clean rain water and cover several systems like landscape swales, constructed wetlands, and vegetated roofs.

These designs contribute to the management of water as well as the increase of biodiversity.

All the techniques used for the last decade for this aim are also called Low Impact Development-LID. Catching and depositing soil water to raise it up underground water level are the applications increasing green water levels in aquatic ecosystem and soil humidity (Kinkade-Levario, 2007; Sert, 2013).

Like the USA, New Zealand also developed Low Impact Urban Design and Development (LIUDD) project. Although the applications such as rain gardens and green roofs are similar with each other, improvement and conservation of urban biodiversity are focused more on natural plant species and fauna (Ignatieva et al., 2008).

Waitangi Park in New Zealand is an example of Low Impact Urban Design and Development (LIUDD) project. Natural plant species are used to improve and utilise rain water.

In Adelaide (Australia), biodiversity design vision is a part of integrating sustainable approach. An application, Ecopolis (an applied urban village program Christie Walk Alan work) in Adelaide includes innovative building architecture and renewable gardens depositing rain water and the use of natural plants together with sustainable materials in designs (Downton and Ignatieva, 2007).

2.4.3. Small scale projects on urban biodiversity designs

These are the designs and applications where biodiversity is increased in small – scale parks, gardens, small habitats (roadsides, streets, turfs, front and backyards etc.). One of the visual approaches developed in the USA in the last years is a type of design using natural grassy plant clusters in urban areas. This approach expresses the use of plant forms which are not

seen in natural flora but in semi-natural ones and have visual attractiveness and functional characteristics (Hitchmough, 2004).

3. GENERAL EVALUATION OF URBAN BIODIVERSITY IN THE WORLD

It is aimed to increase wild life biodiversity composed of butterfly, insects, birds, natural and semi natural plant species in private gardens. Kew Botanic Garden in the UK is a good example for biodiversity design strategies (Beatley, 2000).

Strengthening biodiversity through the design with spontaneous plant cover without a conscious intention in the designs and by planting seeds from seed banks or via natural distribution has been realised in Germany, which has huge amount of experience in urban ecology research and defending design with nature for at least 50 years. This site is an abandoned area and covered with naturally growing plants. According to some ecologists, this site is suitable for recreation, nature experience and the conservation of biodiversity.

Approach in Germany is to strengthen natural plant communities. Vegetation forming spontaneously is more attractive. They have the idea that alternatively ornamental plants can be used in cities (Kuhn, 2006; Ignatieva, 2010). Such an approach is an opportunity to increase biodiversity with the combination of natural and semi natural species.

Many of other European countries tried to develop a naturalistic approach by conserving and using spontaneous plant communities together with natural and some exotic species, which are important sources for biodiversity. European landscape architects advocate that in the areas where temperate and Mediterranean climatic conditions are prevalent, natural plants which are the valuable sources of urban biodiversity, should be strengthened and conserved (Florgard, 2007; Castro, 2008).

In the states like Arizona, New Mexico and California, where arid climatic conditions are prevalent, water conserving xeriscape applications were completed using water saving plants. With this approach, water is used efficiently and drought tolerant desert plant species are used sustainably by contributing to the increase of biodiversity (Knopf et al., 2002).

3.1. Urban Biodiversity in Today's Cities

The increase of ecological and identical problems in today's modern cities directed designers to an understanding of forming natural sites in urban areas. Formation of biodiversity in urban areas with natural plant species has given cities important roles for their ecological and cultural identities. Native plants are used in many urban parks, gardens and other landscape types in Europe.

In the countries in southern hemisphere, with the approach of "go to nature" and natural plants, biodiversity is sought to be increased (Spellerberg and Given, 2004). Since 1990s, the approach of the use of "Native New Zealand Plants" has been very popular in design understanding (Robinson, 1993). In Low Impact Urban Design and Development (LIUDD) program developed for Ecological Solutions in Design, these types of plant species are used in private gardens, streets, traffic islands, park areas, landscape swales and ponds.

In New Zealand, natural plant cover is being destroyed in order to open agricultural lands, settlements and form forests. In the US, natural plant cover is in harmony with that in Europe. Plant cover in the US shows similarities that in West Europe. Naturally growing deciduous forest trees in Europe such as *Quercus*, *Acer*, *Fraxinus*, *Ulmus* and *Tilia* take place also in the plant cover of the USA (Nowak, 2010).

Ecological crisis and loss of native and natural plant cover are experienced in the states such as Arizona, Florida and California in US lying in tropical, subtropical, Mediterranean, and

desert type climatic regions and sheltering plant cover so-called tropical heaven (Ignatieva, 2010).

There are only a few sources about biodiversity and design in Southern America and the United Kingdom. In the second half of 20th century, the idea of forming natural landscape using native plant species for landscape design (Vaccarino, 2000).

When tropical and arid cities are compared in temperate climate countries and Africa, Indonesia, South East Asia, India and Middle East, it is seen that former group is slower in the provision of different design solutions on urban biodiversity at different landscape scales. There are also modern contemporary private parks and garden examples in rapidly developing megapoles.

There are some studies in Brazilian cities on biodiversity, green infrastructure and sustainability (Frischenbruder and Pellegrino, 2006). Landscape ecological planning and studies on biodiversity were conducted in Rio de Janeiro (Herzog, 2008).

In the cities of Argentina, in modern private gardens, generally exotic universal plant material is used (Faggi and Madanes, 2008). There are some approaches developed in Argentina to use natural plants providing urban biodiversity (Burgueño et al., 2005; Bernata, 2007).

In Dubai, surrounded by desert, exotic plants are used as sustainable elements to moderate urban microclimate (Taylor, 2008).

In the Far East Countries, urban biodiversity is supported by the use of natural or native plant species in cities. The use of native and natural plant species in Orchard Street in Singapore (Figure 3) contributes to urban biodiversity.



Figure 3. The use of native and natural plant species in Orchard Street (Singapore)

Green network systems are focused on in an Indonesian metropole, Jakarta, in the works conducted on biodiversity. Roadside green areas are constituted between linear corridors and pedestrian walks. *Pterocarpus indicus* (Malay pad) is the dominantly used species in the roadside areas. It is seen to be used with palms and blooming bushes. Seasonal plants and blooming bushes are generally used on the intersections. In Indonesia, for urban biodiversity native species are employed more than exotic ones (Arifin and Nakagoshi, 2010).

An effective ecological network was formed in the city centre of Bogor, Indonesia between Bogor Botanical Garden and green belts around the city. Such a situation affects positively the biodiversity in the city (Arifin and Nakagoshi, 2010).

Green roofs are the structures contributing to urban biodiversity. The city of Basel in Switzerland exhibits their beautiful examples, where green roofs harbour generally geophytes and succulent plants. Sedum species are also used widely in the roofs since they contribute to biodiversity of fauna (Brenneisen, 2012). There are some green roof examples in Wollishofen (Switzerland) using moderate and humid climate plants. Some orchids species and other rare and endangered species can grow in the mentioned examples.

4. RESULTS

It was seen from the reviews in literature that at global scale there is a lack and need of design examples to develop urban biodiversity even though some European countries have achieved successful relationship between research and design issues in urban biodiversity.

It can also be withdrawn from the study that in urban plantation studies there is a gap between ecologic information (composition, structure and dynamic characteristics of plant communities) and design quality and principles (colour, texture, form, balance, contrast, harmony and diversity).

Some countries in the world such as European countries, USA, Australia and New Zealand widely and rapidly work on urban biodiversity designs and sustainable planning.

Majority of US and Europe programs (LID, LIUDD, natural plantation) started to affect many other world countries. Western culture also prefers ecology based new landscape applications.

Success of urban biodiversity design is directly related to the analysis of the modern applications of globalisation and understanding the needs of people today.

Design in biodiversity is a complex ecological approach. Not only plants, but also animals such as butterflies, birds and vertebrates are given places (Barnett, 2008).

Since the sprawl of urban areas towards rural habitat reduces the area of natural habitats and due to the densely expansion of agricultural lands and decreasing quality of rural habitats (Benton, 2003), it has turned out to be an important issue to increase urban green areas and use natural plant species in cities.

In order to conserve urban biodiversity, urban planning has focused on natural areas and the conservation of corridors.

Although green infrastructure is important, the minimal effects of surrounding neighbourhoods and commercial areas are very important in conserved areas. In order to conserve urban biodiversity, green infrastructure systems should be constituted which are defined to be natural open spaces and corridors (Hostetler et al., 2011).

For the development and sustainability of urban biodiversity, specialists from different occupational disciplines such as landscape architects, ecologists, architects and city planners should work together. For the success of biodiversity - sensitive design some types of education should be given from primary school to university.

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