

# ADAPTATION OF BIOPHILIC DESIGN STRATEGIES IN URBAN ENVIRONMENTS FOR OPTIMIZING THE USER COMFORT; STUDY OF ENTRANCE SPACES IN ACADEMIC ENVIRONMENTS

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## Abstract

*In generally architecture crafts in-built human tendency to associate with nature, inward the contemporary world directs to build environment to be vital approach towards humanitarian design including physical and mental wellbeing. The idea of humanitarian build environment generates biophilic design intervention to understand the human evolution in adaptive re-joining factors to natural and human created forces.*

*The confront of biophilic Design in urban environment is to state the lack of coherent and the user comfort of passionate built fabric in the urban tissue. Biophilic Design pursue to produce respectable territory to people through establishing the strategies and frameworks by better architectural practice. The thesis sets out to speculate on how biophilic design strategies contribute to optimize user comfort in urban environment examines the selected building entrance spaces in educational environment. The study argues that, the use of biophilic strategies and impact of using the strategies in urban spaces to improve the quality of the academic entrance spaces, how these spaces are influenced by the culture of the community, and design strategies that can be evolved in the earliest with humility and understanding in urban spaces.*

*Based on the review of building documentation, interviews and building output analysis, the thesis evaluates and critiques on strategies of Adaptation of Biophilic design, in particular: (1) how effectively biophilic elements are adopted in urban places and (2) how these elements can be productively incorporate with cultural impact to comfort and healing, in the entrance space of academic environment. The research concludes that adaptation of biophilic elements in academic environment can provide comfort and healing, and this will be affected by cultural specific attributes.*

**Keywords:** Biophilia, Biophilic element, Biophilic Attributes, Culture specific attributes, Comfort, healing.

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## **Introduction**

At the present time contemporary urban built environment has universal advancement, this contemporary environment is the main cause for the massive transformation and reduction of natural system and elevated the separation of human life from the natural world. It resulted critical in psychological health, physical health, maturation and productivity. Human evolution is a long process, in this natural process natural environment proved partly involved in enhancing human physical, emotional, and intellectual fitness. Few Centuries ago people of Sri Lanka lived an environmental friendly life which is more closer to natural environment, especially ancient people of Sri Lanka used natural environment for relaxation and as a main method of healing illnesses and psychological stress, compare to modern era, ancient Sri Lankan people lived psychologically and physically healthy life, in 1st century BCE Ritigala ancient monastery may define how Sri Lankan lived closed to the nature and used Biophilia as an element for healing and relaxation.

This research debates how biophilic elements can be used in a public space, especially in an urban situation through university entrances. And how Biophilia can be used to create comfortable spaces with the use of biophilic design elements and attributes, and this research analysis will be, how Biophilic design strategies can be used to represent the culture. Lack of passive design strategies in the congested urban setting makes people living in an urban environment physically, emotionally, and intellectually sicker. Introduction of the Green Plot Ratio and urban Park concepts through Biophilia is discussed as a healing impact. So this study will help to analysis the importance of implementation of biophilic strategies in the urban environment.

The intention of this study is to describe the use of elements and attributes of biophilic design strategies in an urban places and to understand the connection with the culture of the community, and to understand how far Biophilic design strategies can impact on human psychological comfort in selected case studies, and understand the involvement of biophilic elements and attributes in terms of psychological healing in certain public spaces.

Finally, the research states how to understand the importance of biophilic design strategies to create sustainable urban environment, understand how effectively biophilic elements are adopted in urban places and how these elements can be productively incorporate with user's psychological comfort and healing. Understand the current aggressive deviation of the human form nature, this deviation affect human behavior in a critical ways, such as stress and depression, various practice methods with restraint and respect, can avoid arrogance and environmental degradation. This study explain the use of biophilic strategies and impact of using the strategies in urban spaces to improve the quality of the academic entrance spaces, how these spaces are influenced by the culture of the community, and design strategies that can be evolved in near future with humility and understanding in urban spaces.

## **Usage of Biophilia as an Architectural Concept:**

When Biophilic design strategies integrated into the design then it will become a biophilic architectural concept, this can be achieved in many ways, such as direct representation and indirect representations. There are six basic biophilic elements are identified through the literature and, representation of these elements evolved with human evolution with nature and the later stages of contribution of the built environment influencing technologies and modern materials. Biophilia defined as a fundamental human affection towards the nature which

describing several strategies to incorporate with biophilic design elements, such as natural materials, natural light, vegetation, natural views and other experiences of the natural world. According to Kellert (1993), Globally Biophilic design can be experienced as six basic principles, defining 1. Environmental features, 2. Natural shapes and forms, 3. Natural patterns and process, 4. Light and space, 5. Place based relationships and 6. Evolved human nature relationships. **Environmental features** are identified by attributes which can be experienced directly in natural environment, and direct optimization of these attributes into a built environment. **Natural shape and forms** represents the replication or bio mimicry version of the nature to biomorphic art and design defining building forms, facades and interior spaces. **Natural patterns and processes** represents the built environment and adaptation of properties found in nature. This element is an experiential element plays with forms and shapes plus various sensory experiences. Light and space, this element signifies the way of adopting light, and how human emotions and behavior can be controlled in different forms, such as warm, cool, shaped, filtered, diffused, inside vs. outside. A fifth biophilic design element is **place based relationships** and this element incorporate directly with culture with amount of natural environment and geographical context. Deep relationship with place will reflect on human behavior and life pattern, and this belongingness will lead to the control of the territorial dominance. **Evolved human-nature relationships** reflects the direct or indirect involvement of human based activities with natural based environment.

As stated by Seymour V. ( 2016) Human psychological and physical connection with nature is complex, this human nature connection is a reflection of long evolution of human being, and it has a strong connection with history, so design can adopt powerful attributes of biophilic design to provide memorable memories based on prospect and refugee spaces, ordered spaces and complex spaces, curiosity and enticement, mastery and control, affection and attachment, security from threads and protection from the danger, exploration spaces and discover paths, information and cognition, fear and awe.



**Figure 1:** place based relationships bastille viaduct Paris  
Source: canacopegd.com



**Figure 2:** Evolved human-nature relationships mont saint Michel  
Source: reddit.com

Defined by Edward O. Wilson (1986) as the “the innate tendency to focus on life and lifelike processes”, in human evolutionary process, humans are depends on nature for survival and fulfillment of their life, so humans were always connected to the nature and other biotic forms because of their lifestyle. Attraction towards nature in in the core of the human, that can be seen in day-to-day life, now a days people living in a contemporary living and built environment spend money to move away from built environment and mostly attracted by activities or sites which are connected with nature, such as natural parks and natural preserves, involvement beach activities, relax on beaches, mountain hikes, and exploration of forests. And involvement in sports around

nature such as skiing, biking in mountains, and surfing in beaches. In 2019 Sri Lanka ranked as a best country in the world for tourism, because activities close to the nature are widely available all around the Island. From a perspective of tourist, people are spending more to resort hotels, which have more views to capture the nature. Sri Lanka well known for jungle safari, and more tourist are attracted towards forests to see wild animals, because of Biophilia. Integration of living species also concerned as the part of the nature and the way of attraction towards the nature.

As stated in the Space and Place by Hunziker, Buchecker and Hartig (2007) the experience of space and place is used to enhance and improve the human well-being by the use of spatial relationships. Several attributes are used in experience of space and place, such as, prospect and refuge effect, organized complexity, integration of parts, transitional spaces, mobility, and cultural and ecological attachment to place. Experience of Biophilia in built environment can be achieved in better ways if each of these attributes considered individually carefully. Biophilic elements and attributes can be adopted in any type of buildings, there are no restrictions of using these elements and attributes, so designer/ architect and client must collaborate with each other to adopt biophilic design principles in the built environment within their scope and efficiently to reach their occupants.

### **Defining Academic Environment and Entrance Creation**

Academic environment is the atmosphere in which one attempts to learn, which can aid in the learning experience or, a context interconnecting various agents and processes in academia.

A university may be defined as a self-governing, mainly publicly funded, community of academics and students engaged in absorbing, advancing or disseminating knowledge. Normally a university occupies a well-defined physical area, giving it a sense of identity and social focus. There are exceptions, such as the UK's Open University, which relies upon electronic media and summer schools for communicating with students engaged in academic discourse, but generally buildings make a university in both functional and spiritual terms. Since universities are diverse communities of scholars engaged in collective pursuit of knowledge, it is normally necessary to express the academic character of different institutions in built form and spatial pattern. Reinforcing the high ideals of learning through the physical fabric gives architects the opportunity to experiment or innovate. Historically, and particularly over the past fifty years, some of the most challenging and original works of architecture have been for university clients.

Universities are places of teaching and learning. They generate a feeling of community in whole and in part. The role of colleges is to create small, self-regulating units of residential scholars who share dining and other social spaces. Sometimes the challenge is not so much that of establishing a distinct character for a college but for a faculty. Here a group of buildings or a single large one may require its own identity in order to reinforce the sense of a distinctive academic community

The sense of place helps universities market themselves to potential students. In the competitive world of higher education, architectural quality matters. As students generally visit different universities before making their final choice, the visual impact of the campus is vital. The quality of environment is seen as an important selling point for universities judging by the images used in university prospect. Most show students busying themselves against a backcloth of modern buildings and friendly external spaces. Some prospect also show off the latest buildings by passionate architects (Thames Valley University with its new library by the Richard Rogers Partnership) in the hope of attracting students to the campus.

The marketing of universities through design provides a further justification for the pursuit of architectural quality. If the university does not project a positive image of itself through its built fabric, it is unlikely to attract the best students. Since many universities supplement their income by hosting conferences or attracting business clients, the character of the campus has economic significance here as well. As universities become increasingly business orientated, marketing through architectural image helps raise awareness of the economic value of good design.

If a university is defined as a community of scholars engaged in the collective pursuits of knowledge, then questions of community take on academic, social and cultural connotations. Intellectual space - the territory of the mind where learning occurs - has necessarily to engage with social space and to a degree with cultural space that is space fashioned by a scholar's sense of history and geography. It is one thing to design a university with a feeling of community and operational flexibility, quite another to give it a sense of regional location beyond the pastiche. The problem is exacerbated by the too frequent employment of 'named' architects for university projects anywhere in the world. The want of bedding education into place and time is a common cause of alienation among university students from developing countries. The best university plans balance the creation of abstract space for learning with a strong national identity.

### **Entrance as a First Impression of the Built Environment**

Entrance is the important element of any built environment or urban spaces, especially entrance play a major role in any kind of transitional spaces which connect any outer world to internal territory. The main role of the public entrance have evolved with time, and throughout the history, entrance design responding to the change of cultural needs and change of attitudes. Mostly in buildings, building façade take the major role as a face of the buildings, and it's make the first impression, but in such academic environments, entrance structure play a major role as a face of the entire built environment. If role of the built environment change, then the entrance also should respond to the changes.

In the history of human being, many societies formed in a formal and informal public and private spaces in their settlements. Public place is a place which is accessed by general public for their own enjoyments (Jackson, 1974). Private place is contrast to public place, which is accessed by only certain amount of people for specific purposes. The demarcation of public and private places are defined by the entrance of the private place, this entrance function as a defining element of the private place, and it define the access into the private environment. And to make the best connection between private and public places, entrance needs to be identifiable and recognizable by specified users, and it should create a sense of belongingness to those specified user.

Environmental psychology is well known study to understand the connection between both natural environment and built environment. There were many researches performed to understand the Environmental psychology. More attention paid on how humans are reacting with the immediate environment, and to understand the interrelationship between both. For an example, decision makings in the built environment which was integrated with natural material, and how deeply it's affected the decision making, and integration of natural environment and impact in human physical, psychological health and human well-being. Building planning play a major role in the function of the building, for example, handling the natural environment inside the building or vies of the natural environment will affect the human well-being. "We shape our space, thereafter, our space shape us." this text adapted from Winston Churchill provided the fundamental understanding of relationship between public space design and human behavior based on the context of spatial arrangement. It explains the responsibility of the designer of a

space and the impact of design decision to the quality of public life. It could be understood that a well-designed public space not only has strong influence to the longevity and success of the space but also the quality of public life

Adoption biophilic design strategies have indirect economic benefits, commonly urban environment integrated with humans and buildings, so introduction of biophilic design strategies maybe act as a third element. Adaptation of biophilic elements in a built environment needs to have a special attention on proper maintenance to ensure the quality of the experience remain same, and that costs a maintenance cost, and with time it may change the spatial quality of the space, this may lead to affect human behavior and pattern progress. When adopting biophilic design strategies, there needs to maintain a balance between natural environments and built environment, misbalance may occur due to composition. Adaptation of biophilic elements can create fear and owe, that may lead the design to its complexity. So there is a need to integrate, limitation and balance of biophilic elements urban environment.

### **Biophilia as a culture specific design strategy**

“A culture is a way of life of a group of people--the behaviors, beliefs, values, and symbols that they accept, generally without thinking about them, and that are passed along by communication and imitation from one generation to the next”

(Macmillan, 1938)

In human evolution definition of Biophilia also evolved with the time, at the beginning Biophilia was everywhere, because human lived with nature, but with the evolution definition of the Biophilia has changed, and need of Biophilia also has increased, time, generations, social status, gender, and educational levels are the main factors for this change. These factors are representing the layers of cultural, so it's clear there is an influence of culture in Biophilia that can be observed in different places of the world, this will be discussed in this part of the study.

Different ways of biophilic practices are practiced by various communities around the world. Biophilia can be successfully achieved by adopting fundamental principles and number of various objectives of the communities. Several factors can be influence on this adaptation. Culture to culture preferences may vary, such as color, building material, types of plants integrated with the design, etc. Six principles that represent the fundamental conditions of the effect practice of the biophilic design. Such as environment features, natural shapes and forms, natural pattern and processes, light and space, places-based relationships and evolved human-nature relationships. Strong connection between Biophilia and cultural principles needs to have continuous connection or repeating connection with nature, evaluation of culture happens with the immediate natural and man-made environments, the evolution evolved with human adaptation and advanced human health and fitness. Biophilic design strategies play a major role in human emotional attachment especially with place and space.

## Influence of Culture as a Place Attachment Factor

Different part of the world have different cultural practices, every practices born for its nature, so with the influence of time cultural practices have improved with the changes in the community, so this cultural practices representing community's cultural identity, and geology. So these cultural practices are having a psychological connection with people, which influence the place. People even from same culture carry several different preferences according to their layers of psychological programing among them. Different layers of culture exist as i) the national level ii) the regional level iii) the gender level iv) the generation level v) the social class level and vi) the corporate level. Every culture has a unique identity, which represented by their buildings, dress and behavior. So every cultural practices in the world need a unique identity, so people need designs, which belongs to them. In Built Environment culture impacts on colour of the built context and bhiophilic context.



**Figure 3:** Cultural Influence on Colour- larung gar, Tibet, Source: Google



**Figure 4:** Cultural Influence on Biophilia Shirakawa-go, Japan, Source: Google

## Place and Culture

In parallel with Relph, Tuan (1977) Argued that places were essentially "centers of meaning constructed out of lived experience" that through time would be understood as meaning to the lives of the people. There is an evidence by Arefi (1999) when growth of the urban alteration arise with the traditional framework it will lower the chance of transformation of the meaning of place, and growth will be influenced by the culture of the place, and it will have the essence of the self-belongingness.

Development in the urban places have an impact on the identity of the place, when designing such urban places, there should be a contextual approach and clear understanding of complications to integrate the identity in their places. The disappearance of the place meaning and the attachment to the place cause the inefficiency to feel the belongingness to practice and evoke wisdom. A loss of identity can cause transformation of spaces and changes in the building, changes in the built environment and changes in its functions. When built environment failed to integration or corporation or detachment (e.g. when community has been resettled in a different location) it will lower the place attachment. Several researchers argues, modernist approaches are incapable of facing the contemporary problems, and this encouraging the fall of the historical cities (Salama, 2009). This will lead to collapsed of the self or group identity, as a result loss of identity, sustainability of the meaning and identity of the urban elements and icons, such as objects, structures and images. These elements are significant because its provide self-identity,



sense of community and sense of place to the community. (Hull et al., 1994). Integration of any design to the urban place needs to be authoritative to understand the level and form of the attachment and meanings associated with the places to unravel place significance.

A Place is an expression of human culture. "A place is a manifestation of human culture. Culture is a social process where people create meaning to give themselves a sense of identity" (Cohen, 1994). "The cultural spaces imbued people way of life and devoted cultural phenomenon are essential to building a place identity" (Lai, 2013). "The spaces will turn into places at the point where the setting's physical and cultural characteristics meld with the individual's affective perceptions and functional needs" (Bott, 2005). Sensation of the place and the activities at the attached place also needs to be transformed in place making process.

Culture, environment and psychological process are commonly functions as internally connected systems. They are linked with the psychological activities and behavioral activities, sensory activities, such as seeing through eyes, hearing through ears, smell through nose, interpreting, beliefs and attitudes and behavioral activities such as reactions for the activities and acts towards the environments (Altman and Low, 1992.). In urban place experienced as a personal perception, how people experience the place (physically and psychologically).

### **Introduction to Methodology**

Various methods employed in data collection for this research, include interviews, photography, published materials, personal observations and internet resources. Three case studies are used in this study, to compare and understand the places and the culture. In addition online survey also used to collect information from various type of students. Because culture vary from student to student in many ways, such as gender, region students came from, generation level (culture may be differ from first year to final year), social class level (experience of the place maybe differ from lecturers and students), and corporate level.

In this study only students are considered to understand the comfortable level provided by the biophilic environment, and to examine the influence of Biophilia among different layers of culture. In order to understand the comfortable level of the students several methods are used, such as personal observation, past researches and interviews. To get more accurate result survey has been used, in this survey some selected or directly observed biophilic attributes are used as a method to understand the psychology of the students, such as green plants, building material, shading, views, weather, natural ventilation, natural lighting, use of landscape, use of colors, sounds, shape of the entrance, seating areas, gathering areas, paving, and form of the entrance.

Photographs and sketches are used to understand the section of the entrances and to examine the comfortable level of the entrances using the theories, collected technical data used to cross projects results, because technical data provide the result form students' direct observation, and moderated factors also discussed in this research. In this study only the entrances of the academic environment used to understand the impact of Biophilia.



**Table 15: Methodology**

	Data	Person A	Person B
<b>Cultural Parameters</b>	Age Gender Occupation If Student ( current Year) Used Entrance as a gathering space How often Activities at gathering space  Personal Connection Entrance Impact on Daily activities Impact range (1- Low, 5- High) Do Entrance Guide to the Destination Do you like more colours in the entrance What is your favorite Colour		
<b>Biophilia Attributes</b>	Rate these elements (1- Low, 5- High) (According to the availability of the material) How much comfortable you are	Green plants Building Material Shadings Views Weather Ventilation Lighting Landscape Colors Sounds Shape of the Entrance Seating areas Gathering Spaces Paving Form of the Entrance	

### Introduction to Case Studies


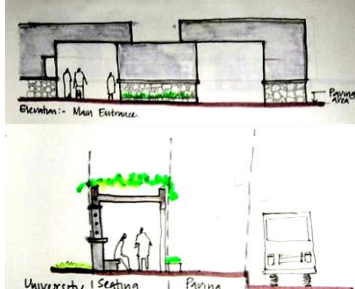
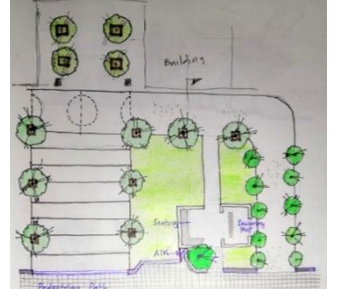
Three case studies selected for the study, which are closer connection to the environment in different way, first one Sri Jayewardenepura University which is recently refurbished with biophilic elements, second is National School of Business Management which known as NSBM Green University and according to the university it's integrated with green techniques (environmental friendly), then final case study is Sri Lanka Institute of Information Technology Malabe university, well known as a SLIIT, which has a both natural environment and built environment, to enter the main building people should walk along a landscape and series of courtyard, so in this campus also they have connection with biophilic element, and it's well known for its usage of colors in buildings. So three different universities, and three different strategies, so these case studies have a potential to compare different biophilic environments and to find the real comfortable can be provided by Biophilia.

### Cross Project Analysis: Culture specific Biophilic Strategies used to maximizing user comfort in selected case studies

In Jayewardenepura University, NSBM and SLIIT, only few cultural levels have been used, such as gender level and generation level. In this study all the users are studiers so all are from same

corporate level, so gender level and generation levels are used. In gender level both male and female students are interviewed, place preferences and activities are different from gender to gender, that affect the familiarity of the place and self-belongingness, according to the study, mostly gathering places at the entrances are used by male students, and female are using the entrances places only for limited number of activities. And generation level also preference changed, every batch can considers as a generation, in generation level first years are in a different generation compare to final years, with time familiarity change and self-belonging will increase. In state university fear of first year students also play a major role in finding the comfortable place in the entrance. Where final year students feel the belonging.

**Table 2:** Comparison of Green Plant and Shading. Source: Author

University of Sri Jayawardenepura	National Institute of Business management	Sri Lanka Institute of Information Technology
		

In all these three universities biophilic elements play a major role with the influence of gender and academic year of the student, which is a different levels of culture, so it's clearly prove that culture is influencing in comfort of the academic environment

**Table 3:** Comparison of Building material, Use of Colour, Shape and Form of the Entrance and Paving. Source: Author

University of Sri Jayawardenepura	National Institute of Business management	Srilanka Institute of Information Technology
		

**Table 4:** Comparison of Building material, Use of Colour, Shape and Form of the Entrance and Paving

University of Sri Jayawardenepura	National Institute of Business management	Sri Lanka Institute of Information Technology

### Conclusion

This study consolidates that use of biophilic design strategies in public urban places increase the comfortable and sense of belongingness to the users. This explains about the alterations or strategies that can be adopted in the built environment to enhance the connection with the places and moderate the human behaviors in the places. In this study three different academic environments selected as a case study and analyzed deeply, to understand the optimization of biophilic design strategies in the urban places and the comfortable level that achieved by biophilic design strategies, and cultural layers of the university ,comfortable achieved by biophilic designs are experienced as a culture specific design strategy.

The final result of the study shows that, culture specific designs are more sensitive, when Biophilic design strategies are adapted, it need to be studied well with the context to optimize the biophilic design strategies. And need to do the analytical study to predict the future interventions, because Biophilic design is subjective with the time and people. If it is not studied sensitively, then it might lead the whole community which depend on the built environment into different direction, especially entrance of the academic environment needs to be more sensitive, otherwise it may lead students' behavior in to different path, because built environment always influence the human psychology. Specific finding of this study is, Biophilia is a part of human evolution, humans are evolved with the nature, but modern built environments separated the humans from nature environment, this impact can be seen in modern urban area, most of the communities lost their identity because of the modern built environment, globalization plays a major role in it. So there is a need of adaptation of biophilic design strategies in modern built environment, and these design strategies needs to be handled carefully to keep the identity of the people and their culture. And study prove, optimization of biophilic designs into the building improve human psychology and good for physical body as well.

One critical aspect of biophilic design is, same design can perceive by its users in many ways, because with the change of the user's culture impact of Biophilia also changes. Culture have several layers, so when design a public urban places there might be many people with different cultural backgrounds, so needs are mutual but way of experience is different from person to person. So for a community base or academic base designs need to response for all category of

people. In Srilankan academic situation there is shall be need of biophilic designs, because of modern globalization, approach to achieve the urban environment has changes and identity for the Srilankan academic environment have dominated by other factors, so there is a need of restore the cultural identity and sense of familiarity. And adoption of Biophilia improves the quality of the environment.

Firstly, Biophilia is a human connection towards the nature, every human have different specific needs according to the culture he belongs to, so every places can be experienced differently by every human being. So Biophilia is always a culture specific design strategy. Finally in this research several biophilic attributes and elements were discussed, and how these design strategies can optimized to make comfortable places in the academic environment and this optimization can be done through direct and indirect representation to improve the psychological and physical comfort.

As a way forward from this study, it would be worth to evaluate how these system changes when biophilic design integrated into the built environment, human behaviors and cultural responses take an important place in culture specific biophilic design. This study, on its part, has established a theoretical basis to discuss, understand and evaluate a behavior of human in biophilic environment and discussed about the needs that need to be accommodating in urban places.

#### References:

- BOOTH, N. K. (1983) *Basic Elements of Landscape Architectural Design*, Oxford, Elsevier.
- Ettehad S., Karimiazeri A., Kari G. (2014) *The Role of Culture in Promoting Architectural Identity* Front Public Health , eCollection 2016
- HALL, E. (1966) *The hidden Dimension*, New York, Doubleday.
- Hunziker M. Buchecker M Hartig T.(2007) Space and Place – Two Aspects of the Human-landscape Relationship , A Changing World: Challenges for Landscape Research :Springer (pp.47-62) DOI: 10.1007/978-1-4020-4436-6\_5
- Kellert, S, J. Heerwagen, M. Mador, eds. (2008) *Biophilic Design: the Theory, Science, and Practice of Bringing Buildings to Life*. Hoboken, NJ: John Wiley.
- Kellert, S. (1997) *Kinship to Mastery: Biophilia in Human Evolution and Development*. Washington, DC: Island Press.
- Kellert, S. (2005) *Building for Life: Understanding and Designing the Human-Nature Connection*. Washington, DC: Island Press.
- Kellert, S. 2012. *Birthright: People and Nature in the Modern World*. New Haven: Yale University Press.
- Kellert, S. and E.O. Wilson, eds. (1993) *The Biophilia Hypothesis*. Washington, DC: Island Press.
- Kellert, S., & Calabrese, E. (2015) *The practice of biophilic design*. Retrieved from [http://media.wix.com/ugd/21459d\\_7b0461761b9f45e0b3607d14e8523390.pdf](http://media.wix.com/ugd/21459d_7b0461761b9f45e0b3607d14e8523390.pdf).
- Kellert, S., & Calabrese, E. (2015). The practice of biophilic design. Retrieved from [http://media.wix.com/ugd/21459d\\_7b0461761b9f45e0b3607d14e8523390.pdf](http://media.wix.com/ugd/21459d_7b0461761b9f45e0b3607d14e8523390.pdf).
- Kellert, S.R. & E.O. Wilson (1993). *The Biophilia Hypothesis*. Washington: Island Press
- Kellert, S., Heerwagen, J., & Mador, M. (2008) *Biophilic design: The theory, science, and practice of bringing buildings to life*. Hoboken, N.J., Wiley.
- Seymour V. ( 2016) The Human-Nature Relationship and Its Impact on Health: A Critical Review Terrapin Bright Green. (2012) *The economics of biophilia*. New York, NY: Terrapin Bright Green LLC.
- Wilson, E. (1986) *Biophilia*. Cambridge, MA: Harvard University Press.