



## BIOCOMFORT IN URBAN PLANNING STUDIES

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### ARTICLE INFO

#### Article History:

Received 11th April, 2017

Received in revised form 5th

May, 2017 Accepted 10th June, 2017

Published online 28th July, 2017

#### Key words:

Biocomfort, urban planning, climate.

### ABSTRACT

It has been proven that air and climate have a significant impact on people's behavior and physiological condition, and directly affect human performance and happiness. People feel healthier and more dynamic when environmental conditions such as temperature, precipitation, humidity and wind are at certain intervals. These values are called "bioclimatic comfort" or "biocomfort", when they are at the level that is suitable for human life. A lot of studies have been done on this issue in recent years with the understanding of the biocomfort principle. However, unfortunately, the studies that have been carried out cannot be actively used in urban planning yet and therefore the work done in this area cannot be transferred to application sufficiently.

This study aims to explain the importance of biocomfort, the methods that can be used to calculate the biocomfort of an area and how it can be used in urban landscape planning studies. Additionally, information about some studies done in the world on biocomfort have been given.

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## INTRODUCTION

### *Biocomfort in Urban Planning*

Migration from rural to urban areas has increased rapidly after the industrial revolution (Kalaycı and Birişçi, 2013; Birişçi *et al.*, 2016). Today, more than half of the total population continues to live in urban areas. By 2030, it is estimated that 60-90% of the world's population will live in cities (Kaya *et al.*, 2009). More than two-thirds of the total population in European countries live in urban areas. At the same time, the migration from rural to urban is still continuing and it is estimated that the population of the city will increase further in the coming years (Mansuroğlu *et al.*, 2016a; Birişçi *et al.*, 2017a,b,c; Cetin *et al.*, 2017a,b; Cetin, 2017).

Population growth in urban centers requires the settlement of new areas in city centers, and therefore the structure of cities is changing and developing (Gülğün *et al.*, 2014).

However, in addition to the new settlement area, the expectations of modern people's living spaces are also changing, and the factors that are not even aware of or appreciated by anybody as far as the near future, play a significant role in the choice of the region where people live today (Malkoç True *et al.*, 2014). Social opportunities, recreational activity opportunities, closeness to nature and air quality are some of these factors (Sönmez Türel *et al.*, 2014; Cetin and Sevik, 2016a,b; Kalaycı Önaç and Birişçi, 2017; Cetin 2016a,b). Therefore, in the last years, especially the regions close to the forest areas began to be intensively preferred by the people to live in. The forest areas offer many functions together. The plants clear the air and provide aesthetic value in the environment where they grow (Kalaycı *et al.*, 2008; Kalaycı *et al.*, 2009; Söğüt *et al.*, 2016; Birişçi *et al.*, 2017a).

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The biocomfort conditions have also begun to be effective on the region preferences of people to live in recent years. People feel healthier and more dynamic when environmental conditions such as temperature, precipitation, humidity and wind are at certain intervals (Alpay *et al.*, 2013). These values are called "bioclimatic comfort" or "biocomfort", which is appropriate for human beings to live on. It is determined that air and surface temperatures in urban areas are higher than those in rural areas and that this temperature difference can reach up to 13°C (Cetin, 2015a; Cetin *et al.*, 2016), while bioclimatic comfort is not at the appropriate value range, people are disturbed in those areas and want to get away (Cetin, 2016a,c). Air and climate have a significant impact on people's behavior and physiological condition. Human performance and comfort can be distinguished by climate changes. Climatic condition or thermal comfort refers to healthy and dynamic weather conditions for a person's mood and therefore human satisfaction (Cetin *et al.*, 2010; Topay, 2013; Cetin and Zeren 2016a,b; Zeren *et al.*, 2016). Therefore biocomfort is one of the phenomena that must be taken into consideration in urban planning, and it has begun to gain more and more importance in recent years.

**The Importance of Biocomfort**

Bioclimatic factors have 6 important parameters. These are; temperature, relative humidity, wind velocity, precipitation, radiation and insolation. (Synnefa *et al.*, 2007; Cetin *et al.*, 2016; Cetin, 2017) Human beings generally feel healthy and dynamic when environmental conditions such as temperature, precipitation, humidity and wind are at certain intervals. It is called Bioclimatic comfort that these values are in appropriate intervals for human life. In the middle latitudes of our country, the temperature value that is accepted as appropriate for bioclimatic comfort is between 17-24,9 ° C depending on the humidity and wind (Koçman, 1991). If all other conditions are normal, a temperature of 21-27 ° C and a relative humidity of 30-65% creates a comfortable environment. Under these conditions or above, the heat or radiation energy or shade, wind and specific humidity (Altunkasa, 1990) are reported to be required. The relationship of the climate with the natural and socio-cultural environment is shown in Fig.1.

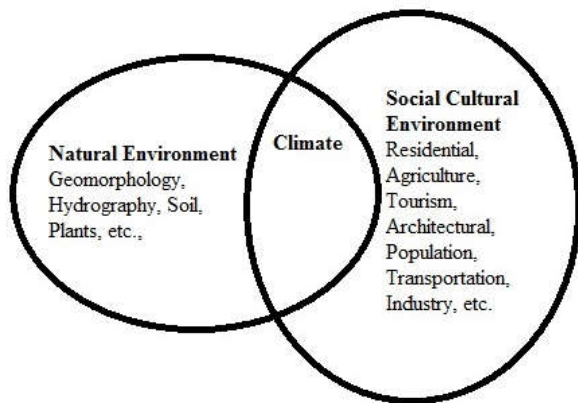


Figure 1 The relationship of the climate with the natural and socio-cultural environment (Cetin *et al.*, 2010)

Climate is an important factor affecting all the activities of human beings on earth positively or negatively (Brooks

and Cetin, 2013a,b; Cetin, 2015e; Cetin, 2013; Mansuroğlu *et al.*, 2016b). Many factors such as the determination of the objectives in the life cycle, residential areas and lifestyle are shaped under the effect of the climate (Cetin 2015a; Cetin 2016a; Cetin *et al.*, 2016). Climate has a position that determines the livability of the geographical environment and integrates socio-cultural processes with natural processes. Therefore, it is proximately influential in the formation of both natural and socio-cultural environments (Birişçi *et al.*, 2017b). Therefore, to live in the climate conditions they feel more comfortable makes a significant contribution to people's happiness and health.

**Calculation of Biocomfort**

Numerous studies have been carried out to date to determine the upper and lower bounds of climate conditions that enable biocomfort, and values have been obtained that differ from each other at the least. However, Olgay (1973) 's bioclimatic comfort approach, developed to determine the bioclimatic comfort needs of all people living outside the Ecuadorian and Arctic regions, has a special importance in this respect. Olgay (1973) identifies climatic conditions providing bioclimatic comfort with the help of a coordinate system. By this coordinate system called The Bioclimatic Chart presented on Fig. 2, climatic data on any area can be processed to reveal the climatic values necessary for bioclimatic comfort on that area (Altunkasa, 1990).

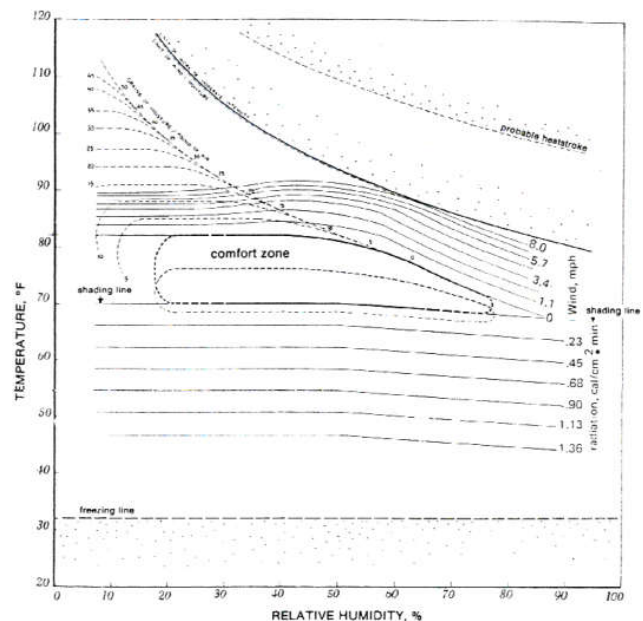


Figure 2 Bioclimatic Chart (Cetin *et al.*, 2010).

While calculating the biocomfort intervals, biocomfort maps are produced according to the physiological equivalent temperature index by using the climate data of the region where the study area is located. Firstly, the climatic data of the area is obtained from the meteorological stations in these studies. The obtained data are converted to annual mean values and annual temperature, humidity and wind velocity maps are generated using various programs (the most frequently used program is determined to be the Rayman Program). In later stages, thermal perception maps are produced with the help of geographic information system (GIS) software

(Arıcaç *et al.*, 2009; Cetin 2015b,c,d; Cetin 2016c). In this phase, ESRI software is generally used as a universal linear cricking interpolation with the help of ArcView GIS, and climatic factors are evaluated and suitable areas in terms of bioclimatic comfort are determined (Zeren and Cetin, 2016). The obtained data must be interpolated while calculating the biocomfort, "Inverse Distance Weighting (IDW)" is used as the interpolation method (Boz, 2017).

### Former Studies about Biocomfort

Cetin *et al.* (2010) pointed out that studies in our country about the determination of bioclimatic comfort and its reflection on the urban planning process have begun to be seen in the late 1960s, and Berköz (1969) focused on a method that could be used to determine the appropriate ceiling height in terms of bioclimatic comfort. As quoted by Cetin *et al.* (2010); Sungur's 1980 study found that the optimum effective temperature values for Turkish people were 16.7 - 24.7 ° C, but that these values were subjective. But Koçman (1991) determined effective temperature values for our country as 17.0 - 24.9 ° C.

Çınar (1999) determined the criteria that can participate in the planning process which area balanced with climate by revealing the bioclimatic structure of the Fethiye district. Çınar (2004) then carried out a study on the effectiveness of bioclimatic comfort criteria in the urban planning process on the Muğla-Karabağlar Plateau. Topay and Yılmaz (2004) prepared a study on the possibilities of using GIS for the identification and mapping of areas with bioclimatic comfort and they prepared first bioclimatic comfort maps.

After this date, numerous studies have been carried out on biocomfort mapping, especially by using GIS. Topay (2007) in Muğla; Cetin *et al.* (2010) in Kütahya; Zengin *et al.*, (2010) on Erzurum-Rize interurban road, Cetin (2015a) in Kastamonu; Çalışkan *et al.* (2012) in Bursa; Cetin *et al.*, (2010) in Kütahya; Sisman and Bolu (2015) in Gala Lake; Cetin, (2016a) in Cide; Malkoç and Özkan (2010) in İzmir; Cetin *et al.* (2016) in Aydın; worked on bioclimatic comfort.

### Recommendations

Biocomfort is one of the issues that must be taken in to consideration in urban planning studies. However, it is seen that many of the studies carried out have been made in very limited areas and only remain as researches. It is obvious that the scientific researches about the issue cannot yet be transferred to practice sufficiently.

Taking into consideration the scientific studies carried out in this context in urban planning and determining the urban planning decisions according to biocomfort principles have an essential role in providing more comfortable living spaces to people.

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