La confortabilidad climática en los parques Las Peñas-Los Ocotillos y sus efectos en el bienestar humano

The climatic comfort in Las Peñas – Los Ocotillos parks and its effects on human welfare

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Resumen

Los parques Las Peñas-Los Ocotillos se localizan al este de Ciudad Guzmán, municipio de Zapotlán El Grande, Jalisco, México. El objetivo fundamental del trabajo es evaluar el grado de confortabilidad climática que proporcionan dichos parques a los habitantes de Ciudad Guzmán. Para hacerlo se analizan los factores que intervienen en la confortabilidad humana, tal es el caso de la temperatura del aire, la humedad atmosférica, la velocidad del viento y la radiación solar. La metodología implementada consiste en índices, como el régimen térmico, la temperatura efectiva y el de enfriamiento eólico, así como el diagrama bioclimático de Terjung. Los resultados obtenidos definen a estos lugares como áreas confortables la mayor parte del año. Cabe destacar que la elaboración de este tema coadyuvó con los estudios justificativos para la declaración de los parques Las Peñas-Los Ocotillos como área natural protegida, distinción recibida en septiembre de 2015.

Palabras clave: confortabilidad climática, Las Peñas-Los Ocotillos, Ciudad Guzmán.

Abstract

Parks Las Peñas – Los Ocotillos are located east of Ciudad Guzman, municipality of Zapotlan El Grande, Jalisco, Mexico. The fundamental objective of the work is to assess the degree of climatic comfort provided by these parks to the inhabitants of Ciudad Guzmán. So that it discusses the factors involved in human comfort, such is the case of the air temperature, humidity, wind speed and solar radiation. The implemented methodology consists in indices, such as the thermal regime, the effective temperature and the wind cooling, as well as the diagram Terjung bioclimatic. Results define these places as areas comfortable most of the year. It should be noted that the elaboration of this topic contributed with supporting studies for the Declaration of the parks Las Peñas – Los Ocotillos as a protected natural area, distinction received in September 2015.

Key words: climate comfort, Las Peñas – Los Ocotillos parks, Ciudad Guzmán.

Fecha recepción: Enero 2015 **Fecha aceptación:** Julio 2015

Introduction

The main purpose of this paper is to highlight the function of climatic comfort provided to the inhabitants of Ciudad Guzman, Jalisco, by the parks Las Peñas – Los Ocotillos, and in this way contribute with the initiative to declare these as protected Natural Area (Figure 1).

To do this several interrelationships were analyzed, among solar radiation, air temperature, relative humidity and the speed of wind, and their effects on the well-being of the people. For this index are used as the effective temperature of wind cooling, or comfort zones are delimited through bioclimatic diagrams.

This research includes concepts and theoretical foundations necessary to achieve in the reader greater clarity and ease of understanding of the subject. It also contains the sufficient explanation in relation to the indexes and diagrams bioclimatic considered in the study.

Climatological records of the Meteorological Observatory of Ciudad Guzman were used in its preparation. This information consists of two sets of data, the first cover from 1981 to 2000, and the second from 1981 to 2010, both recovered from the Service Meteorological National - National Water Commission (SMN-CNA).

In terms of achievements, as well as check the function of climatic health giving parks Las Peñas – Los Ocotillos to the inhabitants of Ciudad Guzman, it should be emphasized that this theme as part of the research project, called supporting studies for the Declaration of the Parks Las Peñas – Los Ocotillos Ciudad Guzmán as protected Natural Area, contributed to these places to receive that distinction in September 2015

Figure 1. Entrance to the Park of Las Peñas, Ciudad Guzman.

Theoretical and conceptual foundations

The climate is an element of the natural environment whose influence is decisive in the distribution of the living beings on the Earth's surface. From the human point of view, Griffiths says that "the man no matter where you are, has to adapt to the climate" (1985, p.97).

It was Hippocrates who stated clearly in his famous scientific work: *About the airs, waters and places*, the influence of climate and environment on the well-being and health of people. This clarifies that the air, water and climate are fundamental factors influencing the health of the inhabitants of a certain city (Tornero, Pérez and Gomez, 2006, p.148).

The concept of comfort is a term which can be seen from different points of view. The majority of the authors understand it as a State of well-being climatic or thermal. The welfare State is the result of a certain balance between man and his environment, and between the environmental and physiological conditions (Tornero et al., 2006, p.147). For his part, Fernandez defines it as the set of environmental conditions under which people most manifest feeling good (1996, p. 199).

Therefore, a comfortable climate is what allows the human body maintain its internal temperature without excessively run their physiological processes regulating it. However, this condition can vary according to individual perception and appreciation that an individual has an environment, and according to the personal characteristics of the subject, such as your mood, age, sex, activity performed, health status , physical condition and clothing.

Thus, trying to explain climate comfort considering only the air temperature, causes a vague idea of the actual thermal sensation. The feeling of well-being or displeasure not only based on the effects of climate causes a single variable, but the combination of several. "The heat, for example, is much more tolerated in a dry atmosphere and ventilated in a wet and calm environment; likewise, the wind considerably strengthens the character of the cold bite "(Besancenot, 1991, p.35).

According to Griffiths (1985, pp. 99, 117), the air temperature is the most important climatic variable and that most directly influences the degree of well-being in people. So man absorbs heat when the air temperature is above 33 ° C, but when the air temperature is lower than this value, the opposite occurs. In this regard for a person wearing the optimum temperature is between 18 ºC y 24 ºC.

The humidity is the second factor in the sense of comfort. So that if high temperature and humidity are combined, an oppressive feeling occurs. Moreover, a low temperature with high

humidity, causes people to spend a sultry feel a cold wet heat. As Dreyfus (1960), Soto and Jauregui (1968, p.11), you can only feel comfort in environments where the relative humidity is between 20% and 70%. Fernandez (1996, p. 204) indicates that below 20% moisture, increases the risk of infection by dryness of the respiratory tract and in warm conditions when the humidity exceeds 60% and, particularly, when it is higher 80%, the sensation of heat increases because sweat is produced, but no evaporation. Finally, Aguilera, Borderías Gonzalez and Santos (1990, p. 409), indicate that normally the comfort zone is between 30% and 65% relative humidity.

Air movement increases heat dissipation accelerating the evaporation of sweat found on the skin surface. However, when temperatures are above 40 ° C, the air lifts the warm feeling. The soft wind promotes a perception of calm and wellbeing, while intense winds cause uneasiness and discomfort.

The radiation outside is that which comes directly from the sun or the diffuse sky and clouds, or issuing the floor and walls of buildings. An individual exposed to sunlight receives heat energy, in addition to its own metabolism, therefore, that the body temperature does not rise must get rid of this heat by convection, conduction and evaporation the sweat from the skin. According to Landsberg (1954) and Soto Jauregui (1968, p. 60), that heat loss in normal conditions is effected by radiation in 44%, 35% and 21% by driving by evaporation.

In health, Griffiths (1985, p.108), warns that an increase in the amount of ultraviolet radiation received by the visitor of the mountains, can cause severe burns, conjunctivitis, cataracts and skin cancer. Conversely, ultraviolet radiation weakens some bacteria and germs also helps prevent rickets. In the psychological aspect, sunny days people happy, especially after a period of cloudy sky.

Information and methodology

Parks Las Peñas-Los Ocotillos are located south of the state of Jalisco, in the part of the Sierra del Tigre which is located east of Ciudad Guzman, municipality of Zapotlán El Grande, Jalisco (Figure 2). The Rocks Park is among the coordinates 19 ° 41'34 " 19 ° 42'12 " and 103 ° 26'19 " to 103 ° 27'07 " and from 1552 to 1817 meters. The Ocotillos 19 ° 41'23 " 19 ° 41'48 " and 103 ° 26'45 " to 103 ° 27'09 " and from 1570 to 1769 meters. Both north latitude and west longitude. As for the surface comprising, Las Peñas has approximately 86.7 hectares and Los Ocotillos August, totaling 94.7 hectares. In both predominantly pine-oak forest.

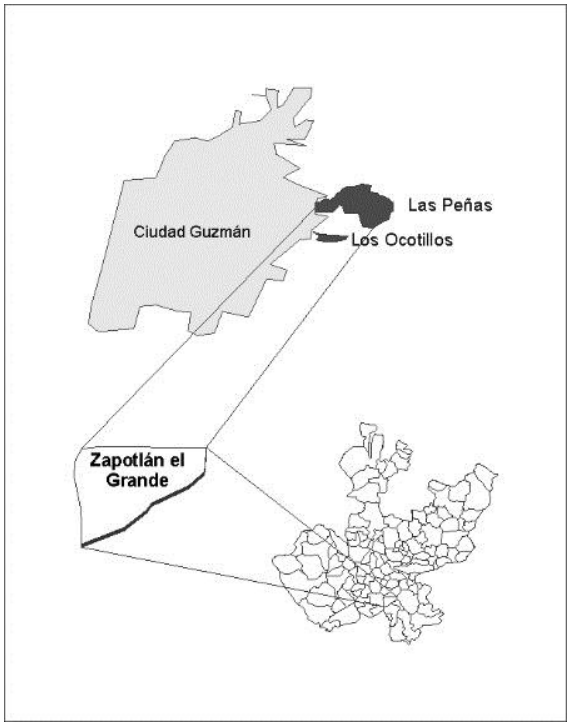


Figure 2. Map of the parks The Rocks-The Ocotillos.

Source: Prepared based on vector data Instituto Nacional de Geografía y Estadística (INEGI, 2010).

To carry out the analysis of climate comfort of the Rocks-The parks Ocotillos, weather data from the Meteorological Observatory of Ciudad Guzman, the NMS-CNA were used, whose geographical coordinates are 19 ° 43 '05 "N, 103 ° 27' 53 "west longitude and 1515 meters. This information comprises two data sets, one covering of 1981-2000, and is wind data, relative humidity and cloudiness; the second consists of 1981-2010 and integrates normal air temperature. According to Turner et al. (. 2006, pp 153, 154), recent studies of climate comfort are based on the use of two types of methods: The analytical and rational method, and synthetic or empirical approach. The first is based on the human energy balance, using computer techniques. The second is based on the effect upon man a climatic variable or a combination of several. Ignore the functions of the human body, activity, clothing, weight, age, health, and so on. According to Fernandez (1996, p. 205), "the results are expressed as an index or by areas of comfort called bioclimatic diagrams or charts."

Indexes and bioclimatic diagram applied for the preparation of this work, integrates those under their requirements could be solved with the information collected at the time of realization. Among them are the following: calculation of air temperature, which is made with reference to

the temperature data Meteorological Observatory Ciudad Guzman; as well as the thermal gradient (in the troposphere, temperature decrease with height at a rate of 0.65 ° C per 100 meters), causing the representative series of air temperature parks The Rocks-The Ocotillos.

The uneven distribution of temperature on the various components of the surface of the earth, contributes to a great diversity of climatic nuances. Mosino and Benassini (1974, p. 94) and Garcia (1981, pp. 16, 17), using the average annual air temperature for classifying thermal zones in Mexico. For this study the authors said criterion is followed for the appointment of the thermal zone they belong to the above parks (Table 1).

Table 1. Criteria for delimitation of thermal zones in Mexico

ZONA TÉRMICA	TEMPERATURA MEDIA ANUAL EN °C
Muy cálida	Sobre 26
Cálida	Entre 22 y 26
Semicálida	Entre 18 y 22
Templada	Entre 12 y 18
Semifría	Entre 5 y 12
Fría	Entre -2 y 5

Fuente: Mosiño y Benassini, 1974, p. 94.

The annual oscillation of temperature is the difference between the highest and lowest average monthly temperatures. Mosino and Benassini (1974, p. 102), Garcia (1981, p. 18) and Vidal (2005, p. 95) indicate the range of annual oscillation of temperature for Mexico, based on the following parameters : i: isothermal, with temperature difference between the coldest month and the warmest less than 5 ° C; (I '), oscillation between 5 and 7 ° C; (E) extremes, swing between 7 and 14 ° C; (E ') very extremes, the greater swing of 14 ° C.

The effective temperature (TE) was calculated using the methods of Missenard, and Landsberg. The effective temperature is defined as "the equivalent temperature in still air would experience a sedentary, healthy subject, in the shade, wearing work clothes, if the relative humidity was 100%" (Tejeda Mendez, Utrera Rodriguez, 2005, p. 115). In this regard, Dreyfus (1960) and Soto Jauregui (1968, p. 63) indicates that the comfort range is between 21º and 25º effective temperature and a relative humidity below 80%. The discomfort begins between the 25th and 26th of effective temperature in people adapted to hot and 21º to 22º for those not accustomed to such environments environments. For Griffiths (. 1985, p 101) effective temperature above 31º

cause discomfort in people; while 35 ° is the upper tolerance limit. According to Turner et al. (2006, p. 154), Missenard (1937) raised the equation 1, which is expressed as follows:

$$ET = T - 0.4\,(T - 10)\left(1 - \frac{HR}{100}\right) \qquad (1)$$

Where TE is the effective temperature T is the air temperature in degrees Celsius and relative humidity HR percentage.

The effective temperature according to Landsberg (1964) and Soto Jauregui (1968, p.63) can be calculated using Equation 2:

$$TE = 0.4\,(T_s + T_h) + 4.8 \qquad (2)$$

Being effective temperature, it is the dry bulb temperature and Th wet bulb temperature both in degrees Celsius. The results of this equation are compared with the parameters in Table 2.

Table 2. Effective Temperature and thermal sensations in the human body

TEMPERATURA EFECTIVA (ºC)	SENSACIÓN		RESPUESTA FÍSICA
	TÉRMICA	CONFORT	
40	Muy caliente	Muy incómodo	Problema de regulación
35	Caliente		Aumento de tensión por sudoración y aumento de flujo sanguíneo
30	Templado		Regulación normal por sudoración y cambio vascular
25	Neutral	Cómodo	Regulación vascular
20	Ligeramente fresco	Ligeramente incómodo	Aumento de pérdidas de calor seco
15	Frío	Incómodo	Concentración de vasos en manos y pies
10	Muy frío		Estremecimiento

Fuente: Fernández, 1996, p. 207.

Siple y Passel (1945), They analyzed the ability of the moving air to cool the human body skin level. The feeling of cold hands and face are good indicators of this factor (Griffiths, 1985, p. 99). The wind chill index K Siple and Passel, expressed in Kcal / m2 per hour by Equation 3.

$$K = (33 - t)(10\sqrt{v} + 10.5 - v) \qquad (3)$$

Where t is expressed in ° C d in m / s (in this case the data of annual average monthly maximum wind and Meteorological Observatory Ciudad Guzman were used). The sensation scale for K shown in Table 3.

Table 3. Power air cooling as Siple y Passel

ESCALA DE SENSACIÓN DE *K*	
Kcal/m² por hora	Sensación
50	Caliente
100	Tibio
200	Templado
400	Fresco
600	Muy fresco
800	Frío
1000	Muy frío
1200	Congelamiento glacial
1400	Congelamiento de piel expuesta
2000	Congelamiento de piel expuesta en 60 segundos
2500	Intolerable

Fuente: Griffiths, 1985, p. 99.

The comfort conditions in open spaces such as parks Las Penas-Los Ocotillos requires evaluation of all of bioclimatic factors. To quantify solar radiation into calories per square centimeter per day, it was necessary to apply the procedure indicated the degree of cloudiness in Ortiz (1987, pp. 33-45). Once you made this method, if required you can get the average global solar radiation in W / m². To this we must consider that 1cal / cm² · min = 697.3 W / m (Vide, 1999, p. 56).

According to the Ministry of Public Works and Transport (MOPT, 1992, p. 145), the rate of climate comfort Terjung is based on the combination of air temperature with relative humidity, so that you can define areas of comfort . Temperatures in ° C, are in the abscissa, and relative humidity in% arranged in curves towards the axis of ordinates. This means that any temperature situation and on humidity throughout the year is represented by a point within a so-called comfort zones.

Results

The shape of the Earth, the movement around the Sun and the tilt of its axis in the plane of the ecliptic determine the seasons and the length of the days and nights. These fluctuations in day length, cause variations in the uptake of solar radiation on the earth's surface, and to a greater or lesser degree of warming components thus resulting in the course of the year the temperature oscillation.

According to the above, the minimum temperatures in the park Las Peñas are presented in the first and last months of the year, while the maximum occurring in the months of April, May and June (Figure 3). Meanwhile, Table 4 shows the annual march of temperature park The Ocotillos.

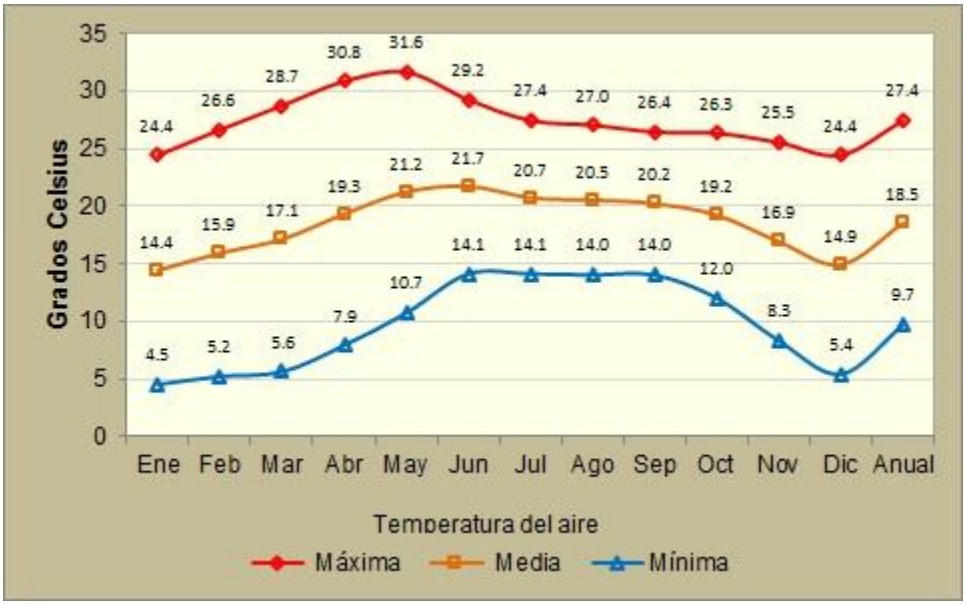


Figure 3. Monthly and annual temperature variation, park Las Peñas. Fuente: Elaboración propia. Datos del SMN-CNA, periodo 1981-2010.

Table 4. Air Temperature, parque Los Ocotillos

TEMPERATURA	*ENE*	*FEB*	*MAR*	*ABR*	*MAY*	*JUN*	*JUL*	*AGO*	*SEP*	*OCT*	*NOV*	*DIC*	*ANUAL*
Máxima	24.6	26.8	28.9	31.0	31.8	29.4	27.6	27.2	26.6	26.5	25.7	24.6	27.6
Media	14.6	16.1	17.3	19.5	21.4	21.9	20.9	20.7	20.4	19.4	17.1	15.1	18.7
Mínima	4.7	5.4	5.8	8.1	10.9	14.3	14.3	14.2	14.2	12.2	8.5	5.6	9.8
Oscilación térmica	19.9	21.4	23.1	22.9	20.9	15.1	13.3	13.0	12.4	14.3	17.2	19.0	17.8

Fuente: Elaboración propia con datos del SMN-CNA. Periodo 1981-2010.

According to the criteria for the definition of thermal zones in Table 1, the park Las Peñas semicálida is in the thermal zone, with an average annual temperature of 18.5 ° C, the average temperature of the coldest month (January) is 14.4 ° C and the average of the warmest month (June) is 21.7 ° C. With an annual oscillation of monthly average temperatures of 7.3 ° C (extremosa). Figure 4 illustrates the annual rate of this variable in both parks.

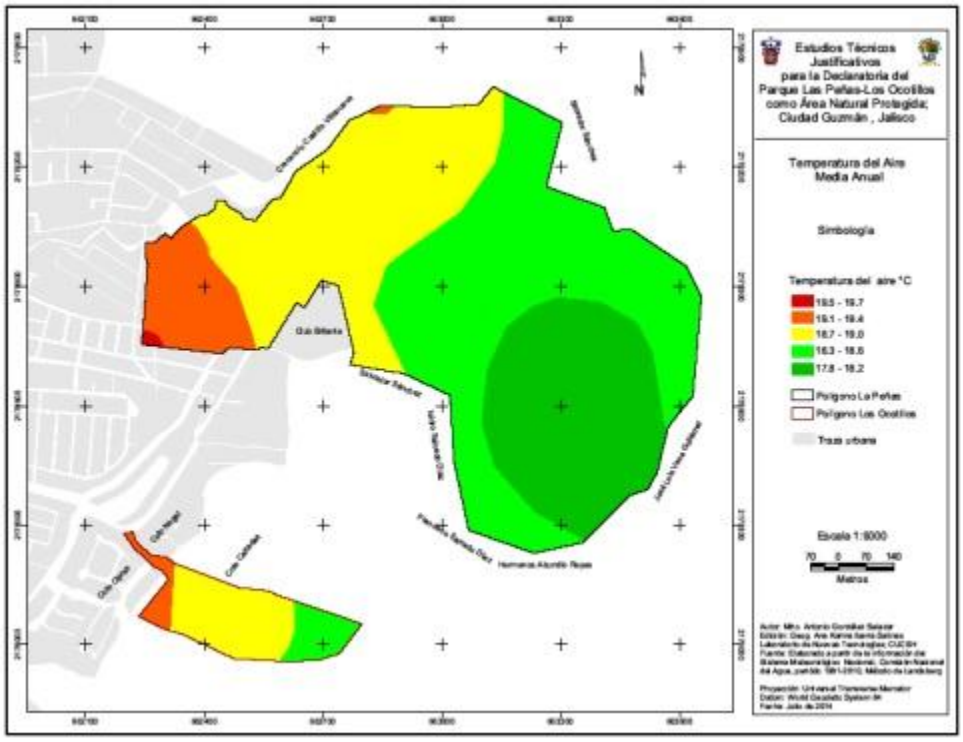


Figure 4. Average annual temperature. Parques Las Peñas-Los Ocotillos.

The effective temperature according to the method of Landsberg (equation 2) is due to interaction of air temperature with atmospheric moisture; It is calculated taking into account the parameters in Table 2, resulting in what is shown in Table 5.

Table 5. chill and comfort according to the method of Landsberg, parque Las Peñas

PERIODO	*SENSACIÓN*		*RESPUESTA FÍSICA*
	TÉRMICA	CONFORT	
Enero	Frío	Incómodo	Concentración de vasos en manos y pies
Febrero a mayo	Ligeramente fresco	Ligeramente incómodo	Aumento de pérdidas de calor seco
Junio y julio	Neutral	Cómodo	Regulación vascular
Agosto a diciembre	Ligeramente fresco	Ligeramente incómodo	Aumento de pérdidas de calor seco
Anual	Ligeramente fresco	Ligeramente incómodo	Aumento de pérdidas de calor seco

Fuente: Elaboración propia. Parámetros de confortabilidad en Fernández, 1996, p. 207.

The temporal representation of this factor being calculated by the methods of Missenard and Landsberg (equations 1 and 2 respectively), with the average monthly and annual temperature is illustrated in Figure 5. For its part, the results of both procedures the two parks are shown in Table 6. for its part, the spatial distribution of the effective temperature in January (the coldest month), June (warmest month) and annual average correspond to figures 6, 7 and 8.

Table 6. Effective Temperature, methods Landsberg y Missenard, parques Las Peñas-Los Ocotillos

PERIODO	MÉTODO			
	LANDSBERG		MISSENARD	
	LAS PEÑAS	LOS OCOTILLOS	LAS PEÑAS	LOS OCOTILLOS
ENE	14.9	15.1	13.8	13.9
FEB	15.7	15.9	14.9	15
MAR	16.9	17	16	16.1
ABR	18.5	18.6	17.7	17.9
MAY	20	20.1	19.4	19.5
JUN	20.8	20.9	20.3	20.5
JUL	20.2	20.4	19.6	19.8
AGO	20	20.2	19.4	19.6
SEP	20	20.1	19.3	19.4
OCT	19	19.1	18.2	18.4
NOV	17	17.2	16.1	16.2
DIC	15.5	15.7	14.3	14.4
ANUAL	18.2	18.4	17.4	17.5

Fuente: Elaboración propia con datos del SMN-CNA. Periodo 1981-2010.

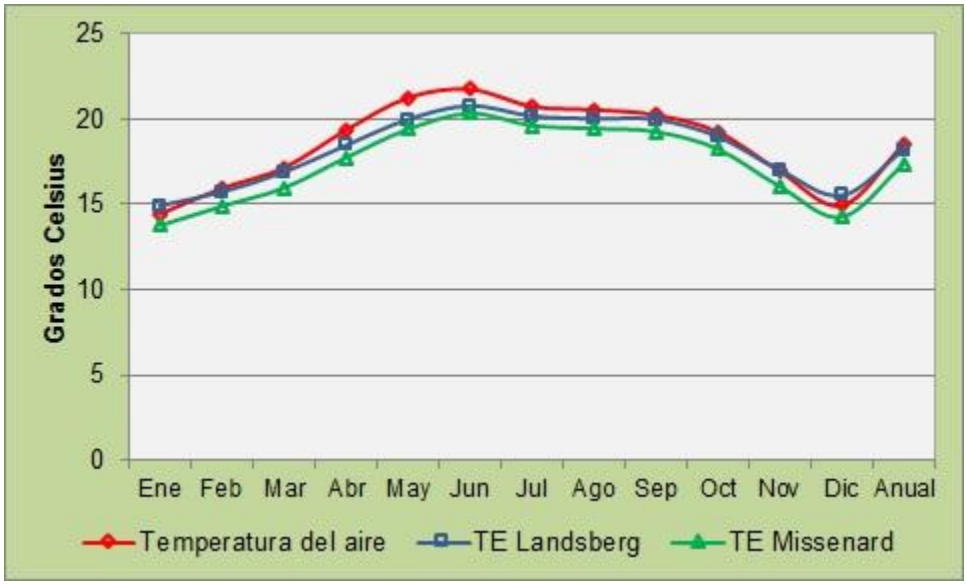
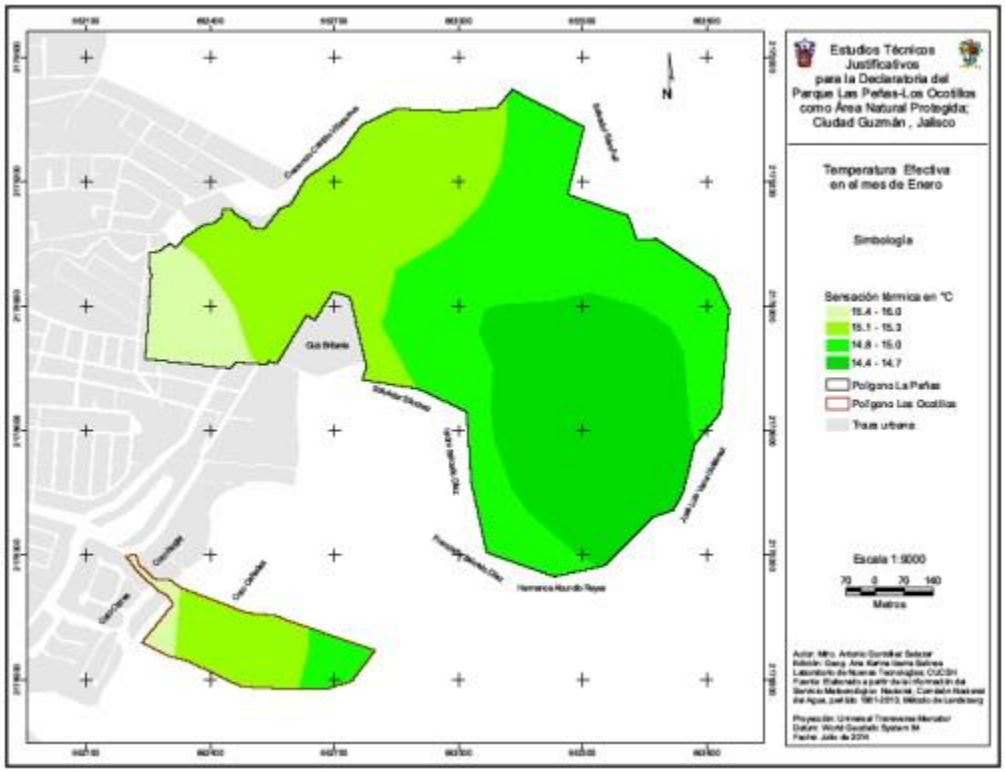


Figure 5. Air temperature and effective temperature average monthly and yearly, parque Las Peñas.



Temperature Figure 6. Effective January parks Las Peñas-Los Ocotillos.

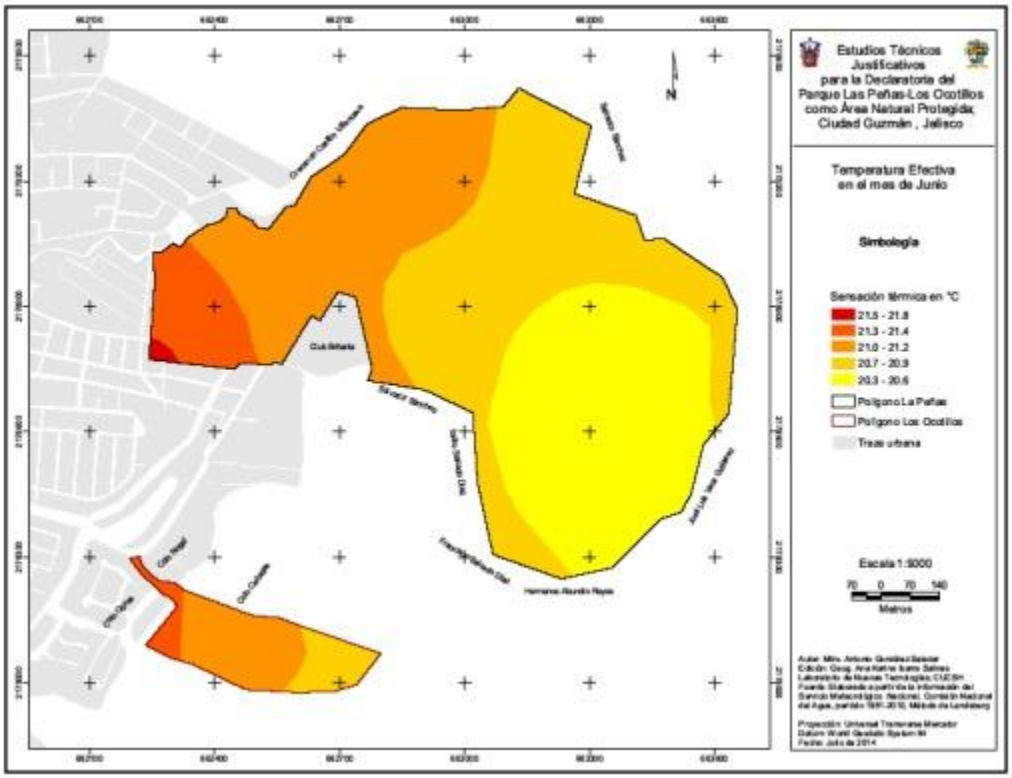


Figure 7. Temperature effective June, parks Las Peñas-Los Ocotillos.

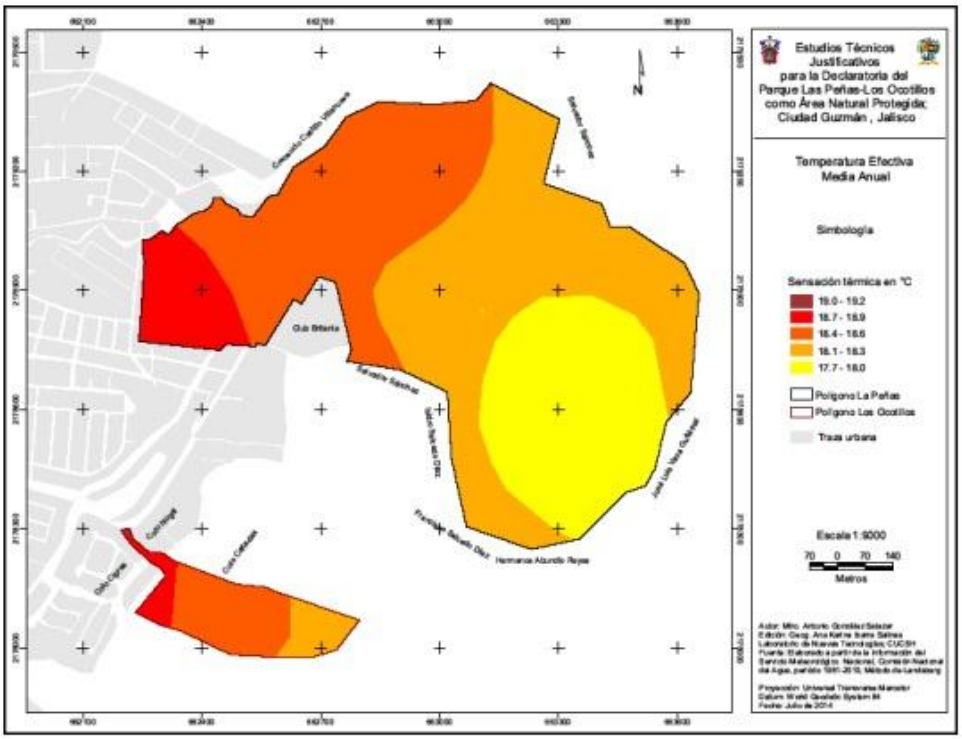


Figure 8. Annual average effective temperature, parks Las Peñas-Los Ocotillos.

The rate of cooling wind Simple and Passel (Equation 3) based on the combined effects of temperature and the cooling power of the air on the skin of the human anatomy pointing Table 3 resulted described thermal sensations in Table 7.

Table 7. Index air cooling Siple y Passel, parques Las Peñas-Los Ocotillos

SENSACIÓN TERMICA												
ENE	*FEB*	*MAR*	*ABR*	*MAY*	*JUN*	*JUL*	*AGO*	*SEP*	*OCT*	*NOV*	*DIC*	*ANUAL*
MF	MF	MF	MF	F	F	F	F	F	F	MF	MF	MF

Nota: MF: Muy Fresco, F: Fresco.

Fuente: Elaboración propia.

The data in Table 8, represented in climate diagram Terjung (Figure 9), designate the climatic environment of the parks The Rocks-The Ocotillos as follows: January (cool), February and March (temperate), from April to October (nice), November (mild), December (cool) and annual (nice).

Table 8. comfort index Terjung (1967), parques Las Peñas-Los Ocotillos

PERIODO	VARIABLE			
	TEMPERATURA MEDIA		HUMEDAD RELATIVA	GRADO DE COMODIDAD
	LAS PEÑAS	LOS OCOTILLOS		
Ene	14.4	14.6	62	Fresco
Feb	15.9	16.1	56	Templado
Mar	17.1	17.3	59	Templado
Abr	19.3	19.5	57	Agradable
May	21.2	21.4	59	Agradable
Jun	21.7	21.9	70	Agradable
Jul	20.7	20.9	74	Agradable
Ago	20.5	20.7	74	Agradable
Sep	20.2	20.4	76	Agradable
Oct	19.2	19.4	73	Agradable
Nov	16.9	17.1	68	Templado
Dic	14.9	15.1	66	Fresco
Anual	18.5	18.7	66.2	Agradable

Fuente: Elaboración propia con datos de humedad relativa del SMN, Observatorio Sinóptico Ciudad Guzmán, Jal. Periodo 1981-2000.

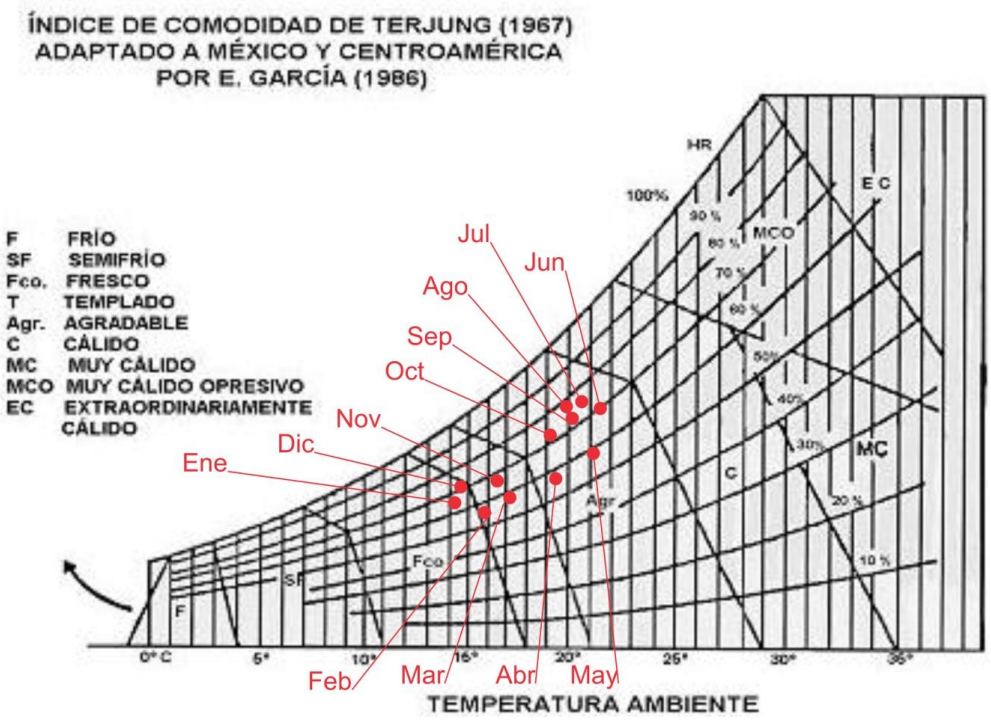


Figure 9. Areas degree of comfort and convenience according to the climatic health index Terjung.

The relative humidity in the parks The Rocks-The Ocotillos (Figure 10) presents the lowest values during the months of January to May, then it shows a rise in the period spanning from June to October; precisely because at that time of year the summer rains occur. In November it decreases gradually; month indicating the start of the dry season.

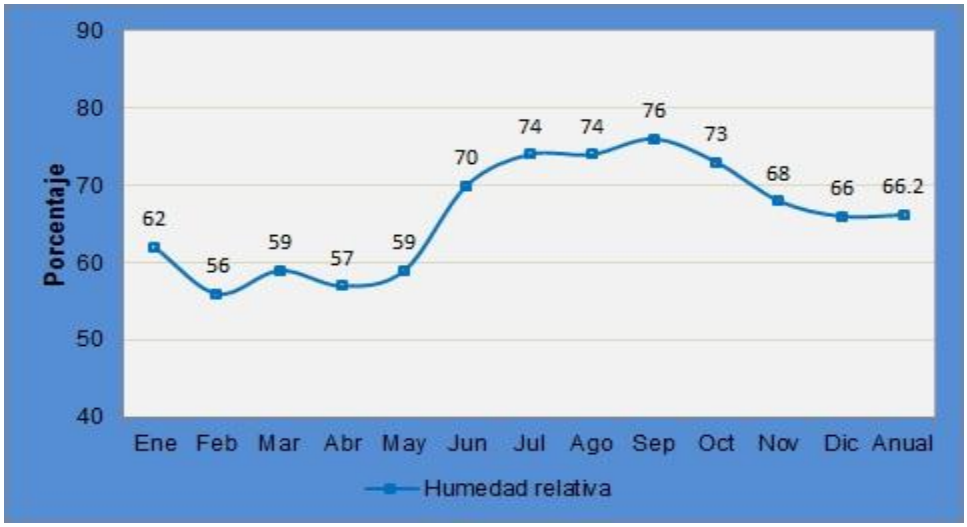


Figure 10. Variation of the relative humidity, parks Las Peñas-Los Ocotillos. Fuente: Elaboración propia con información del SMN-CNA.

Solar radiation is the most important source of energy for our planet, Fernandez (1996, p. 63) notes that all climate variables directly or indirectly depend on solar radiation.

As for comfort, the succession of the seasons and the variation in the length of daylight or sunshine, brings about changes in the incidence of solar energy in a particular place and therefore changes in the elements of weather, for example, increase or decrease in temperature, cloud cover and air humidity and wind, which cause changes in the degree of comfort or discomfort people. Figure 11 shows the distribution of the average solar radiation.

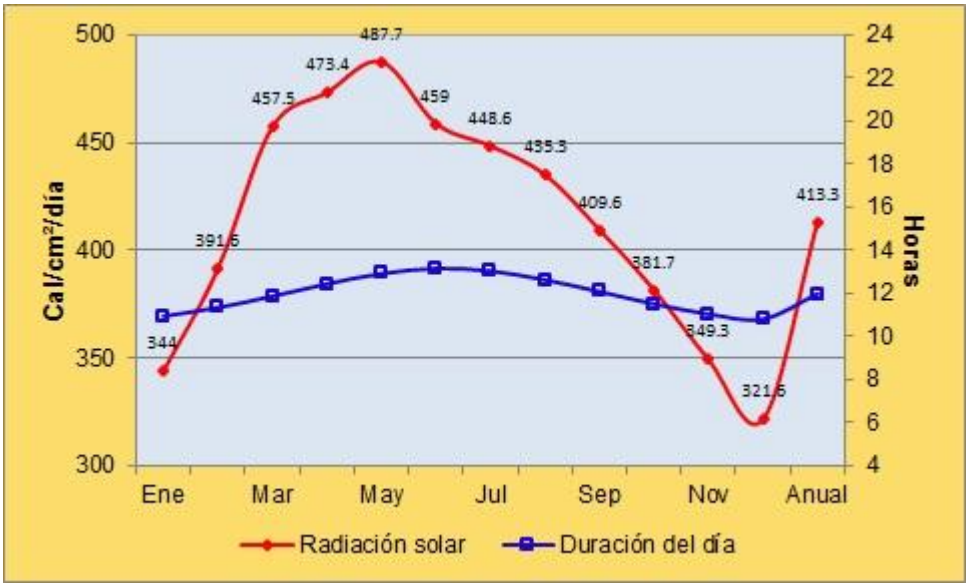


Figure 11. Solar Radiation Cal/cm²/día. Parques Las Peñas-Los Ocotillos. Fuente: Elaboración propia. Datos de nubosidad del SMN-CNA, 1981-2000.

Conclusión

As already mentioned, the degree of comfort of a person who is exposed to a given environment depends not only on the effect that climate can cause you a single element but a combination of several. Also, the degree of comfort also due to individual characteristics such as age, sex, mood, health, activity performed, clothing and so on.

According to Griffiths (1985), the temperature range that provides a greater degree of comfort to a person dressed and outdoor, comprising of 18 ° C to 33 ° C; and further between 18 ° C and 24 ° C. Considering the average temperature park-Los Ocotillos Las Peñas, the time of year with this quality runs from April to October. The previous and following months are slightly fresh.

According to the criteria for the definition of thermal zones in Mexico of Mosino and Benassini (1974) and Garcia (1981), parks Las Peñas-Los Ocotillos semicálida are in the thermal zone, with an average annual temperature of 18.5 ° C and 18.7 ° C respectively, and annual oscillation of monthly average temperatures of 7.3 ° C, which are designated with a high degree of comfort.

Considering the relative humidity values that characterize the Meteorological Observatory of Ciudad Guzman, it follows that parks the Rocks-The Ocotillos have ideal conditions of humidity throughout the year.

The effective temperature is as optimal comfort range 21 ° C to 25 ° C. According to this parameter, and performing together the results generated by applying the rate of wind cooling Siple and Passel and bioclimatic diagram Terjung, provides that the feeling of comfort for the parks The Rocks-The Ocotillos is as follows: January March, very cool to cool; April-friendly October; from November to December, from cool to very cool.

In addition to climate welfare that provide the inhabitants of Ciudad Guzman, parks the Rocks-The Ocotillos are areas of recreation and leisure, natural barriers against wind power, thermal regulators, steam generators, producing oxygen and catchments supply water and precipitated the undercurrents.

It should be emphasized that this issue as part of the research project, called business cases for the declaration of the park The Rocks-The Ocotillos Ciudad Guzman as protected areas, contributed to these parks received this distinction in 2015.

Finally, it should be noted that only thorough the various atmospheric conditions that normally occur in a location analysis, can effectively meet the environment to which is subject the visitor, especially at that time of day when outliers are recorded bioclimatic elements; something that does not happen with the average values, which as its name suggests offer an average idea of reality. Meanwhile, indices and diagrams used in this work have an eminently empirical nature, however, intend to provide results intended to approach reality.

Bibliography

Aguilera, A. M. J., Borderías, U. M. P., González, y. M. P., Santos, P. J. M. (1990). Ejercicios Prácticos de Geografía Física (1ª ed.). Madrid: Universidad Nacional de Educación a Distancia.

Besancenot, Jean-Pierre (1991). Clima y turismo. Barcelona, España: Masson, S. A.

Fernández, G. F. (1996). Manual de Climatología Aplicada. Madrid: Editorial Síntesis, S. A.

García de Miranda, E. (1981). Modificaciones al Sistema de Clasificación Climática de Köppen (3ª ed.). México, D. F., Universidad Nacional Autónoma de México.

Griffiths, J. F. (1985). Climatología Aplicada (1ª ed.). México: Publicaciones Cultural S. A. de C. V.

Ministerio de Obras Públicas y Transportes (1992). Guía para la elaboración de estudios del medio físico. Madrid.

Mosiño, P. A., Benassini, O. (1974). Los climas de la República Mexicana (1ª ed.). En De Cserna, Zoltan (Comp.) El Escenario Geográfico, Introducción Ecológica (pp. 56-172). México, D.F., Secretaría de Educación Pública, Instituto Nacional de Antropología e Historia.

Ortiz, S. C. A. (1987). Elementos de Agrometeorología Cuantitativa, Universidad Autónoma de Chapingo.

Seoánez, C. M. (2001). Tratado de climatología aplicada a la ingeniería medioambiental. Madrid: Ediciones Mundi-Prensa.

Soto, M. C., Jáuregui, O. E. (1968). Cartografía de elementos Bioclimáticos en la República Mexicana. México, D.F., UNAM.

Vidal, Z. R. (2005). Las Regiones Climáticas de México. México, D.F., Instituto de Geografía, UNAM.

Vide, J. M. (1999). Fundamentos de Climatología Analítica. Madrid: Editorial Síntesis.

Instituto Nacional de Geografía y Estadística (2010). Censo de Población y Vivienda 2010. Recuperado el 27 de octubre de 2014 en: http://www.inegi.org.mx/prod_serv/contenidos/espanol/bvinegi/productos/censos/poblacion/2010/panora_socio/jal/Panorama_Jal.pdf

Servicio Meteorológico Nacional, Comisión Nacional del Agua (s.f.). Normales climatológicas, observatorio sinóptico Ciudad Guzmán, Jal. Periodo 1981- 2000. Recuperado el 13 de septiembre de 2014, de http://smn.cna.gob.mx/observatorios/rhistorico.html

Servicio Meteorológico Nacional, Comisión Nacional del Agua (s.f.). Normales climatológicas Observatorio Ciudad Guzmán, Jal. Periodo 1981-2010. Recuperado el 28 de enero de 2014 de: http://smn.cna.gob.mx/index.php?option=com_content&view=article&id=42normales-climatologicas-por-estacion&catid=16:general&Itemid=28

Tejeda, M. A., Méndez, P. I., Utrera, Z. A., Rodríguez, V. L. (2005). El concepto de Temperatura Efectiva aplicado a las tarifas eléctricas domésticas en el oriente de México. Investigaciones Geográficas, Boletín del Instituto de Geografía, UNAM. ISSN 0188-4611, Núm. 58, 2005, pp. 106-121. Recuperado el 18 de septiembre de 2014 de http://www.revistas.unam.mx/index.php/rig/article/view/30050

Tornero, J., Pérez, C. A., Gómez, L. F. (2006). Ciudad y confort ambiental: Estado de la cuestión y aportaciones recientes. Cuadernos de Geografía, 80, 147-182. Valencia. Recuperado el 11 de agosto de 2015, en http://www.uv.es/cuadernosgeo/CG80_147_182.pdf