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POTENTIAL DURATION OF ACTIVE RECREATION SEASON BASED ON BIOCLIMATIC EVALUATION

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Abstract

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The objective of this study is to determine the bioclimatic recreation potential of a forest area located just north of Istanbul. The stages of the study covered: identifying the climatic and bioclimatic parameters, characterizing and evaluating the weather conditions, determining the bioclimatic characterization of the air temperature variation, the bioclimatic characteristics of the local weather conditions and a bioclimatic evaluation of the daytime weather conditions. The bioclimatic recreation potential is related to the various levels of human body activity during forest recreation. Therefore, forest recreation can be categorized into activities with 'high', 'moderate' or 'low' human body activity. The accepted mean and borderline bioclimatic values for the various levels of human body activity were calculated using international standards, heat indices and data from previous studies of this area. The obtained results were correlated and analyzed with regard to the distribution of the average number of visitors in the area for the periods between 1970-1985 and 1990-2008. E established a clear link between the number of visits and types of physical activity to weather conditions. Compared with raw meteorological data, the potential for lower body activity decreased by 6.5%, the moderate body activity by 12.1%, while high body activity by 14.1%. Weighted average reduction was 11.2%, which equaled 18.1 days with 14 hours in the day for recreation. This classic approach to assessing the bio-climatic, combined with levels of physical activity, allows for specific forest management decisions in shaping the forest recreation areas.

Key words: forest recreation, bioclimatic, thermal comfort, body activity, forest management

Introduction

Nowadays, human activities occur in time of intensive urbanization and industrialization. Therefore, optimal solutions should be sought to ensure an optimal thermal environment for people. These require universal bioclimatic standards, which are to be used in planning open spaces. To achieve that, there are ongoing discussions on the Universal Thermal Climate Index (UTCI) developed by the International Society on Biometeorology (ISB) Commission 6 and the European COST Action 730 (Jendritzky and de Dear, 2008; Jendritzky et al., 2008). At the same time the demand for forest recreation services is on the increase. Tourism is also sensitive to climate changes, which directly or indirectly affect a wide range of natural resources critical for it (Scott et al., 2009). The same author argues that unfortunately, the knowledge of climate impact on tourism as well as of climatic changes affecting this sector is limited. The work of de Freitas (2003) grew from initiatives of the International Society of Biometeorology's Commission on Climate, Tourism and Recreation (ISBCCTR). The ISBCCTR was formed during the 15th Congress of the ISB held in November 1999 in Sydney, Australia. Among the issues discussed there was the need for a tourism climate index (or indices) that integrates all facets of cli-

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mate, uses standard data and is objectively tested and verified. The objective of similar studies has also been to determine and forecast the bioclimatic tourism potential at local and regional levels. For example, Matzarakis et al. (2007), based on 10-day intervals, forecasted the tourism potential of the low mountain ranges in Germany after a change in the climate conditions. The results were presented using a Climate Tourism Information Scheme (CTIS) based on biometeorological, physical and aesthetic criteria as well as on the frequency of extreme meteorological phenomena. Having the same objective but approaching it through regional climate simulations, Endler et al. (2009) analyzed the potential adaptability of tourism in the low mountain ranges in Germany for the period 1961-2050. To produce the climatological diagrams of the bioclimatic potential of a Croatian island off the Adriatic coast, Zaninovich and Matzarakis (2009) also used data over 10-day intervals. According to the same authors, the availability of both climatic and bioclimatic data is extremely valuable to tourists as this enables them to choose the most suitable holiday period meeting their preferences and requirements. A similar study by Blazejczyk (2002) based on the heat balance of the human body worked out a bioclimatic calendar for outdoor recreation in Warsaw using a number of climatic and meteorological data. In addition, holidaymakers travelling to long-distance destinations often experience thermally induced physiological strain called "acclimatization thermal loading" (ATL) by De Freitas and Grigorieva (2009). To estimate, for practical purposes, the ATL when such a trip goes through different climate conditions, these researchers developed the Acclimatization Thermal Strain Index (ATSI). Matzarakis et al. (1999) and Jendritzky et al. (2001) also worked on "universal thermal index" for "assessing climate for tourism purposes" (Matzarakis, 2001) and "adaptation to the tourism and recreation" Scott et al. (2009).

One of the biggest problems of forest recreation is the practical inapplicability of the results of bioclimatic studies. Thus, the results of bioclimatic studies help in forest management of forest recreation areas in relation to stand structure to provide an ergonomic environment for visitors.

The reason is the lack of interdisciplinary studies with general-purpose applications.

A primary aim of this illustrative study is to determine the bioclimatic recreation potential by type of human body activity, and to establish its correlation with the distribution of the average number of visitors in the studied area for the periods between 1970-1985 and 1990-2008. Along with this, a derivative aim of the study is to ascertain if it is possible to develop a realistic bioclimatic calendar based on 10-day intervals by using only regional climate data obtained from previous regional studies as well as the accepted international standards. The main objective of the study is to compile enough detailed results that can be used in the forest management practice for planning forest areas for recreation.

The Object of Study and Materials

The object of study is the forest area located in close proximity north of Istanbul. It comprises 12 recreation zones visited by the citizens of the megalopolis. Its boundaries were defined based on the results obtained from the climatic study of East Thrace by Irmak et al (1980). This hilly region has a relatively homogenous distribution of the most important climate parameters: air temperature, precipitation, relative air humidity and characteristic meteorological phenomena (Figure 1).

The data used in the study was received from the Bahcekoy Meteorological Station in Büyükdere, located at an altitude of 129.63 m, $49^0 09'$ N and $29^0 03'$ E, and local time difference of 64 minutes. From tables of meteorological observations are derived data covering 42 years: from 1964 to 2004.

According to the accepted classifications for category, type and class, the recreation in this area falls

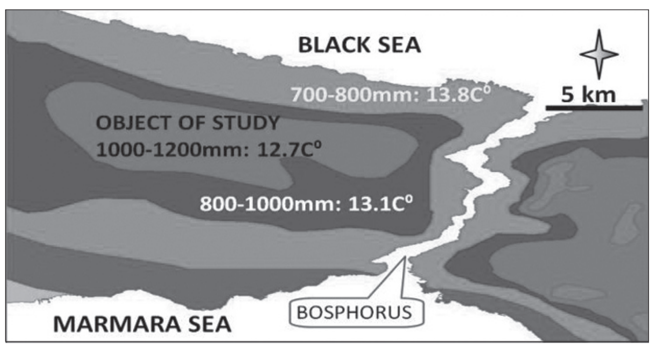

Fig. 1. Location of object of study

into: the category of relaxational and educational forest recreation; the type of summer palliative recreation with only daytime visitors; the class of quiet recreation with low-level physical activities, walking, mass events and games with moderate level physical activities, and a small part belongs to the sports and fitness class requiring a high level of physical activity.

Methodology

The theoretical basis for determining the bioclimatic recreation potential of the studied area is the classification by Tishkov (1989). This classification was made using the steps of the Integrated Climate Analysis developed and applied in different variants in Eastern Europe. The methodology is presented below and has the following stages:

Identifying the bioclimatic parameters, characterizing and evaluating the weather conditions

The data used served as the basis for the calculation of the following **climate parameters**: mean air temperatures (^{0}C); number of days with degree of cloudiness in the ranges: 0.0–1.9; 2.0–8.0 and 8.1–10.0; air temperature (^{0}C) from 7 am to 9 pm; relative air humidity (%) from 7 am to 9 pm; duration of sunshine; number of days with decreased visibility (up to 1000 m); number of days with strong wind and thunderstorms; number of days with snowfall and snow cover; number of days with snow or rainfall; number of days with average relative air humidity of over 70%; water vapour pressure (mb); mean air and thermal sensitivity temperature (TH) in June, July and August. The sensible temperature was calculated using air temperature and humidity values from the following formula (Palmer, 1997):

$$TH = - 42.379 + 2.04901523 * T + 10.1433312 * RH - 0.22475541 * RH - 6.83783 * 10^{-3} * T^2 - 5.481717 * 10^{-2} * RH + 8.5282 * 10^{-4} * T * RH^2 - 1.99 * 10^{-5} *$$

Where, T – is the air temperature in ºF; RH – is the relative humidity in percentage. This formula calculated the sensible temperature in ºF, and this value was converted to ºC. The cooling wind effect at low temperatures was calculated using the Cactus2000 Converter for Wind Speed.

The next stage of the methodology involved determining the **bioclimatic characteristics of the air temperature variation**. The aim of this was to establish the thermal potential of the aboveground air layer and the potential thermal comfort perceived by people. Using the above-mentioned climate and bioclimatic parameters, the following indicators were established: daytime and day-to-day temperature amplitudes. These bioclimatic indicators express the frequency of changes during the daytime and day after day. They were classified in groups based on their impact on the thermodynamics of the human body.

The daytime temperature amplitudes (at intervals of 4^{0}C) can be:

- indifferent amplitudes (0-4^{0}C) which indicate body thermal comfort during mass recreation activities under favourable climate conditions;
- transitional amplitudes (4.1-8.0^{0}C) which are easily endured by healthy people, and therefore they are regarded as not restricting mass recreation activities;
- sensitive amplitudes (8.1-12^{0}C) which are temperature amplitudes perceived by healthy people, causing them negative body responses; therefore these amplitudes indicate a lack of thermal comfort during recreation activities;
- irritating amplitudes (>12^{0}C) which are strongly perceived amplitudes causing disruption of the thermal balance of a healthy individual; to a larger degree, they make mass recreation activities impossible (Tishkov, 1989).

The day-to-day temperature amplitudes (at intervals of 2^{0}C) show the increase or decrease of the mean temperature over a 24-hour period in comparison with the one of the next 24-hour period. And daily temperature variations are divided into four groups: indifferent (0–2^{0}C); transitional (2.1–4^{0}C); sensitive (4.1–6^{0}C; irritating (> 12^{0}C) (Tishkov, 1989).

Bioclimatic evaluation of daily weather conditions is made in respect of human body activity during recreation in forests. The classification by Tishkov (1989) was also used to characterize the daytime weather conditions from a medical and climatic point of view. According to this classification, the results of the bioclimatic evaluation were grouped into three categories:

- Without Time Restrictions (WTR) category indicates the potential for a prolonged outdoor activity;

- Time With Partial Restrictions (TWPR) category is a weather condition with short contrasting daytime weather variations typical of the respective area which requires temporary (partial) discontinuation of some types of recreation activities; this is an indicator of a restricted potential for daytime recreation activities;
- Time Constraints (TC) category is a weather condition with long-lasing contrasting changes or extremely adverse daytime conditions, which require discontinuation of all types of recreation activities (Tishkov, 1989).

The evaluation was made based on criteria, standards and factors related to the various levels of human body activity during recreation. Therefore, recreation was categorized into activities with 'high', 'moderate' or 'low' human body activity. The range of recreation activities considered for the purposes of this study comprised activities of all categories and types of recreation typical of the studied area. The results were summarized based on the above-mentioned categories (WTR, TWPR and TC). The summary is the generalized evaluation of the bioclimatic recreation potential of the area.

The values of the various parameters for the various levels of human body activity were obtained from the studies of Bahadir and Shen (1996) on the effect of sensitive temperatures in Turkey in terms of the human health (Table 1).

These effects and their related temperature ranges, however, are valid at a very low airflow velocity (up to 0.1 m/sec) as well as indoors. In fact, the greater part of the studies on this factor is valid for indoor spaces. For example Wigo and Knez (2005) studied the effect of low (0.15 m/sec) and high (0.25 m/sec) air velocity in a classroom. The participants in the experiment said that the air temperature had decreased during the experiment although it had been increased from 21°C to 24°C (at air velocity of 0.15 m/sec) and from 25°C to 27°C (at air velocity of 0.25 m/sec). Kaynakli and Yilmazkaradeniz (2003) found out that the comfort air temperature of 25.5ºC at air velocity of 0.1 m/sec changed at air velocity of 0.5 m/sec to 27.8ºC. The literature focusing on thermal comfort of indoor spaces says that any decrease of the relative humidity by 10% requires an increase of the air temperature by 0.3ºC. Overall, the studies show the great combined effect of air temperature, humidity and velocity on the thermal body comfort. This study made use of the New Wind Chill Temperature Index (NWCTI) and Expected Clothing Insulation (ECI), as well as their calibrated results (Table 2)

Blazejczyk et al. (2009) argued that with respect to the averaged dynamic thermal sensation, the UTCI values between 18 and 26ºC may comply closely with the definition of the "thermal comfort zone" supplied in the Glossary of Terms for Thermal Physiology (IUPS Thermal Commission, 2003). The UTCI equivalent temperature categorized in terms of thermal stress is as follows: above +46ºC extreme heat stress; +38ºC to +46ºC very strong heat stress; +32ºC to +38ºC strong heat stress; +26ºC to +32ºC moderate heat stress; +9ºC to +26ºC no thermal stress; +9ºC to 0ºC slight cold stress; 0ºC to -13ºC moderate cold stress.

The bioclimatic evaluation of daytime weather conditions was made taking into account the results of the above-mentioned studies, the standards ASHRAE 55-2004 (1995) ISO 7730 (1995), ISO 8996 (1990) and ISO

Table 1
Temperature-Humidity Index (part of the table Bahadir and Shen 1996)

Temperature, ºC	Relative Humidity, %									Category
	10	20	30	40	50	60	70	80	90	
25	22	23	24	25	25	26	26	27	27	IV: 27-31ºC - Exhaustion, nervousness and circulatory and respiratory disorders due to the effect and duration of a stay under stress conditions
26	22	24	25	26	26	27	27	28	29	
27	24	25	26	26	27	28	29	30	31	
28	25	26	27	27	29	30	32	33	35	III: 32-40ºC - Strong thermal stresses leading heat cramps and heat exhaustion to sunstrokes,
29	27	28	29	30	31	32	34	36	39	
30	27	29	29	31	32	33	36	38	43	II: 41-53ºC Strong thermal stresses leading to heatstrokes

9920 (1995), the results obtained by Çaglayan (1999), Destan (2001) and Ozcan (2009) as well as the data from the Regional Forest Directorate in Istanbul about the number of visitors to the area and the types of recreation. The following criteria, standards and factors were adopted in relation to the various levels of human body activity:

low body activity – passive relaxation in a sitting or lying posture, short walks, light outdoor games; days with mean minimum temperature of 17^0C and mean maximum temperature of 27^0C, clothing and thermal insulation (Clo factor) Clo = 0.15-0.6, metabolic energy losses Met = 0.8÷1.9, (60 W/m^2 on average), relative humidity (RH) during the day (10 am – 6 pm) from 60 to70 %, average wind velocity from 0.5 to 5 m/s for outdoor spaces; comfort temperature t_{co}= 25.6^0C at 50% relative humidity and 0.5-3.0 m/s wind velocity;

moderate body activity – brisk walking, stand-up games, picking berries, mushrooms and herbs, visiting natural and archaeological sites with an educational purpose; days with mean minimum temperature of 10^0C and mean maximum temperature of 23^0C, comfort temperature t_{co}= 18^0C at Clo=0.7÷1.0, Met=2.0÷4.0, (120 W/m^2on average), RH = 50 %, and average wind velocity up to 2.1÷3.0 m/s;

high body activity – body activity characteristic of sports; days with mean minimum temperature of 8^0C and mean maximum temperature of 23^0C, comfort temperature t_{co}= 12^0C at Clo=0.32÷1.2, Met=4.1÷8.0, RH = 50 %, and average wind velocity up to 0.5÷2.50 m/s for outdoor spaces;

The factors restricting recreation are very significant from the point of view of the human psyche and biometeorology. The following factors are considered restricting:

Precipitation (snow, rain and mixed) – the duration of precipitation during the day is calculated by season: in autumn, winter and spring it is taken as a whole day, while the average precipitation duration in summer is calculated as follows: half a day of recreation is 14/2=7 hours of rainy time. The precipitation duration is deducted from the total hours of each level of body activity for a month regardless of the air temperature variation during the day;

High air temperatures – depending on the relative air humidity and wind velocity, temperatures over 27.1^0C (and in particular over 30^0C) restrict high body activity. The duration of this parameter is deducted from the total hours of high body activity;

Days with **decreased visibility** – at 7 am and at 2 pm (up to 1000 m);

Days or parts of days with **strong wind and thunderstorms** are regarded as whole days (2 pm).

The duration of the sum of these parameters is the Time with Partial Restrictions (TWPR) category. It is deducted from the Without Time Restrictions (WTR) total for each level of body activity.

An estimate of the light level of the studied area was made with regard to its emotional and psychological impact on the people involved in recreation activities. This is important because the light level is often the deciding factor for visiting a particular recreation outdoor site. It is mainly affected by the level of cloudiness. When the level of cloudiness is the criterion determining the light level, its value can be easily calculated as a percentage of the days in a year. The studied area is known to ex-

Table 2
Calibration New Wind Chill Temperature Index (NWCTI) and ECI

NWCTI, °C	Calibration (Bluestein and Osczevski 2002)	Sensation	ECI, Clo	Calibration (Błasejczyk et al. 2009)
> 35	> 36	very hot	<0.3	<0.34
27 - 35	30 - 36	hot	0.3 - 0.5	0.34 - 0.48
23 - 27	24 - 30	warm	0.5 - 0.8	0.48 - 0.52
21 - 23	12 - 24	confortable	0.8 - 1.2	0.52 - 0.88
17 - 21	6 - 12	cool	1.2 - 2.0	0.88 - 1.50
9 - 17	0 - 6	cold	2.0 - 3.0	1.50 - 2.20
< 9	< 0	very cold	> 3.0	> 2.20

perience precipitation at cloudiness above level 6. Level 6 to 8 cloudiness was characteristic of approximately ¼ of the days with level 2-8 cloudiness. This was found out by comparing the data about cloudiness, precipitation and sunshine duration obtained from the respective tables of meteorological observations. However, the calculations made of the light level were provisional and indexed only against precipitation. To calculate accurately the light level, detailed data about sunshine duration can be used. For example, the total annual sunshine duration of the studied area is 2316.1 hours. Theoretically, the average duration of recreation activities in the studied area during the active season of recreation is 14 hours. Therefore, the light level is [(2316.1/14)/365]*100 = 45.3% of the total number of days in a year. Using the same method, the light level during the active season of recreation (April, May, June, July and August) is 62.4%.

Determining the duration of the potential and real active recreation season

The Potential Active Recreation Season (PARS) is an important indicator of the potential for organizing mass recreation activities. In order to determine it, the results about the potential monthly distribution of recreational activities by body activity estimated based on the bioclimatic evaluation of the daytime weather conditions were used.

Determining the Real Active Recreation Season (RARS)

With the purpose of comparing the PARS with the RARS of the area, it was necessary to update the empirically determined real active recreation seasons for the periods between 1970-1985 by Pehlivanoglu (1986) and 1990-2000 by Destan (2001). It has been accepted that the duration of the RARS should be calculated using the minimum number (or percentage) of visitors calculated in advance and serving as a borderline value of mass recreation. This is the minimum number of visitors, which delimits the beginning and the end of the RARS. The limiting criterion is the degree of mass recreation, required services in the area and profitability. According to these criteria, 68% (± 3%) of the total number of visitors come to the area in this period. In fact, they represent the majority whose requirements should be given priority consideration when planning the forest recreation in the area.

Results

The results are presented in a sequence following the stages of the study. The graphs are given in sets in order to be easily used; at the same time, their understanding is facilitated by avoiding data overload and presenting monthly average values for part of the indicators. The initial distribution of mean air temperatures (Figure 2a) was re-calculated into sensible temperatures (Figure 2b).

In order to account for the Time with Partial Restrictions (TWPR) category), the graphs showing the annual distribution of meteorological events (Figure 3a, 3b, 3c and Table 3).

To determine the Time Constraints (TC) category, the graphs of the daytime and day-to-day temperature amplitudes were produced (Figure 4a, 4b and 4c).

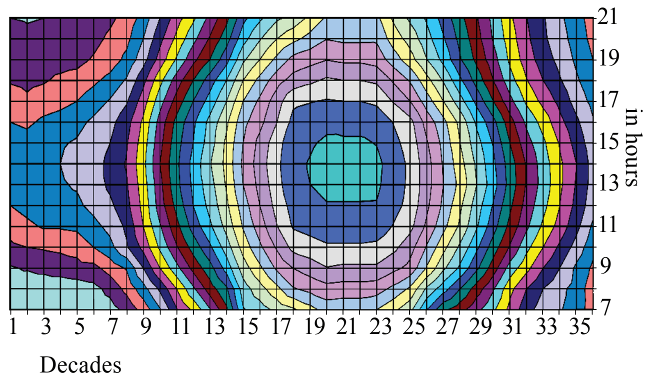

Fig. 2a. Annual distribution of mean air temperatures in the studied area

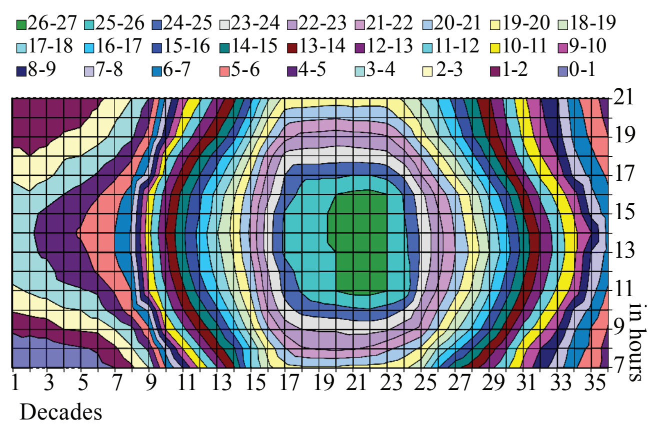

Fig. 2b. Annual distribution of mean sensible temperatures in the studied area

When determining the Time Constraints (TC) category, the irritating daytime and day-to-day temperature amplitudes were regarded as continuing for 14 hours (for a whole day), while the sensitive ones – for half a day (14/2=7 hours). A more realistic graph of the results was drawn (based on the rows in Figure 2b), along with the graph of the distribution of body activity types during daytime recreation (Figure 5). The next stage was producing the graph (Figure 6a) of the annual distribution of the types of body activity while accounting for

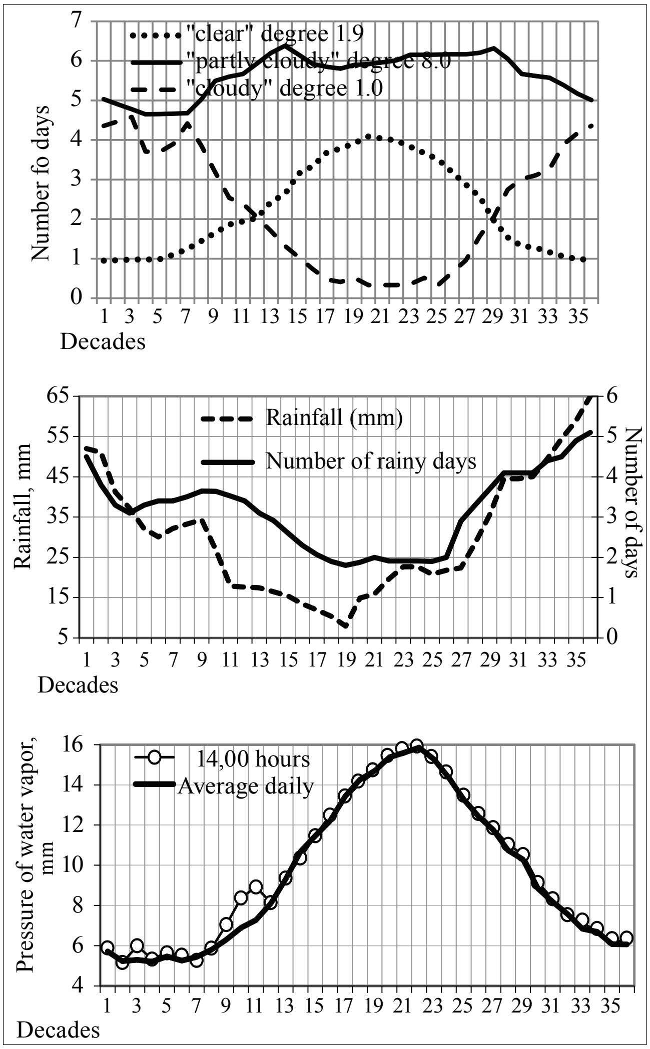

Fig. 3. More important climatic parameters in the studied area

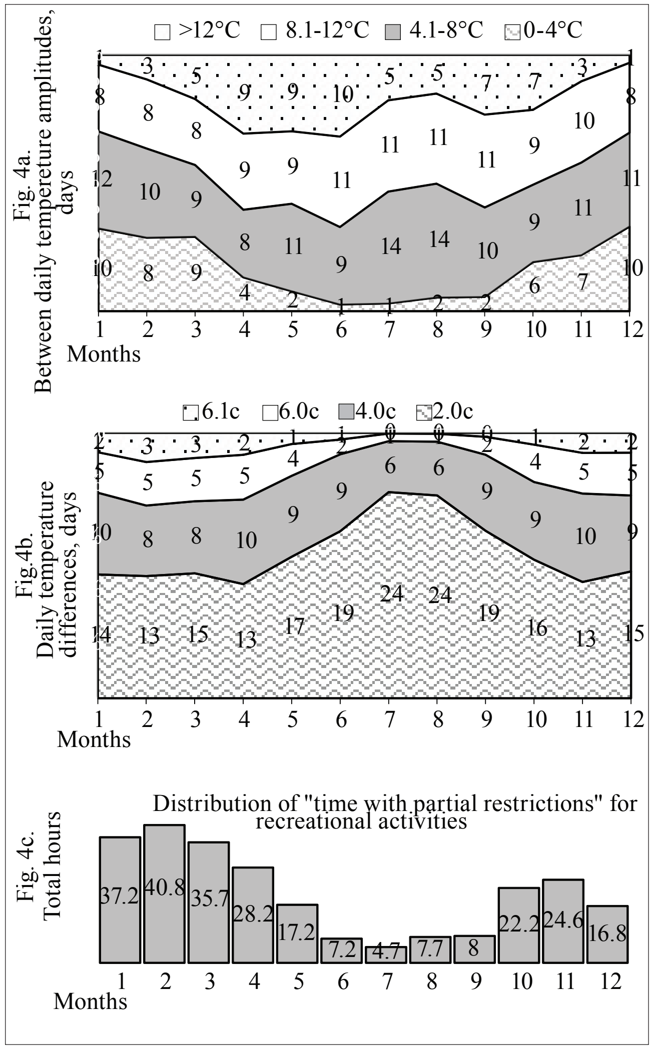

Fig. 4a, 4b, 4c. Bioclimatic characteristics of the air temperature variation

Table 3
Duration of weather restricting recreation

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Days with low Visibility, days	7.00am	1.74	2.54	2.83	2.49	1.17	0.29	0.11	0.17	0.46	1.23	1.54	0.91
	14.00pm	1.00	0.94	1.14	0.40	0.14	0.00	0.00	0.00	0.00	0.03	0.20	0.37
Days of strong wind and storm, days	Strongwind	0.74	0.63	0.49	0.46	0.31	0.26	0.37	0.46	0.31	0.15	0.51	0.51
	Windstorm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00

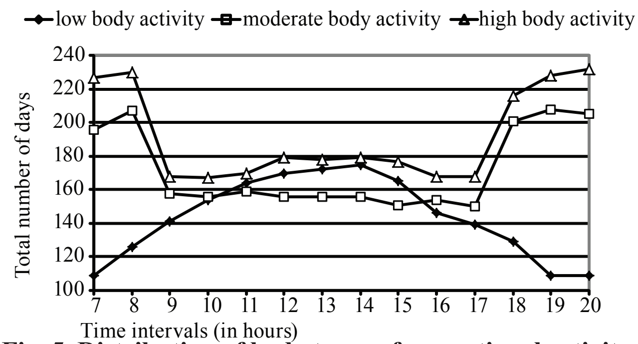

Fig. 5. Distribution of body types of recreational activity during the day

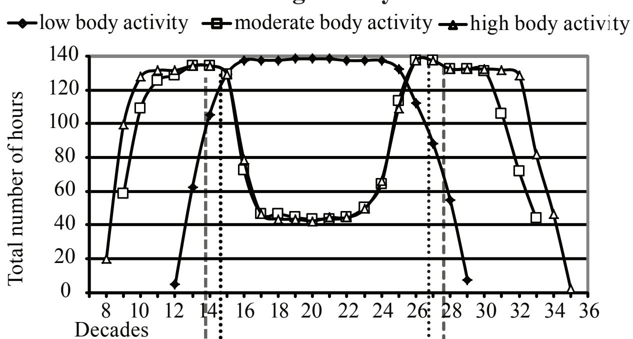

Fig. 6a. Annial distribution of optimal phisical activity as perceived air temperature and weather phenomena

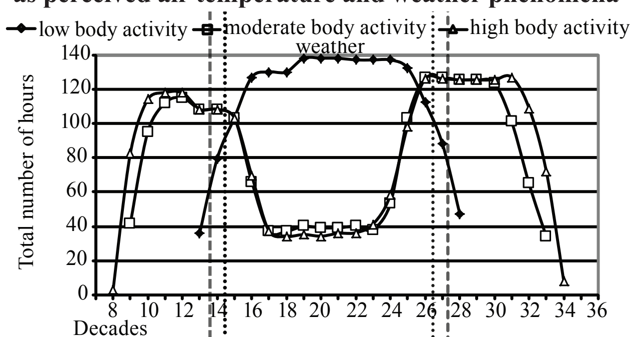

Fig. 6b. Annial distribution of optimal phisical activity according to the tipes weather

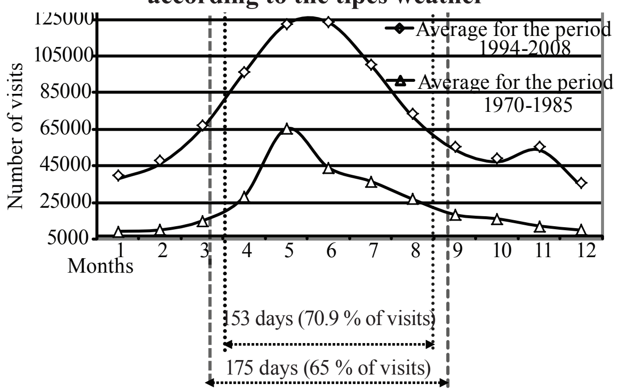

Fig. 7. Average number of visits and duration of the real activity recreational seasons in periods 1970-85 and 1994-2008

the daytime and day-to-day temperature amplitudes (obtained from Figure 4a and 4b) and the mean sensible air temperatures (obtained from Figure 2b). The obtained results were used for drawing the graph (Figure 6b) of the calibrated annual distribution of the types of body activity based on the weather variation (presented and analysed in Figure 3a, 3b, 3c; Tables 3, 4a, 4c, 5 and 6a). The results of the above figures were separately analysed in view of their effect on each type of body activity. The results are presented as a total number of hours for 10-day intervals for a year. In order to correlate it with these results, the graph of the number of visitors of the studied area (Figure 7) was produced.

The width of the interval and the average number of days the most important parameters gives an idea of the variation in the studied climate region (Table 4).

Conclusions and Recommendations

The results confirm the conclusions of many bio-climatologists (eg. Matzarakis, 2007) that *meteorological or climatologically parameters in the form of means, extremes, frequencies and possibilities may not be useful unprocessed*. An evidence of this is the 'deformation' of the graph of the sensible temperatures (Figure 2b) re-calculated based on the mean air temperature (Figure 2a). This deformation can also be seen in the distribution by type of body activity (Figure 6a) determined based on the sensible temperatures, and reinforced by the effect of the values of the Time With Partial Restrictions (TWPR) category (obtained from

Table 4
Width of the interval in days of the most important climatic parameters

Number of days	min	max	mean
With rainy	80	159	114
With strong wind	1	14	5
With relative air humidity ≥ 70%	286	352	308
With between daily sensitive temperature amplitudes	11	58	43
With between daily irritating temperature amplitudes	10	54	19
With daily sensitive temperature differences	83	137	112
With daily irritating temperature differences	47	86	65

Figure 4c). However, the most pronounced deformation is in the yearly distribution by type of body activity based on the weather variations (Figure 6b). This graph shows the accumulation of the deformation effect of the sensible temperatures and the Time with Partial Restrictions (TWPR) and Time Constraints (TC) categories. In comparison to Figure 6a, the potential for low body activity recreation shows a decrease by 126 hours (6.5%), the average body activity recreation by 277 hours (12.1%) and the high body activity recreation by 2181 hours (14.1%). The weighted average decrease was 11.2%, which equalled 18.1 days with 14 hours of daytime recreation. However, it should be noted that this decrease mainly concerned the RARS. The distribution by type of body activity in daytime (Figure 5) was shown as a number of days. These are the annual average results showing the potential for use. At the same time, they provide an answer to the question why the visitors to the area concentrate between 9 am and 6 pm. The plateau-like shape of the curves of the average and high body activity should be noted. This is due to both the hourly distribution of the high daytime temperatures and to the 10-day intervals within the hot summer season. The reasons for the deformations can easily be explained by the detailed graphic data of the rest of the figures.

As it was pointed out, Figure 6b takes into consideration all factors (a total of 12) which were analyzed with regard to their effect on each type of body activity separately. An analysis like this one may have a degree of subjectivism, and therefore, in order to overcome it, a careful approach should be adopted. There is also subjectivism in identifying the criteria, standards and factors characterizing the types of body activity. Although international standards and results were used, the determined ranges of the types of body activity are, in essence, the thermal comfort zone established and accepted based on thermal indices and the physiological equivalent temperature (PET). However, like many other researches, Höppe (1999) also claimed that neither the PET, nor the traditional thermal indices could be an absolute measure of thermal comfort. Even these scientifically identified thermal indices had not been sufficiently tested on people, and did not account for the adaptability to climate conditions (Monteiro et al., 2006). To solve these issues, calibration of equivalent index temperatures is now being applied along with their forecasting based on terrain tests (e.g. Monteiro et al., 2006). However, they are the standards only for the area where tested. Another development of bio-climatic studies is determining the thermal ranges of the thermal comfort zone for people in different geographic areas and counties (e.g. Matzarakis and Hwang, 2009). With regard to planning forest recreation, the studies on the assessment of the thermal environment at a local level are even more important. Analyzing this approach, Mateeva (2001) suggested the planning optimal recreation and tourism required detailed bio-climatic analyses at macro, meso and micro levels.

The updated results show that the PARS begins on 21 March and ends on 10 September (175 days) which is 47.4% of the total days in a year. The total number of visitors during the PARS is, on average, 582,776 people that is 65% of the total number of visitors to the study forest area being 3.82% in the period of 21-31 March and 3.2% in the period of 1-10 September. The difference with the season length for the period of 1970-1985 (153 days) was 22 days or 14.3%, and this was used to update the season length. The reasons for this update were mainly due to the fact that the average number of total visitors for the last five years increased by 324% in comparison to the one for the period ending in 1985. All this proves that the recreation activities in the area changed both quantitatively and qualitatively. The ongoing urbanization of the Istanbul megalopolis (as of 2011 its population exceeds 13 million people, and it reaches 15 million people during the tourist season), the intensified industrialization as well as the insufficient green areas for recreation caused the quest for recreation in woodland environment. The qualitative changes led to the increased share of the types of recreation with average and high body activity. Due to these changes, the potential for recreation with average and high body activity before 9 am and after 6 pm proved insufficient, and the process required the expansion of the Real Active Recreation Season (RARS). Of course, the process involved other social factors as well: non-working days, national holidays etc. These are related to the category of leisure time, standard of living, cultural level, education level etc., and can be studied in further studies.

The purpose of this study is illustrative presentation of a relevant approach, which includes the idea that any user of any forestry can draw a calendar of bioclimatic potential recreation activities. The practical contribution is the established bioclimatic calendar is tied to a specific bodily activity. This information is essential for planning forest recreation in order to take the right silvicultural decisions regarding the canopy cover, stand density, stocking level of a recreation area. This is confirmed by studies as these by Holst et al. (2005) on the radiation balance of two forested slopes facing different directions, by Schiller (2001) who studied the microclimate differences caused by different vegetative units and their impact on people engaged in recreation, by Irwan et al. (2006) on the effect of trees with different canopy covers and etc. This all allows taking the right decisions regarding the required ratio of 'closed', 'semi-closed', 'semi-open' and 'open' spaces in a recreation area in accordance with the types and classes of recreation in this woodland. Failure to take into account the factor of thermal body comfort has always led to inadequate forest management as well as to inefficient functioning of the forest recreation areas. The availability of data about the bioclimatic characterization of the local weather as well as of data about the types of recreation activities that will take place in the areas designed for recreation in a managed woodland will enable a forest manager to recommend the optimal ratio of the area types mentioned above and the required stand density and tree canopy cover.

In conclusion, it should be noted that the studies (e.g. Brandenburg and Arnberger, 2001) whose results can provide feedback on the relationship between man and the environment i.e. the impact of the bioclimate of the environment on the number of visitors engaged in recreation and tourism would be the most important in the future.

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