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Analysis of Human – Tourism Climatic Comfort using Bio-climatic indices in Dezful region

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ABSTRACT

Current human bio-climatic investigations constitute as the basis for civil engineering, architectural design and tourists provisions in urban planning.The aim of this study is assess the climate for human comfort-tourism in greater Dezful region using indices of TCI (Tourism climate index)and THI(Thermo-hygrometricindex).To calculate these indices are used the climatic elements of temperature, precipitation, relative humidity, sunshine hours and wind speed. Then utilizing these indices, to evaluate of human - tourism climatic comfort, Dezful synoptic stations has been during the period (1993 to 2012). The results show that study area during the year in terms of human bio climatic has very hot to cold conditions. The results also indicate that the best conditions for tourism activities in Dezful region are October, November and March, while June, July, August September are worst climate for the tourists. Hence the evaluation of human comfort and human discomfort using these indices in different climatic conditions, can be proportional with climatic characteristics be effective in tourism development planning, urban, architecture and etc.
KEYWORDS: *Bio- climatic, comfort, discomfort, TCI index, THI index, Dezful region.*

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INTRODUCTION

Today bio climatic researches are a foundation in urban planning, architecture and tourism development. .Scientific studies have confirmed, in time, that the climate influences both the activities of all living beings and human society [1], although the relationships between its components are highly complex. The bioclimatic investigates, made over time, have confirmed that the subjective perception which the human body feels regardless of the environmental conditions [2]is the basis for the definition of the state of bioclimatic comfort or discomfort for whose that live in different climatic conditions that may best be quantitatively and qualitatively expressed by means of various bio meteorological/ bioclimatic indices. Climatic parameters such as monthly means of maximum daily temperature, mean daily temperature, minimum daily relative humidity, mean daily relative humidity, total precipitation, total hours of sunshine, average wind speed and global radiation are accepted to be effective on bioclimatic comfort and recreation activities[3,4].Today knowledge optimal models human bioclimatic comfort are use different models which most important thoroughly documented in the literature: [5,6,7,8,9,10,11,12].Also other researchers have done investigate in this field including:[13,14,15,16]. From this point of view, the present study focuses on evaluating of Dezful climatic conditions utilizing synoptic station data and determining this region climate comfort months based on bio climatic indices ,for this reason in this study to determine comfort months in Dezful region was used TCI and THI indices and the results of the analysis are recorded.

STUDY AREA

Dezful has two district (Markazi and Sardasht), its total area is approximately 4700 km² and is located in northern Khuzestan province between 32⁰ 24/ N and 48⁰ 24/ E. It is bounded by Lorestan province from north, MasjedSoleiman and Shushtar from east, Susa and Shushtar from south and Andimeshk from west.
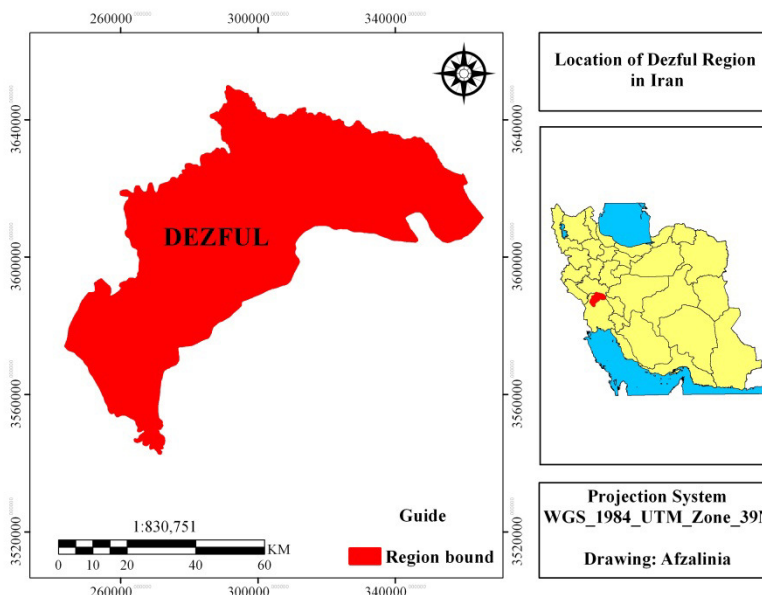

Fig 1. Location of Dezful region in Iran

MATERIALS AND METHODS
In this research, utilizing indices of TCI and Thermohygrometric in a period of 20 years (1993 - 2012) is taken an assessment of the climate for human comfort-tourism in Dezful region is taken. Climatic elements in this study areincluding : temperature, average maximum and minimum temperature, average maximum and minimum relative humidity, precipitation, speed and direction of wind.

RESEARCH FINDINGS
A.TCI index
TCI index is given by [6] with a combination of seven parameters,three of them alone and two as a bioclimatic combination (Eq. 1).

1:          $TCI = 8*CID + 2*CIA + 4*R + 4*S + 2*W$

Where, ClD is daytime comfort index, consisting of the mean maximum air temperature (°C) andthe mean minimum relative humidity (%), ClA the daily comfort index, consisting of the mean airtemperature (°C) and the meanrelative humidity (%), R the precipitation (mm), S the daily sunshineduration (h), W the mean wind speed (m/s). Contrary to other climate indices all the contributingparameters are assessed, each factor can reach 5 points, because of a weighting factor (a valuefor TCI of 100). Values >= 80 are excellent; values between 60 and 79 can be regarded as good tovery good. Lower values (40 – 59) are acceptable, while values (< 40) imply bad conditions fortourism [17], [6].

Table 1.TCI index of Dezful region

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TCI	Acceptable and Good	Good	Very good	Good	Good	Marginal	Marginal	Marginal	Marginal	Very good	Excellent and very good	Acceptable

B.THI (Thermo- hygrometric index)

The index usesthe air temperature (TA) and relative humidity (RH), applicable towarm climatic conditions. It employs a simple linear equation: (Eq. 2)

2: THI (°C) = t–(0.55–0.0055f) (t–14.5)

Where,

THI, is the thermo-hygrometric bioclimatic index

Ta, mean dry temperature in Celsius

RH, mean relative humidity in Celsius

Where t represents air temperature (Ta) and f relative humidity (RH)[8].Calculated thermal comfort results are evaluated considering the predetermined categories in a table (Table 2), which classifies the comfort conditions according to human sensation of temperature.

Table2.The categories of the thermo hygrometric index [THI; Kyle 1994 in Unger 1999]

THI category	Temperature (°C)
Hyper-glacial	<–40
Glacial	–39.9 to –20
Extremely cold	–19.9 to –10
Very cold	–9.9 to –1.8
Cold	–1.7 to +12.9
Cool	+13 to +14.9
Comfortable	+15 to +19.9
Hot	+20 to +26.4
Very hot	+26.5 to +29.9
Torrid	>+30

Table 3.Bio climatic comfort Dezful region based on Thermo-hygrometric index

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Air temperature	11.6	11.4	12.6	22	28	33	35	34.7	30.9	25.4	18.5	14.6
Relative humidity	73	65	50	44	28	27	27	29	35	44	59	71
THI	12.6	11.9	13	19.6	22.6	25.5	26.7	26.8	25.1	22.04	17.6	14.6
THI category	Cold	Cold	Cool	Comfortabl	Hot	Hot	Very hot	Very hot	Hot	Hot	Comfortabl	Cool

RESULTS AND DISSCUSSION

The results (Table 1) indicated that in January climatic conditions has "Acceptable" comfort for tourists in East and Northeast of Dezful region but the climatic conditions is "Good" for tourists in the west and south of the region.Cilmatic conditions is "Good" in February that in terms of comfort climatic for tourists has "Very good" condition in March.

The results also showed that the climatic conditions are"Good"in April and May. Comfort climatic is "Marginal" for tourists in June, July, August and September months which is with arrival the autumn in October has "very good" climatic conditions in the region and this trend is during November in "excellent "conditions in Northeast and East and in the west and south is "very good"conditions.The results indicated that the December has "acceptable" climatic conditions. These findings are similar to the result of [18],[19].

The results of application THI index in assessing Dezful region environmental –climatic conditions show that THI value is less than 13 in January and February and human feel "cold" in open space .The results also indicated that THI value is between 13 to 14.5 in December and March which expression "cool" bio climatic conditions. April and November are less than 20 that represent "comfortable" climatic conditions. May, June, September and October months have "Hot" conditions and July and August have "Very hot" climatic conditions based on THI index. This is also against the results of THI index suggested by [20].

CONCLUSION

Based on TCI and THI indices, October, November and March have been the best time in terms of tourism climate comfort and human bio climatic in Dezful region, while June, July, August and September have the worst time for tourists. So the evaluations show that based on TCI index October, November and March are the best climate for tourism in the region .

The findings of this research can be as an applied model and in the form of an initial model in researches activities linked to ecotourism in the region and using necessary adjustments in urban planning, and consequently establish the necessary infrastructures be utilizing for strengthen of recreation services. Comparative results between the two methods of studies(Tables 1&3) indicate of variety climatic (four seasons) have been in the region so that Spring and Autumn in early "Hot with Comfortable" ,in the mid "Good" and "cold with Comfortable" in the end of the year. That's why the results of this research, period mentioned has considered as the most attractive times for tourism.

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