BIOCLIMATE AND TOURISM POTENTIAL IN NATIONAL PARKS OF TAIWAN

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ABSTRACT Possible changes in global climate will affect tourism, as most tourism takes place outdoors. The research presented here analyzes single climatological parameters such as air temperature and rain. It also includes an analysis of thermal comfort conditions in four National Parks in Taiwan. The analysis is based not only on mean values of parameters and factors but also on frequencies of classes of individual climatological parameters and thermal comfort factors based on the division of 10-day intervals and an analysis of extreme events, which are important for tourism. The temporal-spatial distribution and mobility of tourists is also discussed based on the climatological parameters in order to present the potential of tourism in each National Parks in Taiwan

KEYWORDS: *Tourism Climatology, Physiologically Equivalent Temperature, National Parks Taiwan*

INTRODUCTION

Previous studies reveal that weather and climate are important factors for tourism decision making (Lin et al., 2006, Hamilton and Lau, 2005, de Freitas, 2003, Matzarakis et al., 2004). In order to evaluate the suitability of climate for tourism, several climate-tourism indices were employed in past research (Murray, 1972, Rackliffe, 1965, Davies, 1968, Yapp and Mc Donald, 1978, Mieczkowski, 1985). However, some important issues still need to be clarified with regards to the practical aspect of tourism-climate information. How can an index for tourism climate be established and presented in an easily understandable way? How to include subjective thermal perception of tourists in the tourism-climate index? What is the relationship between tourist flow and climate, and the tourism potential for a particular travel destination? Parts of these issues have been discussed for the tourism-climate and thermal comfort in Sun Moon Lake, Taiwan (Lin and Matzarakis, 2008). However, more research is needed into the correlation between tourists' attendance and climate parameters. Therefore,

this study will focus not only on the tourism-climate information in combination with thermal perception but also on the effects of climate conditions on the tourist flow, which is of practical importance for the tourists themselves, but also the tourism authority and industry.

METHODS

Study area

Four national parks of Taiwan, i.e. Kenting National Park, Taroko National Park, Yamgmingshan National Park and Yushan National Park, are included in this study (Fig. 1). Kenting National Park is located in the south of Taiwan on the coast. It is one of the hottest areas in Taiwan. Taroko National Park is located in the east of Taiwan. This area has good weather but is not very developed due to its remote location. Yamgmingshan National Park is located in the north of Taiwan near the capital city, Taipei, at an elevation of 748m. Yushan National Park is located in the center of Taiwan and is the highest (3844.8 m) and coldest area in Taiwan.

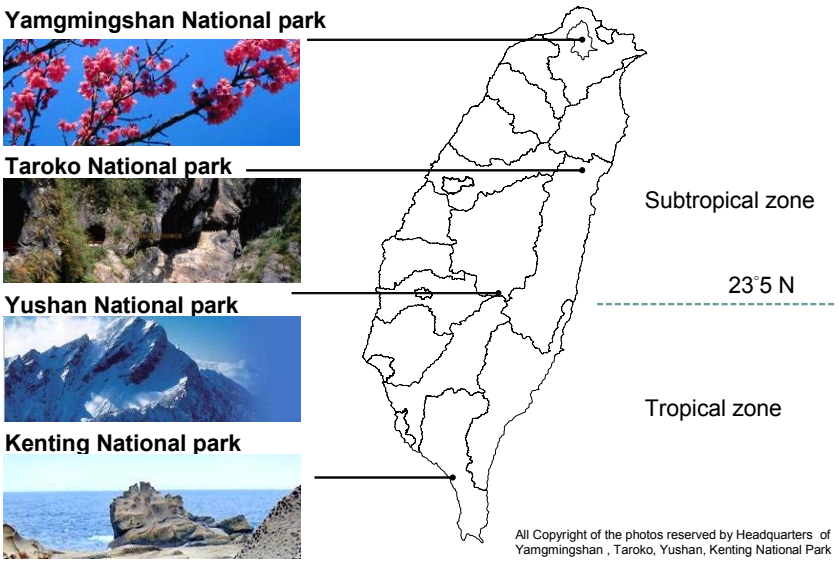

Figure 1: Study area

Climate data

The climate data of Kenting National Park, Taroko National Park, Yamgmingshan National Park and Yushan National Park are obtained from the nearest weather station i.e. Heng Chun, Hua Lien, JhuZihhu and YuShan weather station, respectively, which are owned by the Central Weather Bureau, MOTC of Taiwan.

Calculation of climate parameters

In order to offer more comprehensive and useful weather information, climate parameters are calculated for each ten-day interval. Although it is possible to present the climate data on a daily basis as hourly data are available for this study, we suggested presenting the climate data in ten-day units as climate parameters for ten-day periods are more stable and easier to interpret than those for one-day units. Furthermore, a tourist is generally defined by WTO as a person who spends more than 24 hours but less than a year away from his or her usual place of residence. Vacations typically last for 1, 2 or 3 weeks. Therefore, climate data for ten-day intervals help tourists to determine which periods are suitable for travel. Compared to one-day data, ten-day intervals provide long-range information for tourists. In order to calculate PET in the RayMan model (Matzarakis et al., 2007), the following variables were included in the model: air temperature, vapour pressure, average wind speed, and global radiation.

Thermal comfort database

In order to account for tourists' thermal perception under different temperatures of PET, it is necessary to define PET ranges in which tourists feel comfortable, i.e. the "thermal comfort range" for PET. People from different regions may have different thermal perceptions toward the same PET. Therefore, the thermal comfort range of Taiwan, which was already established (Lin and Matzarakis, 2008) in an earlier study, is applied in this study to fit the thermal sensation of Taiwanese people.

RESULTS

Frequencies of PET

The thermal comfort classification using the Taiwan scale is applied to the PET frequencies for the four national parks (Fig. 2). The frequencies of "neutral" using the Taiwan scale (26-30 °C PET) are similar in Kenting, Taroko and Yamgmingshan National Park, but do not occur in Yushan National Park for the whole year. If we suggest that 22-34 °C PET are in a acceptable thermal range, Kenting is the most comfortable park throughout the whole year among the four national parks.

Climate Tourism Information Scheme

Different people have different recognitions of the climate parameters priority. Even the same person will have different climate preference depending on location. Therefore, the climate information should be flexible for the tourists so that they can evaluate the climate

themselves. The Climate Tourism Information Scheme (CTIS), therefore, offer sufficient climate information for tourists, based on which they can choose their preferred period of travel. CTIS present the frequencies of each facet under particular criteria for each ten-day interval. The CTIS consist of three aspect, i.e., thermal, aesthetic and physical aspects (de Freitas, 2005). Thermal aspects include thermal suitability (PET between 22 °C – 34 °C), thermal stress (PET > 38 °C), and cold stress (PET < 18 °C). Aesthetic aspects include visibility and sunshine (cloud cover > 5 octas) and a fog factor (relative humidity > 93 %). For physical aspects, sultriness (vapour pressure > 18 hPa), rain (precipitation > 1 mm), long rain (precipitation > 5 mm) and windy conditions (wind speed > 8 m/s) are included. Fig. 3 shows sultriness in Kenting and cold stress in Yushan national Park.

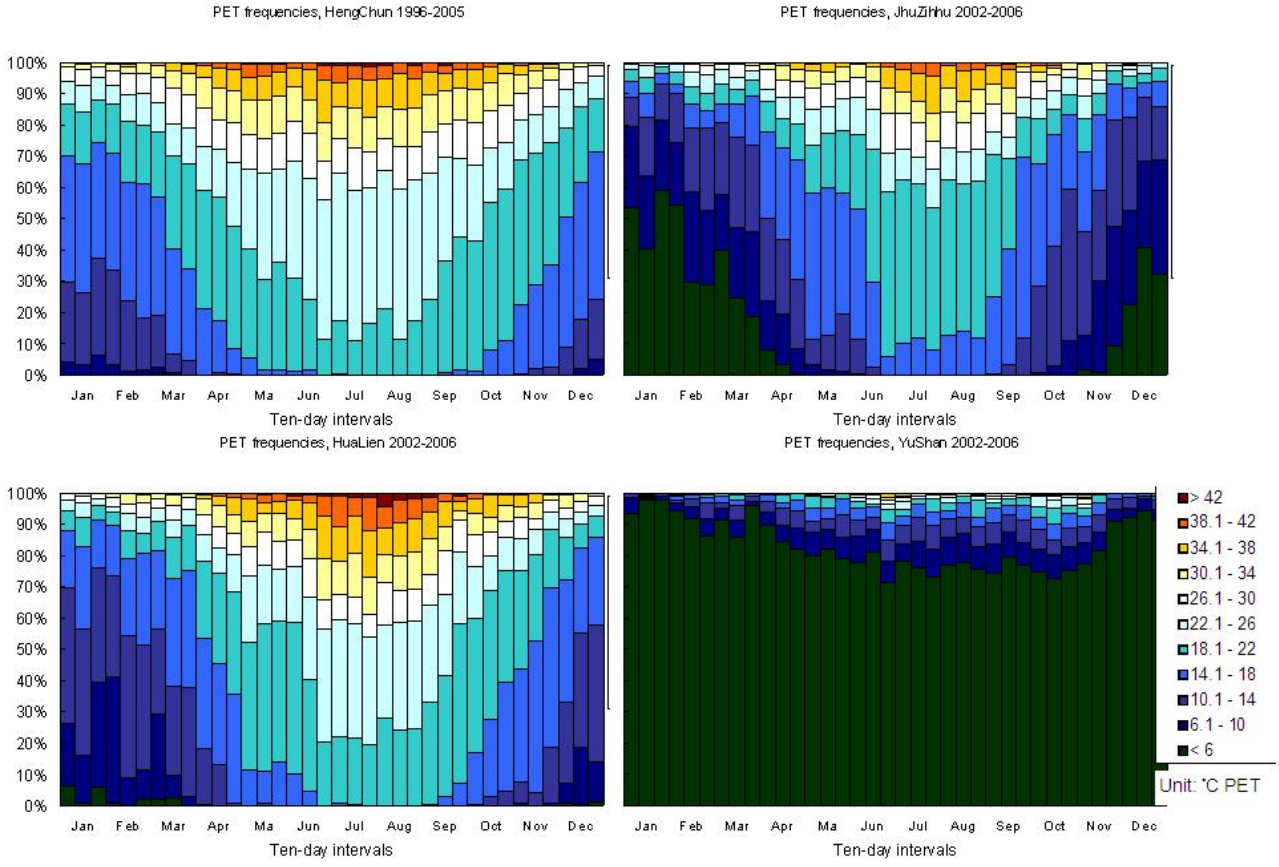

Figure 2: PET frequencies for the National Parks

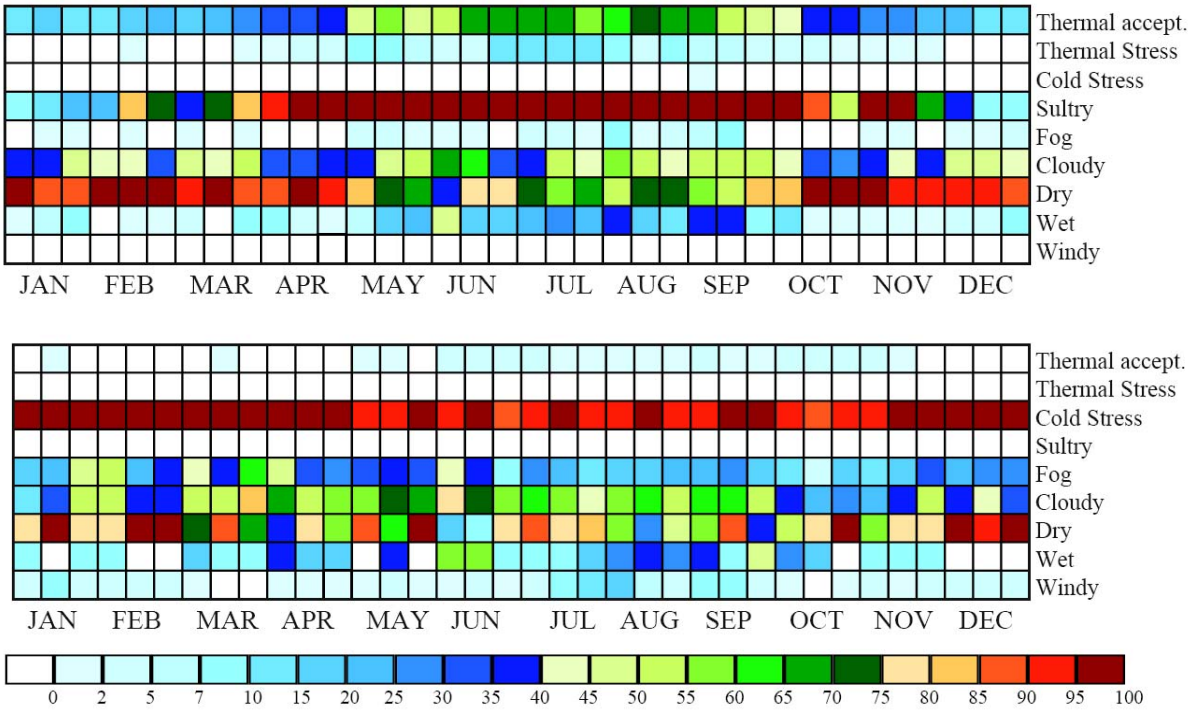

Figure 3: Climate Tourism Information Scheme for Kenting (upper) and Yushan (lower) National Park

Table 1: The result of tourist flow prediction model

National parks	*Weather station*	*Variable in the prediction model*	R^2
Kenting	HengChun	PET 22.1 - 26 Vapour pressure >18 Sun duration hours > 7 Wind speed >1.5 Precipitation >50*	0.51
Taroko	HuaLien	PET < 26 Vapour pressure 21 - 24 Sun duration hours >9 Wind speed <0.25 Precipitation < 3	0.4
Yamgmingshan	JhuZihhu	PET 10.1 - 14 Vapour pressure 9 - 12 Sun duration hours >9 Wind speed 1.5 – 2 * Precipitation <1	0.43
Yushan	YuShan	PET 18-30 Vapour pressure 12 - 15 Sun duration hours 4-7 Wind speed >1.5 Precipitation >50 *	0.40

Tourist flow prediction model

Can tourist flow be predicted by climate parameters? This study aims to use a multiple linear regression method to determine the tourism intensity using a range of climate parameters. Forward stepwise regression is applied in the model and variables are automatically added to the model until the partial F-statistic is <1.0. The dependent variable is tourist flow which is measured by the National Parks. Independent variables include the different frequencies of classifications of parameters, e.g. PET 18-22, 22-26, 26-30. In total there are 28 classifications for PET variables. In addition to PET, vapour pressure, sun duration (hours), wind speed and precipitation are included in the function with different range, 105 climate variables in total. The final results of the model with the best fit are listed in Table 1. The regression models show that the coefficient R^2 ranges from 0.4-0.51, revealing that almost 40-50 % tourist flow can be explained by climate.

DISCUSSION

PET frequencies for ten-day intervals combined with the results of the analysis of thermal comfort range display the likelihood of certain perceptions for the whole year in detail. In this study, the integrated assessment (CTIS) included aesthetic, physical, and thermal factors, which also offer tourists more detailed information on climate. The tourist flow prediction model displays that 40 % - 60 % tourist flows in Taiwan can be explained by climate parameters. The comparison of tourist flows and CTIS reveals that most tourists did not visit the tourism area in the period with most suitable climate. Therefore, it is important for governmental agencies to offer detailed tourism climate information to improve the region's tourism potential.

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