THE ROLE OF WEATHER IN BEACH RECREATION – A CASE STUDY USING WEBCAM IMAGES

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ABSTRACT Beach recreation is one of the most weather-sensitive leisure activities. However, there is a lack of scientific knowledge about how the different weather/climate variables influence beach visitation, and previous work on this area of research is based on stated preferences of respondents and not on behaviour. This study uses webcams in combination with onsite weather data to study the relationship between weather and beach use. Rosas, a seaside town in Spain, was used as a case study. During a period of one and a half months, images were taken every hour and then compared to the specific weather conditions provided by a nearby weather station to assess the relationship between beach visitation densities and atmospheric conditions. Precipitation is the dominating effect and is more important than other weather variables. Wind speed between 4 and 5 m/s is related to high density of users at the beach, while 7 m/s seems to be a threshold for ideal conditions. Finally, the role of temperature is somehow unclear, with tourists leaving the beach during the hottest hours of the day, although it seems that this is related to time and not weather. This pilot study provides an innovative approach to the analysis of the relationship between weather conditions and beach recreation. It raises some interesting questions about tourists’ adaptation to weather and potentially to climate change.

KEYWORDS: Beach recreation, weather, webcams, climate change

INTRODUCTION

There is relatively little scientific knowledge about the exact relationships between weather factors and beach visitation. Although the weather has always been highly variable, the climate was considered relatively stable. Climate change is projected to lead to structural shifts in the spatial and temporal patterns of climatological suitability for tourism purposes (Hamilton and Tol, 2004, Todd, 2003). To be able to estimate the magnitude of these shifts, more knowledge about the current influence of the weather on tourist and leisure behaviour is indispensable.

Models relating weather or climate conditions to tourism or recreation activities are typically of a linear nature. This implies that low scores on one factor can somehow be compensated by high scores on other factors. While this may make sense for factors such as temperature and sunshine, there may be other factors at play whose influence cannot be compensated (de Freitas et al., 2004), such as precipitation and strong wind (de Freitas, 1990). On the other hand, research in the field of weather and beach tourism is primarily based on ‘stated preferences’ (de Freitas, 1990, Gómez Martín, 2006), and problems like the multiple interpretations that respondents might associate with questions and answers could affect the results (Suchman and Jordan, 1990).

The objective of this research is to explore the relationships between weather conditions and beach visitation levels. The frequency of beach visitations is analysed in combination with easily accessible and temporally detailed weather data. The technology of webcams is also used.

Increased access to high-speed internet has proliferated webcam use in many fields, including the tourism sector, which has used them as a marketing tools for destinations and other tourism attractions (Timothy and Groves, 2001). Timothy and Groves (2001) were the first to explore the multiple uses that webcam images could have for tourism research. Benefits of this technology include the possibility to study behaviour, as opposed to ‘stated preferences’ survey-based studies, and the opportunity to analyze different locations at the same time. In beach tourism research Kammler and Schernewski (2004) have used webcams. Their study focused on temporal and spatial patterns of visitors on a German beach. Martínez Ibarra (2006) aimed at identifying the thresholds and optimal weather conditions for different kinds of beach recreation (sunbathing and swimming) along the coast of Alicante (Spain).

More case studies on weather and beach use are needed to verify the results obtained by previous studies, to test new hypotheses, and to allow for comparisons of case study results. Two pilot studies were performed in Zandvoort (The Netherlands) and Rosas (Spain), during July and August 2006. This paper reports the results obtained for the Spanish coastal town of Rosas (for more information about the other case study the reader is referred to Moreno et al., in press). The paper is organised as follows. Section two describes the layout of the study, and its methodological setup. The results are described in section three, and discussed in the last section. It is important to note that in this research the terms ‘tourist’, ‘visitor’ and ‘user’ are used interchangeably to refer to people who are present at the beach with the aim of sunbathing or swimming, thus excluding other uses from the analysis.
METHODS
Rosas is located in Catalonia (Northeast Spain), in the northern parts of what is known as Costa Brava. Its location, less than 30 km to the French border and 160 km from Barcelona, makes it an attractive destination for both international and Spanish tourists. This location fulfilled the following basic criteria: (a) the webcam images were of high enough quality to extract information about density of use, while being coarse enough to avoid moral and legal issues associated with identifying individuals; (b) the images were provided continuously and refreshed regularly; (c) detailed weather data was available from a weather station in the same locality.

Two webcam views were systematically recorded, one for the analysis and one for verification purposes (available at www.roses.net). The images cover an area of several hundred meters of the beach and are updated every 5 minutes. Weather data was obtained from the automatic station that the Meteorological Service of Catalonia has in this locality (available at www.meteocat.com), which provides data in 30 minutes intervals. The weather variables included in this study are: daily precipitation, wind speed and temperature.

A total of 211 images of the coast and weather data were saved every hour between 9 am and 9 pm (July and August 2006). This set of 'raw' data was processed to filter out unusable images. Various techniques were reviewed for assigning images to density classes: the software-based approach used by Kammler and Schernewski (2004), which analyses the pixels to extract information about beach use, was considered very promising but technically unfeasible. Therefore, the more qualitative approach proposed by Martínez Ibarra (2006) was used instead, albeit slightly adjusted. A number of density classes were established, the most representative image for each of them identified, and subsequently all remaining images were allocated to the different density classes based on their similarity to the model images. Instead of the four classes used by the author, three were used in this study: 'low' for situations of low use, 'intermediate' for medium densities and 'high' for a crowded beach.

In recognition of the possible existence of climate-overriding factors, the analysis was performed in two steps. Step 1 tested for the existence of overriding factors: precipitation and strong wind (de Freitas, 1990). If these events were found to be overriding, then these cases were eliminated from the dataset that was used to analyze the influence of temperatures (step 2).
RESULTS

Precipitation
The overriding effect of precipitation was assessed by transforming the variable into a dummy. In this way, precipitation on one day lead to all those units taken after the rain to be coded as 1, while those units without precipitation were coded as 0. The data from Roses showed only two days with precipitation during the study period. During those days the beach was invariably empty, even if it rained before 1 pm.

Wind
The analysis of the influence of wind speed was based on the idea that there is a range of values for ideal wind conditions and a threshold above which high winds cause disturbance through movement of sand and tourist belongings. The results show that high densities of users are linked to wind speeds above 2 m/s, with a distribution of values having a reversed U-shape, with a steep decrease in the number of cases above 7 m/s and only 1% of the cases above the 8 m/s.

Temperature
Before the analysis of temperatures was carried out, the dataset was reduced through elimination of those units for which there was a precipitation or wind speed record above 7 m/s. The analysis of the relationship between temperature and presence of users at the beach for the remaining data units and including all hours of the day is shown in Fig. 1. Beach participation had a bimodal distribution over the hours of the day, with density peaks at 12 and 5 pm, and lower densities between these times. To eliminate the influence time of the day and to study the effect of temperature, 12 pm was selected since it includes cases in all the density groups. In this case ‘low’ densities are associated with mean temperatures of 24 °C, while the ‘intermediate’ and ‘high’ density groups have a similar mean temperature of about 29.5 °C.

DISCUSSION
This study used webcam images to explore the relationship between weather and the presence of visitors on the beach at the coastal resort of Rosas (Spain). The literature identifies two weather elements with an overriding effect over other weather parameters for beach related activities: precipitation and wind speed. The discussion of the quantity or duration of precipitation that constitutes a threshold for the practice of the beach activities has been
largely discussed in the literature. This research confirms the limiting nature of precipitation. However, it shows that, the possibility of rainfall or very low intensity rainfall over short periods of time might constitute a limiting factor *per se*, as suggested by Besancenot (1989). The analysis of the influence of wind speed seems to confirm previous research based on the preferences stated: ‘high’ densities of users are mostly associated with intermediate values of wind speed (de Freitas, 1990), resulting in the relationship being not linear but having a reversed U-shape (‘high’ densities peak between 4 and 5 m/s).

![Figure 1: Distribution of temperatures and densities along the day](image)

The hour of the day (time) appears to be a very important element in the early morning, evening, and probably also between 1 and 4 pm. To eliminate this influence and to explore differences between groups in terms of temperature, the analysis was carried out at 12 pm. The results showed that ‘low’ densities at midday are associated with mean temperatures of around 24 °C, while the intermediate and high densities are related to mean temperatures of approximately 29.5 °C, although the difference between the ‘intermediate’ and ‘high’ groups is not significant.

It was not possible to identify the existence of thresholds of minimum or maximum temperature. In the case of minimum temperature the reason for this was that once the units affected by rain or high wind speeds were eliminated from the analysis, the minimum temperature registered was 21.7 °C at 10 am, with a low density of users caused by temperature and time of day. The existence of a maximum temperature that causes a discomfort level resulting in people leaving the beach could not be confirmed in this study. At

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<th>Mean Density</th>
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12 pm, the time of maximum density, and at 3 pm, the time of minimum density, the maximum temperatures reached similar values of about 34 °C. Therefore, the decrease in the number of people that can be observed during the hottest hours of the day (between 1 and 4 pm) does not seem to be related to the temperatures but other causes, probably cultural reasons (the lunch hour in Spain is between 1 and 4 pm). However, whether cultural or weather related, people leaving the beach between 1 and 4 pm coincides with the hottest hours of the day and somehow it could be seen as an indication of a certain adaptation to high temperatures. This would suggest that previous studies stating that higher temperatures due to climate change might cause fewer tourists to travel to these regions (Perry, 2005) might be overstated, since tourists can adapt to this conditions by, for example, leaving the beach during the hours of maximum heat.

This pilot study attempts to complement those studies which are based on interviewing tourists about their preferences. However, the observed behavior does not necessarily relate to the way tourists perceive their environment and, therefore, the first studies are essential in that they analyse how tourists experience and come into contact with the different weather elements. Only through studies that combine both methodologies it will be possible to improve our understanding about the multiple relationships between weather/climate and tourism and the consequences that climate change might have for the tourism sector.

REFERENCES
Perry, A. (2005) The Mediterraneaen: how can the world's most popular and successful tourist destination adapt to a changing climate? In M. Hall and J. Higham (Eds.), Tourism, Recreation and Climate Change (pp. 86-96). London, UK: Channel View Publications.