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Differential climate preferences of international beach tourists

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ABSTRACT: Weather and climate are a principal resource and constraint for tourism that directly and indirectly influence global demand patterns. Against the background of rapidly expanding literature on climate and tourism, this study sheds needed insight into the complexities of tourist climate preferences and the implications for rating current and future climate resources for tourism. A survey of 472 beach tourists is the basis for comparing the climatic preferences of diverse tourism market segments on the Caribbean islands of Barbados, Saint Lucia and Tobago. Key findings include warmer temperature preferences and tolerances for tourists originating from tropical regions, with lower heat preferences and tolerances for tourists from temperate regions. Statistically significant differences ($p < 0.05$) were also found between temperate and tropical residents for every climate variable examined (temperature, rain, sky conditions, wind). The results are discussed with regard to their implication for the construction of tourism climate indices, demand models and climate change assessments.

KEY WORDS: Climate · Tourism · Preferences · Thresholds · Weather · Beach tourism

1. INTRODUCTION

A number of tourism studies have sought to explore the similarities and differences between sociodemographic and cross-cultural groups in relation to tourism demand patterns. Understanding these differences is important for tourism operators and managers, providing insight into effective decision-making and market segmentation strategies. Such research has revealed that tourist behaviour and perceptions, travel motivations, satisfaction levels and activity selection, all vary according to age and country of origin (e.g. Pizam & Sussmann 1995, Crotts & Erdmann 2000, Moscardo et al. 2001, Kozak 2002, Lee et al. 2004, Diaz-Perez et al. 2005, Kang & Moscardo 2006, Vespestad & Mehmetoglu 2010, Prayag & Ryan 2011, Correia et al. 2011, Thrane & Farstad 2012).

Weather and climate are principal resources and constraints for tourism; they directly and indirectly influence global demand patterns (de Freitas 2003, Scott & Lemieux 2010, Scott et al. 2012). For tourists, weather and climate are considered consciously or implicitly throughout the travel planning process (e.g. Scott et al. 2011), serving as an important travel motivator (e.g. Lohmann & Kaim 1999, Kozak 2002), influencing the timing of travel (e.g. Eugenio-Martin & Campos-Soria 2010), the destination(s) selected (e.g. Hamilton & Lau 2005, Moreno 2010), spending and overall trip satisfaction (e.g. Bardon 1991, Williams et al. 1997, Becken et al. 2010). Recognizing the importance of weather and climate for tourism, researchers have sought to quantify the optimal and threshold (i.e. unacceptable, point of behavioural adaptation) climatic conditions for tourism, both generally (i.e. sight-seeing) and for specific tourism environments or activities (i.e. beach, urban, mountain) (Mieczkowski 1985, Morgan et al. 2000, Maddison 2001, Scott & McBoyle 2001, Lise & Tol 2002, Scott et al. 2003, Hamilton et al. 2005, Bigano et al. 2006, Gomez-Martin 2006, Scott et al. 2008,

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Credoc 2009, Moreno 2010, Rutty & Scott 2010, Denstadli et al. 2011). A noted gap in this literature is a lack of empirical studies that compare climatic preferences for major tourism market segments (e.g. socio-demographic and cultural groups) and tourists originating from different climatic regions (e.g. temperate versus tropical) (Scott et al. 2008, Rutty & Scott 2010, Gössling et al. 2012). Revealed preference studies have not explored market segment differentiation in climate preferences because of the aggregated nature of tourism arrivals data (Scott et al. 2012), while studies using stated climatic preference techniques have either not included demographic characteristics or have captured a narrow range of tourists (e.g. Morgan et al. 2000, Gomez-Martin 2006, Moreno 2010, de Freitas et al. 2008, Scott et al. 2008, Rutty & Scott 2010). It is therefore unclear whether, and to what degree, climate preferences and key thresholds vary. Furthermore, existing studies are geographically restricted to relatively similar cultures and temperate climate zones (Europe, North America and Australasia) (Morgan et al. 2000, Gomez-Martin 2006, Scott et al. 2008, Moreno 2010, Rutty & Scott 2010). Differences in climatic preferences among these limited samples have nevertheless been recorded, raising the question whether differences would be larger in more climatically diverse tourist groups.

This study addresses these 2 knowledge gaps by evaluating climate resources for beach tourism using an *in situ* survey of climatic preferences from a sample of tourists in Barbados, Saint Lucia and Tobago. Three central research questions guided this study:

1. What are the ideal and unacceptable threshold conditions for a beach holiday (temperature, rain, sky conditions and wind)? How do the results compare with the optimum conditions identified by beach climate preference studies in other regions (e.g. Morgan et al. 2000, Gomez-Martin 2006, Scott et al. 2008, Moreno 2010, Rutty & Scott 2010, Wirth 2010)?

2. Do ideal and unacceptable threshold climate conditions differ across age cohorts? Have previous convenience samples of university students (Scott et al. 2008, Rutty & Scott 2010) satisfactorily represented the broader tourism market?

3. Do ideal and unacceptable threshold climate conditions differ cross-culturally? Lise & Tol (2002) and Bigano et al. (2006) concluded that temperature preferences varied little among tourists of different nationalities, while Morgan et al. (2000) and Scott et al. (2008) found significant differences among tourists from different nations. If cross-cultural differences exist, does the degree of difference increase across more climatically diverse nations (e.g. residents from temperate regions compared to those from tropical regions)?

2. ASSESSING CLIMATE PREFERENCES

Beach tourism is strongly related to climate conditions, with many coastal tourists largely, or in some cases entirely, motivated by climatic considerations when selecting their holiday destination (Kozak 2002, Mansfeld et al. 2004, Gomez-Martin 2005, Uyarra et al. 2005, Moreno 2010). Major intra-regional tourism demand patterns highlight the influence of climate for this market segment, with millions of North Americans and northern Europeans annually travelling south to the warm and sunny coasts of the Caribbean and Mediterranean, respectively. The sensitivity of beach users to weather is also apparent, given that the activity takes place in the open natural environment, where tourists are generally exposed to weather and oceanic conditions with little clothing (i.e. a swimsuit) as protection. Weather sensitivities have been recorded, with sunshine and higher temperatures correlated with crowded beaches, and cool temperatures, rain and wind conditions deterring users and resulting in low levels of beach use (e.g. de Freitas 1990, Moreno et al. 2008, Martínez Ibarra 2011). A number of studies have examined beach tourists' climatic preferences, with the identified optimal and unacceptable climate conditions discussed below and summarized in Table 1.

Using survey responses from beach users (northern Europeans) holidaying in Wales, Malta and Turkey, Morgan et al. (2000) adapted Mieczkowski's (1985) tourism climate index (TCI) to formulate their beach climate index (BCI) to develop the rating and weighting schemes of the index. Absence of rain was rated as the most important for a beach holiday (29%), followed by sunshine (27%), wind (26%) and temperature (18%). Respondents were also asked to rank their preferred thermal sensations from 'very hot', 'hot', 'warm', 'neither cold nor warm', 'cool' and 'cold', with a temperature range later assigned to each sensation category using skin temperature values from de Freitas (1985). A 'warm' skin temperature of between 33 and 35°C was ranked as most preferred. Respondents were not surveyed regarding their preferred conditions for precipitation, wind or sunshine, but instead the highest ranked optimal condition was either adopted or prescribed (<15 mm mo^{-1} of rain, winds of 4 m s^{-1} and >10 h of sunshine).

Table 1. Daily climatic optimal and unacceptable threshold conditions for beach tourism

Sample region	Temperature (°C)		Precipitation		Sun/cloud conditions		Wind (km h^{-1})		Source
	Ideal	Unacceptable	Ideal	Unacceptable	Ideal	Unacceptable	Ideal	Unacceptable	
Wales, Malta, Turkey[b]	33–35[d]	–	<15 mm mo^{-1}	–	>10 h sun	–	<14	–	Morgan et al. (2000)
Spain[b]	22–28	16–22	–	>3 h	>11 h sun, ≤25 % cloud	≤5 h sun	<8	>8	Gomez-Martin (2006)
Canada[a]	27	–	–	–	25 %	–	1–9	–	Scott et al. (2008)
New Zealand[a]	25				–				
Sweden[a]	29				0 %				
Belgium[b]	28	–	–	–	>8 h sun 0 % cloud	–	1–9	–	Moreno (2010)
Europe[a]	27–32	<22; >37	0 h	≥2 h	25 %	≥75 %	1–9	≥41	Rutty & Scott (2010)
Germany	27–32[b] 25–32[c]	<22; >36[b] <22; >34[c]	0 h	≥2.5 h	25 %	≥75 %	1–9	≥41	Wirth (2010)

[a]Youth traveller market segment (i.e. student sample); [b]public traveller market segment (i.e. all age cohorts); [c]senior traveller market segment (i.e. 56+ yr old); [d]skin temperature

Modifying Besancenot et al.'s (1978) weather-types method, which catalogs 8 types of suitable weather for general tourism activities from Type 1 (very good weather) to Type 8 (bad weather), Gomez-Martin (2006) surveyed tourists in Catalonia (Spain) to assess their preferences for weather types specifically for beach tourism. The results were then applied to present and future climate scenarios, with the goal of evaluating climate-tourism potential in the region. Respondents selected 22–28°C as ideal and 16–22°C as least favourable (as chosen from 16–22°C, 22–28°C and 28–33°C). Optimal precipitation conditions were assumed to be no rain, with respondents stating that >3 h of rain would 'totally ruin' the tourism experience. On the Beaufort scale from 0 to 8, the majority of respondents stated a wind level of 4 (5.5–7.9 m s^{-1}) to be the maximum tolerated, and therefore wind velocities <8 m s^{-1} were specified as ideal. The majority of respondents stated an ideal 'sunny day' was when the sun shines for at least 77 % of the daylight hours (≥11 h d^{-1}).

Scott et al. (2008) conducted the first *ex situ* study of tourists' stated climate preferences for multiple tourism environments, administering surveys to university students in Canada, Sweden and New Zealand. Respondents were asked to specify an ideal temperature for beach tourism, resulting in a median preferred temperature of 27°C. Based on 5 wind speed categories, the majority of respondents stated a light breeze was ideal (1–9 km h^{-1}). Five sky condition categories were also provided, with the majority of respondents selecting 25 % cloud cover as ideal for a beach holiday. The study found significant differences for temperature and cloud preferences among these national samples, with the Swedish sample preferring slightly warmer temperatures and no cloud cover.

Moreno (2010) surveyed Belgian and Dutch tourists at an airport waiting to travel south to the Mediterranean for a beach holiday. Using the same question format as Scott et al. (2008), the results indicated a preferred temperature of 28°C, a light breeze (1–9 km h^{-1}), >8 h of sunshine and 0 % cloud cover. Respondents were also asked which weather elements had the greatest negative impact on the beach tourism experience, with precipitation being rated the highest (76 %), followed by strong winds (57 %), low temperatures (44 %), cloudy skies (26 %), high temperatures (20 %), high humidity (17 %) and low humidity (5 %).

Rutty & Scott (2010) also conducted an *ex situ* study of university students in Europe (samples from Austria, Germany, The Netherlands, Sweden, Switzerland). It was the first to examine key climatic thresh-

olds in addition to the most preferred (optimal) climate conditions. Scott et al. (2008) noted that clusters of responses in their data were visible at 15, 20, 25 and 30°C, suggesting that these values may be key perceptual thresholds. Recognizing that tourists may have a range of ideal temperatures (e.g. 27°C may be preferred equally to 26 or 28°C), the survey asked respondents to indicate the range of temperatures that is ideal for beach tourism, as well as to indicate threshold temperatures that are unacceptably hot or cold for beach tourism. The survey found that 27–32°C is ideal for more than half (>50%) of beach tourists, with temperatures <22°C and >36°C being given as unacceptable for the majority of respondents. Ideal conditions also include a light breeze, 25% cloud cover and no rain. Conversely, unacceptable conditions include strong winds (41–60 km h^{-1}), ≥75% cloud cover and >2 h of rain a day.

Using the same survey as Rutty & Scott (2010), Wirth (2010) explored whether there was a difference in climate preferences between university students and other demographic groups (i.e. 26–35, 36–55, 56+ yr olds) in Germany. Ideal beach tourism conditions for all demographic groups included no rain, a light breeze and 25% cloud cover. A slightly different ideal temperature was recorded between the student sample (27–32°C) and the oldest demographic group (25–32°C). All demographic groups identified >2.5 h d^{-1} of rain, strong winds and ≥75% cloud cover as unacceptable, as well as temperatures <22°C. However, similar to ideal temperatures, unacceptably hot temperatures differed between the youngest (>36°C) and oldest age cohort (>34°C).

3. METHODS

Self-administered questionnaires were distributed to beach users on the Caribbean islands of Barbados (Accra, Amaryllis, Dover and Holetown beaches), Saint Lucia (Gros Islet and Rodney Bay beaches) and Tobago (Charlotteville, Crown Point, Pigeon Point and Speyside beaches). This study area was chosen because tourism in the Caribbean is predominantly based on a 3S (sun, sea, sand) market. This market segment depends on favourable weather conditions in the coastal zone. The Caribbean also has the most tourism-intensive economy among the 12 regions ranked by the World Travel and Tourism Council (2011) (i.e. tourism represents the greatest proportion of the regional economy), with tourism representing 14% of the GDP and 13% of employment (2.2 million jobs).

A pre-test of the survey was conducted in Canada, with slight modifications made to improve the clarity of some questions in March 2012. A total of 472 persons agreed to participate in the survey, which provided a strong response rate of 89%. Of the completed surveys, 216 were completed in Barbados, 126 in Saint Lucia and 130 in Tobago. The survey was conducted in English in all 3 countries. Respondents were asked to circle the range of temperature(s) they deemed ideal and unacceptable for their beach holiday. For the variables rain, wind and sky conditions, respondents were asked to select the most preferred and unacceptable daily conditions from a list of 5 available options. The data collection extended over 18 d in March and April 2012, with every available person/group on the beach approached and asked to participate. In this period, daily mean and maximum temperatures between 27 and 30°C were recorded, and corresponds to long-term averages in the region.

A few limitations should be borne in mind when considering the results of this study. A common drawback of *in situ* surveys is the time limitations for data collection (without significant personnel costs). In the same vein, there is the possibility of response bias, as those beach-users who prefer weather conditions not available during the days when surveys were disseminated may not be represented in the sample. It is possible that visitors arriving in the Caribbean during the shoulder season (i.e. June–November) may have different weather preferences than those reported here. However, daily maximum and minimum temperatures in the region vary only slightly throughout the year (1–2°C) and may therefore be less of a concern in this study. The survey was also distributed to beach users on the 'dry' part of the beach, which means tourists in the water at the time of the survey were not captured. As such, those who often engage in water sports may be somewhat under-represented in the sample. The extent of these biases is unknown.

4. RESULTS

The survey sample is composed of slightly more females than males (57 and 43%, respectively), with the largest share of respondents falling into the 45–54 age group (22%), followed by 25–34 (20%), 55–64 (19%), >65 (16%), 35–44 (15%) and <25 (8%). The greatest numbers of respondents were from the United Kingdom (UK) (28%), followed by Canada (26%), the United States (US) (16%), Trinidad and Tobago (16%) and Germany (4%), with the remain-

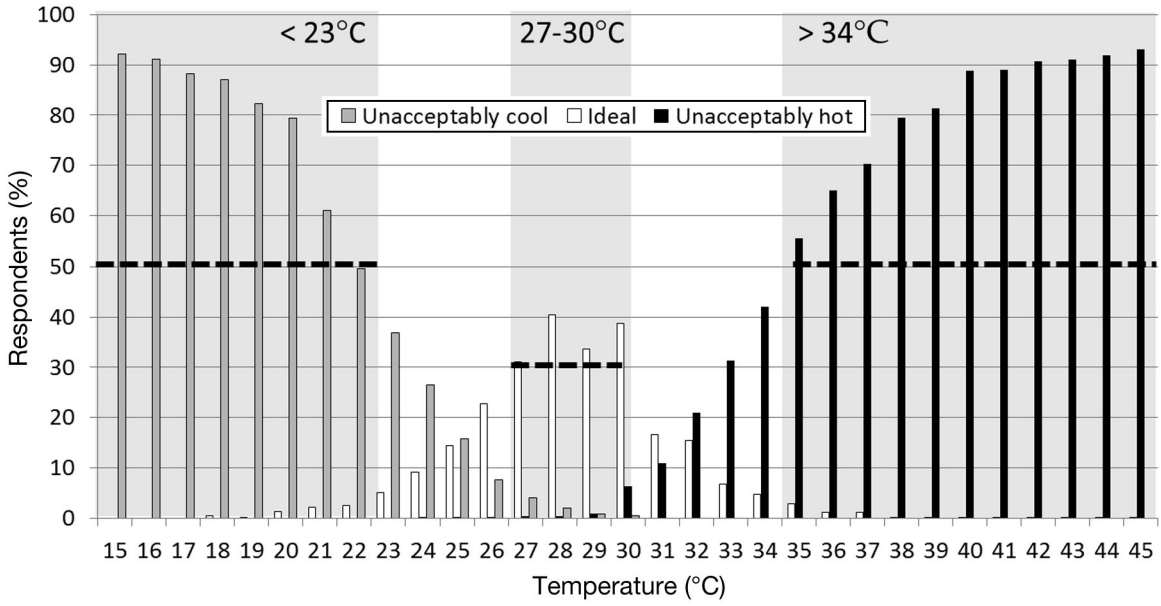

Fig. 1. Temperature preferences and thresholds for beach tourism. Dashed lines: greatest share of respondents

ing respondents from other European (5%), Caribbean (3%) and South American (2%) countries. Based on the Köppen climate classification scheme (Peel et al. 2007), the majority of respondents originate from a temperate/summer continental climate region (75%), followed by tropical (21%), subtropical (3%) and other (1%) climate regions. Most respondents (87%) had travelled to the Caribbean at least once before, with 20% having travelled to the region 10 or more times, and only 13% were first-time visitors.

Fig. 1 shows the distribution of unacceptably cool, ideal and unacceptably hot temperatures for beach tourism. The greatest share of respondents (>30%) defined ideal temperatures for beach tourism as 27–30°C. This is within the range of optimal temperatures identified in the literature, with the exception of Scott et al.'s (2008) New Zealand sample, which identified 25°C as ideal. The majority of respondents (>50%) identified a temperature of <23°C as unacceptably cool for a beach holiday and >34°C as unacceptably hot. The unacceptably cool threshold is 1°C warmer than that identified by Gomez-Martin (2006), Rutty & Scott (2010) and Wirth (2010), and the unacceptably hot temperature is 3°C cooler than that identified by Rutty & Scott (2010) and 2°C cooler than than that identified by Wirth (2010). Therefore, the range of acceptable temperatures for a beach holiday (i.e. 23–34°C) was found to be somewhat narrower than that found in previous studies.

As highlighted in Table 2, the majority preference for rain is 15 min or less per day (52%), with 2 h of rain being unacceptable (59%). As such, this sample has a lower rain tolerance compared to the studies by Gomez-Martin (2006) (3 h) and Wirth (2010) (2.5 h). The majority (73%) of respondents identified scattered light cloud cover (25% cloud cover) as the ideal sky condition (Table 3), which is consistent with much of the literature, but different to the preferred

Table 2. Ideal and unacceptable daily rain conditions (data are percent of respondents)

	No rain	≤15 min	30 min–1 h	2–4 h	≥5 h
Ideal					
Complete sample	27	52	19	2	0
Temperate	24	56	20	0	0
Tropical	41	38	16	5	0
Unacceptable					
Complete sample	9	3	20	59	96
Temperate	7	3	21	64	97
Tropical	12	6	21	41	91

Table 3. Ideal and unacceptable cloud cover according to the percent of sky cover (data are percent of respondents)

	Percent cloud cover				
	0	25	50	75	100
Ideal					
Complete sample	12	73	14	1	0
Temperate	13	76	11	0	0
Tropical	6	64	28	1	1
Unacceptable					
Complete sample	7	2	21	59	91
Temperate	5	1	22	62	93
Tropical	12	3	20	49	83

Table 4. Ideal and unacceptable daily wind conditions (data are percent of respondents)

	No wind (0 km h^{-1})	Light breeze (1–9 km h^{-1})	Moderate wind (10–40 km h^{-1})	Strong wind (41–60 km h^{-1})	Very strong wind (61–90 km h^{-1})
Ideal					
Complete sample	1	82	16	0	0
Temperate	0	87	13	0	0
Tropical	2	64	31	3	0
Unacceptable					
Complete sample	22	1	25	70	92
Temperate	19	0	28	75	95
Tropical	33	3	16	50	80

0% cloud cover identified by Moreno's (2010) Belgian sample and Scott et al.'s (2008) Swedish sample. This study also found that the majority (59%) of respondents think ≥75% cloud cover is unacceptable (Table 3), which is consistent with the existing literature (Table 1). Also consistent with the literature is the majority preference for a light breeze and strong winds being unacceptable for a beach holiday (82 and 70%, respectively) (Table 4). These findings suggest that optimal and unacceptable climate conditions for beach tourism may differ depending on the sample being analysed and the holiday/travel circumstances specific to *in situ* samples.

When comparing demographic groups, ideal temperature preferences were found to be very similar across the 6 age groups, with 28–30°C ideal for 18–24 and 45–54 yr olds and 27–30°C ideal for the remaining groups. However, unacceptably cool temperatures differed up to 2°C, with the youngest group (18–24) the least tolerant of cool temperatures (<24°C), followed by 45–64 yr olds (<23°C) and 25–44 and 65+ yr olds (<22°C). Unacceptably hot thresholds also differed by up to 2°C, with the 18–24 and 35–44 yr olds having the highest temperature tolerance (>36°C), followed by 25–34 and 45–54 yr olds (>35°C), with the oldest age groups (55–64 and 65+) having the lowest heat tolerance (>34°C). However, differences across age groups are not statistically significant for ideal ($F_{5,410}$ = 0.358, p = 0.655), unacceptably cool ($F_{5,403}$ = 0.814, p = 0.540), or unacceptably hot ($F_{5,404}$ = 1.877, p = 0.097) temperatures.

For the other climatic variables: rain, sky conditions and wind speeds, the majority of respondents (>50%) in all 6 age groups selected the same ideal and unacceptable conditions, with no statistically significant differences found (p < 0.05).

To examine whether tourists from climatically diverse regions have different climate preferences for beach tourism, the city of origin for the sample was classified. Using the Köppen climate classification scheme (Peel et al. 2007), respondents (n = 472) were classified into temperate/summer continental (75%) (henceforth shortened to temperate), tropical (21%), subtropical (3%) and other (1%). The latter 2 groups were considered too small for statistical comparisons (n < 20), and were not included in this analysis.

As summarized in Table 5, some differences in climate preferences were observed. Ideal temperatures for temperate residents were between 27 and 30°C, with tropical residents preferring 30°C. This difference in ideal temperature is statistically significant ($F_{1,447}$ = 39.419, p < 0.001), with temperate residents preferring a cooler ideal temperature than tropical residents. Unacceptably cool temperatures differed by 1°C, with temperate residents less tolerant of cool temperatures (<23°C) compared to tropical residents (<22°C), but this difference was not statistically significant (p = 0.229). Unacceptably hot temperatures also differed by 1°C, with temperatures >34°C too hot for temperate residents and >35°C too hot for tropical residents; this was statistically significant ($F_{1,438}$ = 7.062, p = 0.008).

Optimal conditions identified by the temperate sample match those of existing studies (Table 1). However, the sample of tourists from the tropical region, which has not been previously examined, reveals a warmer temperature preference, which is outside of the range identified by Gomez-Martin (2006), Scott et al. (2008) and Moreno (2010) and is in the upper temperature range identified by Rutty &

Table 5. Comparison of temperature preferences and thresholds (°C) by climate region. *Not statistically significant (p ≥ 0.05)

	Unacceptably cool	Ideal	Unacceptably hot
Temperate	<23*	27–30	>34
Tropical	<22*	30	>35

Scott (2010) and Wirth (2010). The unacceptably hot temperature for both samples is 2–3°C lower than previous assessments, but, importantly, revealed that tropical residents stated a higher temperature tolerance, with a greater heat sensitivity among tourists' originating in cooler temperate climates.

A majority of responses from both climate region groups selected <15 min of rain as ideal, with no statistically significant differences ($p = 0.673$). However, a majority of temperate residents stated >2 h of rain was unacceptable (64%), while tropical residents stated that >5 h was unacceptable (91%) (Table 2), which is outside the threshold currently reported in the literature. Tropical residents are therefore more tolerant of rain than temperate residents, resulting in statistically significant differences at the 2–4 h rain threshold ($\chi^2 = 15.918$, df = 1, $p < 0.001$) and the >5 h threshold ($\chi^2 = 7.971$, df = 1, $p = 0.005$).

The majority (76 and 64%, respectively) of temperate and tropical region residents selected 25% cloud cover as the ideal sky condition for beach tourism, but statistically significant differences were found ($p = 0.003$). This can be explained by the additional 28% of tropical region residents that selected 50% cloud cover as ideal. Unacceptable sky conditions differed by climate group, as the majority of temperate residents stated ≥75% cloud cover as unacceptable (62%) and the majority of tropical residents stated 100% cloud cover as unacceptable (83%) (Table 3). Temperate residents are therefore less tolerant of cloud cover compared to tropical residents, with statistically significant differences recorded at the 0% ($\chi^2 = 4.469$, df = 1, $p = 0.035$), ≥75% ($\chi^2 = 4.879$, df = 1, $p = 0.027$) and 100% ($\chi^2 = 7.701$, df = 1, $p = 0.006$) cloud cover thresholds. The results from the temperate sample correspond to the results currently recorded in the literature, but the cloud cover preference and thresholds for tropical residents is different.

A majority of temperate and tropical region residents selected a light breeze as ideal for beach tourism (87 and 64%, respectively) (Table 4), but statistically significant differences were found ($p < 0.001$). This can be explained by the additional 31% of tropical residents that stated a preference for moderate wind speeds. Unacceptable wind speeds were the same for both groups, with the majority of temperate and tropical region residents stating strong winds were unacceptable (75 and 50%, respectively). However, statistically significant differences were found for all wind speed thresholds, with tropical residents less tolerant of no wind and more tolerant of higher wind speeds: no wind ($\chi^2 = 7.771$, df = 1, $p = 0.005$), light breeze ($\chi^2 = 6.880$, df = 1, $p = 0.009$), moderate wind ($\chi^2 = 5.903$, 1, df = 1, $p = 0.015$), strong wind ($\chi^2 = 22.467$, df = 1, $p < 0.001$) and very strong winds ($\chi^2 = 20.228$, df = 1, $p < 0.001$). Once again, the temperate sample matches existing research, but the tropical sample reveals new insight into potential regional differences.

To determine whether differences also exist within climatically similar regions, a comparison of responses among the temperate countries of Canada, the UK, the USA and Germany was examined. All 4 countries had similar ideal temperatures for beach tourism, with Canada and the UK preferring 27–30°C; the USA, 28–30°C; and Germany, 30°C. The unacceptably cool threshold was <23°C for all but Germany, which was 1°C warmer. The unacceptably hot threshold was >33°C for the UK and the USA, with Canada and Germany 1°C warmer. No statistically significant differences were found for temperature preferences or thresholds ($p < 0.05$). These results differ somewhat from those of Scott et al. (2008), which showed lower optimal temperatures for New Zealand (25°C), but comparable temperatures for Canada (27°C) and Sweden (29°C).

Ideal and unacceptable conditions for the climate variables rain, sky conditions and wind were the same for all 4 temperate countries. The majority prefer <15 min of rain, 25% cloud cover and a light breeze, and unacceptable were >2 h of rain, 75% cloud cover and strong winds. No statistically significant differences were found for these climate variables ($p < 0.05$), with the exception of ideal wind ($\chi^2 = 21.607$, df = 6, $p = 0.001$). Almost all respondents from the UK and the USA prefer a light breeze (92 and 96%, respectively), while nearly one-quarter of Canadian and German respondents prefer a moderate wind (23 and 19%, respectively). These results also differ somewhat from the data of Scott et al. (2008), which showed statistically significant differences for cloud cover, with the Swedish sample preferring 0% cloud cover to Canadians preferring 25% cloud cover (similar to our Canadian sample), but no statistically significant differences for wind preferences.

5. DISCUSSION

A number of studies have found that differences exist in climate preferences for holidays among market segments. This study has confirmed some of the results of earlier studies and identified a number of differences among previously unrepresented sample groups. The unacceptable climate conditions identified for this public sample of beach-users in

the Caribbean reveals a lower tolerance for many climate variables, including a narrower range of acceptable temperatures (23–34°C), a lower acceptance for cool and warm conditions, as well as a lower tolerance for rain (<2 h). Consistent with existing studies are wind speed preferences (light breeze as ideal, strong winds as unacceptable), cloud cover preference (25% as ideal, ≥75% as unacceptable), with the exception of Moreno's (2010) 0% cloud cover, and ideal temperatures are also within the range of existing studies (27–30°C). These examples indicate that tourists' threshold conditions are less homogenous than ideal conditions. The lower tolerance for climate variables may be the result of surveying respondents *in situ*, whereby respondents have paid for and are experiencing current weather conditions rather than being asked to envisage climate conditions for a future holiday. This study sample may therefore have higher expectations for optimal climate conditions, with less tolerance for unacceptable climate conditions. The extent of the heterogeneity requires further study, but has implications for the design of tourism climate indices and associated rating scales.

The Caribbean public sample was then analysed by age cohort to better gauge whether a convenience sample (i.e. university student samples in Scott et al. 2008 and Rutty & Scott 2010) are representative of the broader tourism market (i.e. all age cohorts). For all climate variables examined (i.e. temperature, rain, cloud cover, wind), no statistically significant differences were found for ideal and unacceptable conditions. These results are inconsistent with the statistically significant findings of Wirth (2010), in which the youngest age cohort (18–25 yr) both prefers and is more tolerant of warmer temperatures than the oldest age cohort (56+ yr). Although not specifically examining beach preferences, Credoc (2009) also found that older (60+ yr) domestic tourists in France were more sensitive to heat than younger people (18–24 yr). Limb & Spellman's (2001) qualitative interviews with UK travellers found suitable weather conditions differed based on family status, with single professionals more resilient to a range of weather conditions than families with children. These results reinforce that the interaction between climate preferences and age or other socio-demographics (e.g. travelling with children) remains insufficiently understood.

Perhaps the most notable finding from this study is the significant differences in climatic preferences and thresholds for tourists' residing in diverse climate zones. Previous studies have found that among countries with similar climates (e.g. Morgan et al. 2000, Scott et al. 2008, Denstadli et al. 2011), and even within the same country (Credoc 2009), tourists climatic preferences vary. While such differences were not found among tourists from Canada, Germany, the UK and the USA, statistically significant differences were found between tourists originating from temperate and tropical climate regions. The results show that tropical residents have a slightly higher tolerance for certain climate conditions, accepting temperatures between 22 and 35°C, up to 5 h of rain and 100% cloud cover, compared to 23–34°C, up to 2 h of rain and 75% cloud cover for temperate residents. Both climate groups stated a light breeze and 25% cloud cover as ideal, but the tropical residents were more likely to prefer moderate wind speeds and up to 50% cloud cover. Tropical residents also prefer a slightly warmer temperature than temperate residents. Perhaps the temperate sample has a narrower range of preferred climate conditions for a beach holiday because of higher expectations that may result from travelling long distances south, investing a lot of time and money, to experience idealized Caribbean weather that is different from the temperate winter weather conditions experienced at home. Respondents originating from tropical regions are not only travelling much shorter distances, but most (96%) live in Caribbean countries and would be accustomed to, and be expecting, weather conditions that are similar to home. For example, tropical residents would be familiar with the frequent late afternoon rains that characterize many Caribbean islands, presumably increasing their tolerance for rain events. Tropical residents also preferred climate conditions that offer more cooling effects—increased cloud cover and higher wind speeds both reduce the thermal influence of the sun, allowing for warmer temperatures to be tolerated. Depending on tourists' climatic origins, preferences and thresholds for beach tourism can vary. There remains much scope to better understand this influence, with future research needed to examine preferences from additional climate zones, such as dry (arid and semiarid), tropical monsoon, boreal, and polar climates.

An important caveat with respect to comparing studies is the multiple ways tourists' have been asked about their climatic preference(s). For example, temperature preference has advanced from a list of predetermined temperature ranges (Morgan et al. 2000, Gomez-Martin 2006) to a single temperature (Scott et al. 2008, Moreno 2010) to circling a range of temperatures (Rutty & Scott 2010, Wirth 2010, present study). Also, Morgan et al. (2000) refer to optimal

temperatures in terms of skin temperature, not ambient temperature. As such, it can be difficult to make definitive statements on temperature similarities and differences between studies. Moreover, the literature is very limited with regards to unacceptable climatic thresholds for tourism, further compounding the difficulty of identifying generalizable thresholds at the present time. To further our understanding, continued research with a more standardized method to enable comparisons across studies is strongly recommended.

The results from this study also raise an important methodological consideration regarding context dependency. The unacceptably hot temperature for beach tourism was lower in all of the analyses performed (i.e. total Caribbean sample, by age, by climate region and by nationality) when compared to existing temperature threshold studies. Rutty & Scott (2010) and Wirth's (2010) *ex situ* studies were conducted at the end of the winter season, with the possibility that the sample perceived a warm/hot climate to be more desirable/acceptable (Gössling et al. 2012). Conversely, this study was conducted *in situ*, while respondents were experiencing warm temperatures (27–30°C), so that temperatures warmer than this may have been perceived as less desirable/unacceptable. Similarly in the Scott et al. (2008) study, the New Zealand sample preferred 25°C for a beach holiday and the Swedish sample preferred 29°C, with the former surveyed at the end of summer and the latter during mid-winter. As previously noted, surveying respondents *in situ* versus *ex situ* may also affect identified ideal and unacceptable climate conditions. The contextual influence of climatic conditions during the time of the survey has yet to be explored as a source of preference differences (Gössling et al. 2012).

It is also unclear to what degree tourists are able to accurately estimate temperatures and other weather parameters either *in situ* or *ex situ* (Gössling et al. 2012). This relates to both single parameters, such as temperature, and whether tourists can distinguish the influencing effect of other parameters, such as the cooling effect of wind and cloud cover on temperatures felt. Studies that examine the role of such complexities and evaluate the accuracy of tourists' perceived versus experienced preferences and thresholds are needed. While some studies have explored these questions (e.g. Oliveira & Andrade 2007, Lin 2009, Andrade et al. 2011), it has been exclusive to the human biometeorology and engineering literature and has yet to be examined in a tourism context.

6. CONCLUSIONS

Against the background of rapidly expanding literature on climate/climate change (Scott et al. 2012, Becken 2013), the present study sheds needed insight into the complexities of tourist climate preference and the implications of rating current/future climate resources for tourism. Overall, the research indicates that tourists' preferences and thresholds for beach holidays can differ for certain climate variables. This is primarily evident with respect to tourists' climatic zone of residence, even in a simplified framework that examines but one tourism segment. With weather and climate serving as a key travel motivator, influencing the timing of travel, destination(s) selected and overall trip satisfaction, advancing our understanding of tourists' climate needs is both a challenging and fundamental research area if accurate climate change assessments of tourism demand patterns (seasonally and geographically) are to be possible. The results from this study provide relevant insight into existing climate indices (e.g. Mieczkowski 1985, Morgan et al. 2000, de Freitas et al. 2008), demand models (e.g. Lise & Tol 2002, Hamilton et al. 2005, Bigano et al. 2006) and climate change assessments (e.g. Scott et al. 2004, Amelung et al. 2007, Moreno & Amelung 2009, Moore 2010), particularly with respect to claims that some tourism regions (e.g. Mediterranean and the Caribbean) will become seasonally 'too hot' for tourism (Rutty & Scott 2010, Scott et al. 2012). Important research gaps nonetheless remain, and the next steps should involve continued assessments of the similarities and differences across broader tourist market segments and tourism environments, as well as the integration of field work that aims to validate tourists' actual perceptions of, and behavioural responses to, weather and climate.

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