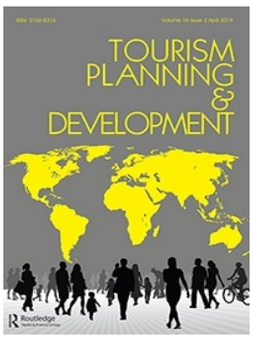

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Tourists' Preferences for Adaptation Measures to Build Climate Resilience at Coastal Destinations. Evidence from Cyprus

Carmelo J. León [a], Elias Giannakis [b], George Zittis [c], Despina Serghides[b], Yen E. Lam-González [a] and Carmen García [a]

[a]Institute of Tourism and Sustainable Economic Development, University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain; [b]Energy Environment and Water Research Center, The Cyprus Institute, Nicosia, Cyprus; [c]Climate and Atmosphere Research Center, The Cyprus Institute, Nicosia, Cyprus

ABSTRACT

The tourism sector is recognised as being highly vulnerable to climate change, and research is still considered scarce to support destinations to enhance resilience capacities. This study aims to analyse tourists' preferences for adaptation measures that can be implemented at coastal destinations to face climate risks. To this aim, 258 questionnaires were completed by tourists visiting Cyprus in the summer of 2019. Tourists were posed with hypothetical situations where several climate risks occur at the destination, and were asked to choose between alternative combinations of policies to counteract these impacts. Results indicate that the programs related to beach protection, heat waves amelioration, water supply and infectious diseases prevention are the most valued by tourists. The study provides recommendations aimed at being useful for all coastal destinations, highlighting the importance of climate-related preparedness and adaptive capacities to enhance the tourist experience value and promote economic impact.

KEYWORDS

Climate change; coastal tourism; adaptation; resilience; sustainability; tourism planning

1. Introduction

Coastal areas are particularly vulnerable to climate change and have already started experiencing its consequences. Besides, climate is a dominant attribute for many tourism segments as it conditions the planning of outdoor recreational activities at destinations (Atzori et al., 2018; Hall et al., 2015). As such, changes in the climate can affect coastal destinations' attractiveness, perceived value and image (Gössling et al., 2012; Nicholls & Cazenave, 2010).

Despite the increasing importance of the tourism industry in coastal areas, relatively few investigations have explored the consequences of climate change on tourism demand patterns (Arabadzhyan et al., 2020; Scott et al., 2012a). The most visited beach-based tourist destinations worldwide, such as the Mediterranean, owe their popularity to their pleasant climate conditions during summer. However, higher temperatures

CONTACT Elias Giannakis e.giannakis@cyi.ac.cy

could lead to a gradual decrease in tourism attractiveness during summer, caused by a higher frequency and intensity of heat waves and the decrease of thermal comfort of tourists (Lemesios et al., 2016). Other expected consequences of climate change impacting coastal destinations in Europe are sea-level rise, ocean acidification, precipitation patterns, thus leading to increased risks of beach surface loss, marine and terrestrial biodiversity degradation, forest fire events, among others (Arabadzhyan et al., 2020). In general, all these changes would affect the quality of the environmental services that support the tourist activities (Hoa et al., 2018), and thus the value of the recreational experience (Schliephack & Dickinson, 2017).

From the tourism perspective, the greater the quality of the management of the attributes which are under threat of modification by climate change, the less the risk of losing attractiveness and value there will be (Hoa et al., 2018). In this regard, a better understanding of tourists' feelings and opinions towards climate-related risks and related policies are also needed (Clemente et al., 2020). This is, tourists adapt their views and attitudes when protection measures against climate change are undertaken at destinations. While some tourists express negative sentiments towards the changed image of the tourist sites, others that are more sensitive, are willing to pay to reward initiatives to mitigate those risks (Mycoo & Chadwick, 2012). Such measures are obviously costly, but ignoring them may lead to much higher losses for destinations (Buzinde et al., 2010).

Thus, this paper aims to analyse tourists' preferences for adaptation measures that can be implemented at coastal destinations to mitigate climate change risks and build resilience capacities in the tourism industry. To do so, a set of discrete choice experiments was conducted, using combinations of adaptation programs and a given price per day from which tourists' willingness to pay to reward such actions was elicited. The model is empirically investigated for the island of Cyprus. This island is currently affected by anthropogenic climate change, mainly by significant increasing temperature trends and a manifestation of drier conditions (Ntoumos et al., 2020; Zittis, 2018). Besides, tourism has been a major engine of growth for the economy of Cyprus before the outbreak of the COVID-19 crisis. In the future, the region is projected to continue to warm faster than global rates (Giannakis et al., 2020). More prolonged droughts and severe heatwaves (Zittis et al., 2016, 2019), as well as, a rise in sea levels (Adloff et al., 2015) are also projected. Considering that these changes are anticipated to be more pronounced during the warm part of the year, the impact on coastal tourism will be significant, thus necessitating efficient climate change adaptation policies.

The choice scenarios built for the model include adaptation initiatives that are considered crucial to cope with very specific and critical risks of climate change for Cyprus, in the context of a wider spectrum of climate actions that may be implemented in this and other coastal regions in Europe. This study is therefore of great importance for tourism management, as it provides methods and evidence on the value tourists attach to adaptation policies, which can be useful in planning the sustainable development of coastal tourism in several destinations.

The paper is structured as follows. Next is a literature review section on the main climate change risks for coastal destinations, with a more detailed discussion of the factors intervening on tourists' perceptions and assessments of climate change impacts and related policies. The third section describes the model and the fieldwork. Section four is dedicated to present the results and finally, sections five and six discuss and conclude.

2. Literature review

The analysis of the relationships between climate change and tourist behaviour has been an important research challenge over the last two decades. Studies are still considered scarce, especially in regard to tourists' feelings towards climate variability and related policies (Arabadzhyan et al., 2020). This section summarises the literature on climate change impacts on coastal destinations with emphasis on tourists' assessment and behavioural response to climate change impacts and adaptation and mitigation efforts of destinations.

2.1. Climate change and tourist behaviour

According to several studies, European coastal and island destinations are mainly exposed to the following climate change impacts: (i) marine and terrestrial biodiversity degradation, (ii) beach reduction, (iii) increased forest fire events, (iv) more heat waves and drier conditions, (v) infectious diseases outbreaks, (vi) floods, and (vii) damages to coastal infrastructures and cultural heritage (Arabadzhyan et al., 2020). These impacts are expected to vary in both magnitude and timing from one coastal region to another, posing a challenge to the downscaled analysis of socio-economic implications (Giannakis & Bruggeman, 2017), and worsening current uncertainties with regard to tourist responses.

Overall, the literature suggests that tourists have the largest adaptive capacity within the tourism system because of their flexibility to replace destination, timing and type of holiday, even at a short notice (Gössling et al., 2012; Michailidou et al., 2016). Anticipate this behaviour is particularly important for destinations (Gössling & Hall, 2006; Gössling et al., 2012), to estimate the potential geographic and seasonal shifts in tourism demand caused by climate change (Sano et al., 2015). Similarly, in a climate change policy context, tourism planning will be more successful in so far it can anticipate tourists' choices and preferences (Lam-González et al., 2019).

In tourism literature, this type of analysis is usually undertaken by using discrete choice experiments, where individuals react or think about the influence of a climate change scenario or policy on their future trips and activities. The principal advantage of this method is that it allows researchers to simultaneously investigate tourists' preferences for various scenarios of a tourist product, thereby framing the choice context in a setting somewhat closely linked to a market situation. It is based on the theory of planned behaviour, assuming that the intention or willingness to engage in a particular behaviour constitutes the best direct predictor of that behaviour (Loomis, 1993).

Overall, the studies confirm that tourists realise the importance of well-developed climate risks management programmes at destinations (Bonnieux et al., 2006) and are willing to pay for risk prevention and carbon off-setting programs (Kountouris & Remoundou, 2011). The socio-demographic profile, travel careers, motivations, and the type of activities tourists usually undertake at destinations are considered the main determinants of their proactive behaviour (willingness to engage in a climate action) (Gössling et al., 2012; Wilkins et al., 2018). In this respect, the study of tourist behaviour in relation to beach nourishment, marine habitat preservation and restoration, and forest fires prevention have received the greatest attention in the literature (Arabadzhyan et al., 2020; Noble et al., 2014).

2.2. Biodiversity degradation

Climate change may indirectly pose a shift in biodiversity both in marine and land environments with severe consequences on the attractiveness of tourism destinations (Marshall et al., 2011; Uyarra et al., 2005). Specifically, the climate-related reef degradation and coral die-off can cause the loss of attractiveness for dive tourism with negative implications for the sustainability of the segment (Kragt et al., 2009). Coral reefs also protect beaches and coasts from erosion (Cuttler et al., 2018), while corals' destruction may trigger the succession of algae that may affect tourist demand (Nilsson & Gössling, 2013). Other species of marine and coastal habitat can also be at risk, e.g. shorebirds (Galbraith et al., 2002) and turtles (Poloczanska et al., 2009), while global warming may increase the jellyfish population and change the timing and length of their seasons as well as their distributions (Purcell, 2011), thus negatively affecting the attractiveness of several marine-based activities (Gössling et al., 2012).

At the same time, the impacts on tourist behaviour are very case-specific, which justify more empirical evidence. Some studies conclude that tourists are willing to pay a fee for coastal and marine conservation in the Caribean destinations (Schuhmann et al., 2019). Other studies carried out in the Caribbean islands conclude that 80% of tourists would not be willing to visit the islands for the same price in a scenario of coral bleaching as a result of increased sea temperatures (Uyarra et al., 2005). Meanwhile, other investigations demonstrate that tourists visiting the coastal region of Mu Ko Surin in Thailand were satisfied with the experience, although they perceive that corals are severely degraded (Cheablam et al., 2013).

Concerning the degradation of the land biodiversity, the lack of research suggests that everything that happens in the background (e.g. forests) have little importance for tourists visiting coastal areas. However, this line of investigation on the value of natural capital is highly demanded by practitioners and public bodies (Lam-González et al., 2021).

2.3. Coastal flooding and beach reduction

Sea-level rise is likely to have profound impacts on coastlines around the globe (Mycoo, 2014), resulting in more frequent coastal flooding (Kopp et al., 2015) and subsequently higher levels of coastal erosion that will alter beaches putting at risk the continuation of tourism activities (Buzinde et al., 2010; Leatherman, 2018).

Beach surface reduction has been negatively associated with the destination image in various locations (Schleupner, 2008; Uyarra et al., 2005). Tourists are generally unwilling to return to coastal destinations in the case of large modification/disappearance (Uyarra et al., 2005) but they claim to reconsider their choice if protection and nourishment of beaches are carried out (Atzori et al., 2018; Magnan et al., 2013).

Not surprisingly, numerous studies focus on estimating the willingness to pay for beach protection measures (Arabadzhyan et al., 2020). In France, Greece and Italy average visitors' willingness to pay for beach defence amounts to €0.5–1.49 per tourist per day (Koutrakis et al., 2011). Overall, the results show that the willingness to pay for the same type of policy differs across destinations, which justify more empirical evidence (Alves et al., 2015; Birdir et al., 2013; Rodella et al., 2019). More empirical works are also justified due to that existing case studies are not originally designed to make their

willingness to pay results transferable. They do not specify in which climate change scenario are being forecasted; moreover, the economic impacts are not based on a homogenous measurement unit (e.g. 1 metre of beach restoration).

Further research is thus required to create a homogenous basis of knowledge aimed at enabling a more straightforward comparability of results, with useful implications for decision-making at destinations. This study addresses this gap by designing more specific policy scenarios that can be used as a reference beyond the case study.

2.4. Forest fires

Another indirect environmental effect of climate change is the increase of wildfire risk through warmer temperatures and drier conditions that lengthen the wildfire season. However, tourists' response to fires is uncertain. Otrachshenko and Nunes (2019) reveal that burned areas have a negative impact on the number of tourist arrivals. However, while the immediate effects of fires on tourism demand can be negative, the long-run tourist behaviour may not alter (Hystad & Keller, 2008). In other cases, where wildfires happen almost on an annual basis (e.g. Florida), it has been shown that tourists are not at all discouraged by the wildfire risk factor (Thapa et al., 2013).

Although studies affirm that tourists do value well-developed forest management programs (Bonnieux et al., 2006) and are willing to pay for measures to minimise fire damages at tourist destinations (Kountouris & Remoundou, 2011), academic attention focus on the impacts on tourist arrivals, renovation and insurance costs (Arabadzhyan et al., 2020), and very little attention is paid to estimate economic benefits derived from policy actions.

2.5. Heat waves and drier conditions

Abundant literature provides evidence of tourism being a highly weather-sensitive activity (Becken, 2010; Scott et al., 2008). Estimates of climate suitability for the tourism sector indicate that the Mediterranean region will become too hot in summer with implications to tourism seasonality and geography (Amelung et al., 2007). Additionally, tourists' comfort may be indirectly affected through a decrease in water availability, itself also a consequence of extra-demand of water generated by tourism (Gómez-Martín et al., 2014), joint to changes in precipitation patterns (Martinez-Ibarra, 2015; Philandras et al., 2011).

In this area, academic attention focuses on the assessment of the quality of climate for different types of tourist activities and propose ideal climate indices for both tourists and industry to select the best moment, activities and place for planning holidays (Lam-González et al., 2019). For the Mediterranean region, one of the main conclusions is that destinations will not only be too hot to be visited in summer, but also more pleasant in the shoulder season. This could be positive from the resource management and biodiversity point of view, while social and economic effects are likely to be detrimental as the tourism offer and demand may be modified. Nevertheless, the study of economic impacts derived from these changes have received scant attention in the literature (Arabadzhyan et al., 2020).

Other studies focus on analysing the impact of increased temperatures on emergency rescue admissions and the willingness to pay of tourists to avoid the risk of

health effects. The main conclusions are that the value attached to health security via heat stress prevention is higher than for mitigation of sea-level rise and biodiversity loss (León et al., 2014).

2.6. Infectious diseases

Climate change may also cause changes in the spatial and temporal distribution of vectors and pathogens (Kovats et al., 2001; Proestos et al., 2015), posing tourists at increasing disease risks (Gómez-Martín et al., 2014; Mather et al., 2005). Tourists are a particularly vulnerable population subgroup even if they are initially in good health because the disease is often underdiagnosed in their home countries (Lau et al., 2010). Studies have shown that the susceptibility of destinations to outbreaks of vector-borne diseases such as malaria and dengue would have long-lived impacts on their attractiveness (Hall, 2006; Scott, 2006).

Few studies focus on anticipating how tourism demand is affected by vector-borne infectious disease outbreaks (Arabadzhyan et al., 2020), while the 2020 outbreak of COVID-19 shows that the impact of this serious disease is highly disruptive for tourism. In this context, the progress of destinations in regard to health security and prevention is likely to modify tourists' preferences also in the medium-long term, which is an under-investigated area.

2.7. Infrastructure and facilities

The increasing climate-related risks from physical exposure to sea-level rise, extreme weather events and erosion can cause significant damages to coastal infrastructures such as transport and recreation facilities, and on cultural heritage infrastructure such as monuments and architecture (Hall et al., 2016). These effects can be even more pronounced if the area is characterised by a high degree of competition, which is the case of coastal areas (Antonioli et al., 2017; Sagoe-Addy & Addo, 2013; Scott et al., 2012b). Such damages are found to have a negative effect on the destination image, especially for tourists who have never visited the destination before (Pearlman & Melnik, 2008). As a result, increased conservation-restoration works are carried out at destinations, which has some value for tourists (Grøntoft, 2017).

According to Arabadzhyan et al. (2020), the value tourists give to the conservation and restoration of infrastructures and cultural heritage is very case-specific, and is more determined by tourists' income and motivations than by considerations on the attributes' improvement. Nevertheless, tourists' preferences and willingness to pay to reward such measures are of great usefulness as an indicator of the cost-efficiency of conservation programs and the enhancement of destination image.

3. Methodology

To analyse tourists' preferences for adaptation measures, a choice model was applied. The model focused on tourists' willingness to pay for several policies that can be implemented at the visited destination to face climate change risks and build climate resilience, when

the purpose of their trip is mainly for carrying out maritime or other tourist activities in coastal areas. The present study provides insights for practitioners and academics, by bringing new empirical evidence on how destinations' initiatives to face climate risks could modify the value tourists give to these tourist sites. Moreover, it explores in which of the climate change risks tourists are more sensitive. In other words, planning the sustainability of tourism in a climate change context implies the study of tourists' preferences in relation to a wide spectrum of climate actions that can be undertaken at destinations.

3.1. The model

Discrete choice experiments consist of several choice sets, each containing a set of mutually exclusive hypothetical alternatives between which respondents are asked to choose their preferred one. Alternatives are defined by a set of attributes, each attribute taking one or more levels (Hoyos, 2010). In addition, a baseline alternative reflecting a "do nothing" situation, (or "no policy" in this case), is also included following Hanley et al. (2001). A common theoretical framework in this context is the random utility theory. It assumes that the preferences of an individual among the available alternatives can be described by a utility function where individuals choose the alternative with the highest utility. Therefore, each choice implies trade-offs between the levels of the attributes included in a choice set.

In this study, choice attributes are conceptualised as adaptation measures that can be implemented at destinations to mitigate climate risks. The model proposes that the sociodemographic profile, trip characteristics and the opinion tourists have on the destination image determine their choice. This model is an adaptation of the model estimated by Lee et al. (2019).

Mathematically, the model is represented by a linear utility equation:

$$U_{ijt} = \beta_0 ASC_j + \beta_1 x_{ij1t} + \beta_2 x_{ij2t} + \beta_3 x_{ij3t} + \beta_4 x_{ij4t} + \beta_5 x_{ij5t} + \beta_6 x_{ij6t} + \beta_7 x_{ij7t} + \beta_8 x_{ij8t} + \beta_9 x_{ij9t} + \delta w_{it} + \varepsilon_{ijt}$$

where U_{ijt} represents the alternative chosen, ASC_j is the alternative specific constant, which takes value 1 if the option "no policy" is chosen, x's represents the attributes of each choice set, w's denotes a vector of individuals' sociodemographic characteristics, trip characteristics, and destination image, and β are the parameters of interest to be estimated in this case.

In summary, the utility that a tourist i receives from choosing each alternative j in a choice scenario t is explained by a set of explanatory variables. These variables include the attributes of the choice alternatives that vary across alternatives and individuals x_{ijt}, and a set of individuals' characteristics that vary across individuals but not across the choice sets w_{it}, and an unknown random component ε_{ijt}.

The resulting choices are finally analysed to measure the contribution of each attribute level to the overall utility of tourists. Moreover, when the price is included as another attribute, the marginal utility can easily be converted into willingness to pay estimates for changes in the attribute (León et al., 2015). Further, discrete choice experiments allow the avoidance of the typically found "scale perception bias" when using Likert scales to elicit tourist preferences (Araña & León, 2012, 2013).

3.2. Study site

The travel and tourism industry is the largest commercial sector of Cyprus, which contributed 21.9% to the country's GDP in 2019. Europe is the traditional tourist market for Cyprus, with the United Kingdom being the most important source of tourism to the island, followed by Russia, Israel and Germany (Cystat, 2020). The majority of tourists stayed in coastal areas of the island, such as Pafos and Polis, Ayia Napa, Paralimni, Larnaka, and Lemesos.

A recent study showed that climate change impacts will result in the reduction of tourists and tourism revenues in Cyprus by 32.2% and 30.3% by 2100, respectively (Magnan et al., 2013). According to estimations, under a climate change high emissions scenario, compatible with RCP8.5 (IPCC), the future of tourism for the island may be affected mainly by the sea level rise and beach reduction, increased forest fire danger, and prolonged droughts and heat waves.

- At the end of the century the sea level is projected to increase by 59 cm leading to a beach surface loss of about ~54%, depending on the beach (Adloff et al., 2015; Mariano et al., 2021).
- Currently, the risk of forest fires in Cyprus is considered the highest among the Mediterranean islands. Latest available simulations show that the increase in fire danger exceeds 20% by the end of the century. This means that the majority of the island will be under *high* and *very high* fire danger (EFFIS fire danger category classification) (Ntoumos et al., 2020).
- Humidity index values greater than 35°C are often considered as an indicator of heat stress for tourists. The index above 35°C leads to discomfort and imminent danger for both, tourists and residents, for the majority of outdoor activities. In the present climate, the days with discomfort in Cyprus cover almost three months per year, while the respective number of days at the end of the century will correspond to more than five months, if no actions are implemented (Zittis et al., 2016). Exceptional heatwaves observed early in the century or thus far unprecedented events could become the norm by the end of the century (Zittis et al., 2021).
- The Standardised Precipitation Evaporation Index (SPEI) is often utilised as an indicator of drought, as it is a combination of both precipitation and potential evapotranspiration. Thus, SPEI also captures the main impact of increased temperatures on water demand. Under the business-as-usual scenario (RCP 8.5) the whole island is expected to be severely affected by meteorological droughts, exceeding the "very dry" conditions threshold (Gutiérrez et al., 2020; Zittis et al., 2020).

Considering that these changes are anticipated to be more pronounced during the warm part of the year, the impact on the coastal tourism will be significant. Consequently, there is a concern within the tourism policy to accelerate the implementation of several measures. This is enhanced because of the relevance of the coastal attributes, the weather, sun and sea in the preferences of tourist demand, which constitutes a remarkable strength for the Cyprus island.

3.3. The empirical model

The first step of the research consisted of designing the choice scenarios. As explained before, choice attributes are conceptualised as the set of adaptation policies that can be implemented at the destination to mitigate potential climate risks that mostly affect coastal tourism activities.

Firstly, to obtain the items to be elicited by tourists, a consultation process was implemented, namely Local Working Group. The main aim of this qualitative stage of the study was to define the climate change risks and the related policies that, according to experts, policy makers and tourism managers in Cyprus, are a priority concern for the island, given their high viability of application, and their relevance to enhance the tourist experience value (Prebensen et al., 2014). Two meetings were organised in 2018 and 2019, which saw the participation of more than ten high-level representatives of the tourism, academy and other coastal sectors at the regional level (fisheries, maritime transport, energy, climate).

This work was supported by the European Union's Horizon 2020 research and innovation program, through the action entitled "Soclimpact project". Project partners in Cyprus received training and guidelines to moderate the discussion. Based on the analysis of several climate change impact chains (Arabadzhyan et al., 2020), participants identified the most significant risks for Cyprus, considering four main aspects; (i) climate hazards: current situation and evidence of impacts, (ii) available climatic and risk projections, (iii) disrupting capacity for coastal tourism, and (iv) empirical evidence of impacts on tourist behaviour and the tourism sector. The process ended on March 2019, stressing that there are nine specific measurable climate risks that can potentially affect the sustainability of tourism in the island:

(1) Beaches are largely reduced due to sea-level rise and erosion, affecting the destination image and attractiveness
(2) Wildfires occur more often due to increased temperatures, and changes in precipitation and humidex patterns, disrupting the tourist activities
(3) Temperature becomes uncomfortably hot for coastal tourism activities (increased frequency of heat waves)
(4) Water shortages and scarcity are more often, facing droughts (due to changes in precipitation-evaporation patterns and the increased water demand).
(5) Coastal infrastructures are damaged due to coastal erosion, storms and heat waves
(6) Marine wildlife is largely reduced affecting the destination attractiveness and image (increased sea temperature and acidification)
(7) Terrestrial wildlife is largely reduced affecting the destination attractiveness and image (heat waves and drier conditions)
(8) High suitability for some species of mosquitos that manage to survive under the new climatic conditions, which transport infectious diseases such as malaria and dengue.
(9) Traditionally built cultural assets are damaged by extreme events, and cultural heritage is affected by sea-level rise and storms while floods and landslides can also have devastating impacts.

All the statements represent severe risks caused by climate change, corresponding to a high emissions scenario (business-as-usual RCP8.5). Some of these risks are actually

projected with very negative evolution for Cyprus, while others show a low probability of occurrence in the country. However, they were also considered important for this study as they are common concerns for all European island and coastal destinations. This way the model shows a more complex picture of tourists' preferences with useful implications for decision making at several coastal destinations.

According to stakeholders' views and opinions, there are nine adaptation measures of mandatory application/improvement in the medium-long term, to ensure a more resilient tourism industry in the context of the abovementioned climate risks. Table 1 presents a description of the chosen adaptation measures, which are, in fact, the variables utilised in the choice model.

It is important to note that stakeholders in Cyprus received a support material, consisted of a list of 24 possible adaptation measures that could be implemented at any destination to cope with climate change impacts in coastal areas. These measures were extracted from the study of Suckall et al. (2018) that considered three main objectives for climate resilience: (i) vulnerability reduction; (ii) disaster risk reduction; (iii) social-ecological resilience.

In order to facilitate the analysis of tourists' preferences for these programs, the choice scenario only considered two levels of each policy measure. "No policy" level implies that

Table 1. Description of attributes considered in the choice experiment.

Attributes/policy	Description	Levels	Variable in the model
Price	Price per day per person. Extra payment per day of stay above current expenses, to reward a specific policy scenario.	0€ (no policy) 1 € 3 € 5 € 7 €	Continuous
Beaches protection	This involves building seawalls and breakwaters, nourishment of sandy beaches when needed and building compensatory artificial beaches across coastal areas.	No Policy Policy	Dummy
Forest fires prevention	This policy consists of improving forest management to reduce combustibility, increasing firefighting technical and human resources, and investing more in post-fires landscape and habitats restoration.	No Policy Policy	Dummy
Heat waves amelioration	This policy consists of early warning, proper information for vulnerable groups, air conditioning in public indoor and outdoor places, increasing green and watered areas and provision of proper medical care for heat-related diseases.	No Policy Policy	Dummy
Water supply	This includes desalination plants and water facilities reinforcement to guarantee fresh water supply.	No Policy Policy	Dummy
Coastal infrastructures protection	This policy will provide proper information on prevention, and emergency facilities against disasters; reinforce coastal structures; and facilitate access to alternative safe places and attractions.	No Policy Policy	Dummy
Marine habitats restoration	This involves removing death seagrass from the beaches sand, offering marine biodiversity-based facilities and providing accurate information on best places for each marine activity.	No Policy Policy	Dummy
Land habitats restoration	This involves reforestation and landscape restoration, enhancing protected areas network and encouraging botanic gardens and wildlife show places.	No Policy Policy	Dummy
Infectious diseases prevention	This policy consists of proper information and advisement to face outbreaks, fumigation of mosquitoes' prone areas, and emergency medical care plans.	No Policy Policy	Dummy
Cultural heritage protection	This policy consists of reinforcing protection of exposed heritage and moving the endangered cultural assets to alternative safe locations.	No Policy Policy	Dummy

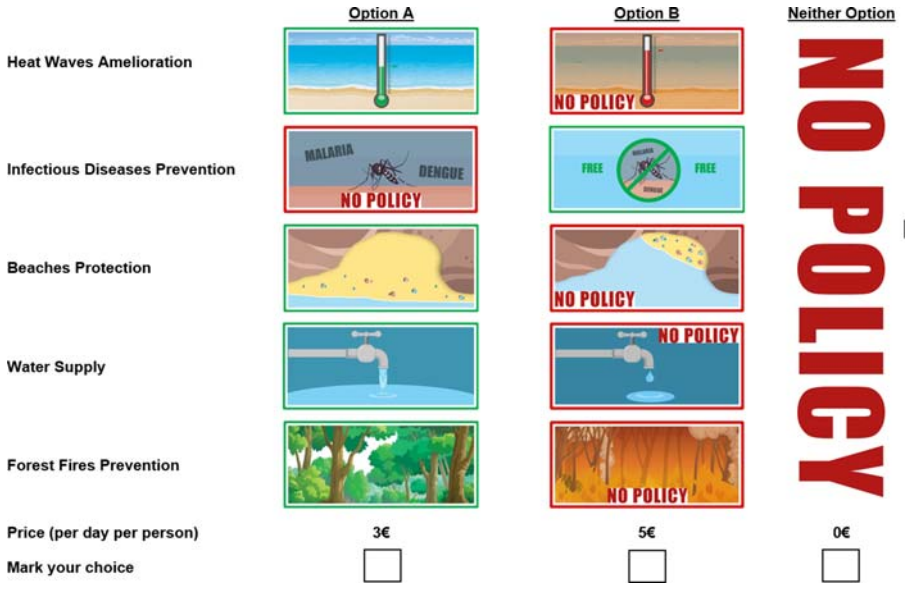

Figure 1. Example of choice set.

the destination will experience a future evolution of the risks according to current projections, under a high emissions scenario (RCP8.5 scenario). In regard to the alternative level, it was assumed that the implementation of the proposed policy is enough effective to ensure that the tourism activity will not be significantly affected by climate change, thus resilient capacities are ensured. In reality, the stakeholders' proposal of interventions is much more complicated than the policy alternatives shown to tourists in the choice cards.

Finally, a total of 18 attribute levels were included in the choice analysis (considering nine policy measures and two levels each). By applying a Bayesian efficient design, 12 choices sets were randomly obtained. To do so, the statistical program Ngene was used. Each choice set contained two scenarios which combined five attributes level, plus the no-policy option or status quo scenario.

The 12 choice sets were transformed into cards, with images and icons that facilitate the interpretation. Figure 1 presents an example of one choice set. Respondents choose only one scenario in each choice card, considering they were the only options available.

Each individual randomly answered 6 choice cards. Before proceeding to analyse the choice cards, a detailed description of the climate risks and the proposed measures were introduced to the subjects. At the same time, tourists should assume that they would have to pay a fee to reward the set of policies chosen, or select the "no policy" option (at price 0 €), which means that the actual price of their holidays would not change. They were also explained what this "no policy" option means.

3.4. The survey

The questionnaire was the main research instrument. The questionnaire was structured of five sections. The first section asked about the demographic characteristics/profile of

tourists (gender, age, education, employment, monthly income and country of residence). Questionnaires were anonymous as no personal information was collected. The second group of questions focused on the trip characteristics (organisation, travel party and composition, type of accommodation, information sources, total expenditure).

The third group of questions aimed to characterise tourists according to the importance they attach to environmental attributes for travelling decisions in general. The importance was measured using a Likert scale of 7 points; where 1 = not important at all; 7 = very important. Some examples of the 13 environmental attributes evaluated by tourists in this section are; (i) lack of wildfires, (ii) comfortable air temperatures, (iii) well preserved flora and fauna, etc. These attributes were presented as positive features in general, while the majority refer to the same work areas of the climate change risks and adaptation measures evaluated by tourists afterwards.

The fourth section was composed of three questions. The first two elicited tourists' perceptions about the island's image and the conservation status of the natural environment. They were evaluated by tourists using a Likert scale of seven points (1 = very negative image; 7 = very positive image). Additionally, they were asked about the affective image of the island by using a semantic bipolar scale (i.e. pleasant/unpleasant destination, etc). This information was important to understand whether the feelings and opinion about the island determine tourists' preferences for adaptation programmes.

The fifth and final section was concerned with the analysis of tourists' aversion to climate change risks. The question considered four possible answers ranging from ¨Definitely, I would NOT change the destination¨ to ¨Definitely I WOULD change to an alternative destination¨. Here, tourists were posed with hypothetical scenarios in which the same holidays were affected by climate risks. They should decide whether to stay in this same holiday in Cyprus or change to an alternative destination, considering each risk separately. Therefore, tourists' willingness to change destination due to a specific risk may be considered as a measure of their high aversion to that risk. In this question, the risks presented to the tourists refer to the same aspects shown in section 3.3. Finally, this survey section also included the economic valuation of adaptation policies for Cyprus (choice cards). Two different questionnaires were prepared, each containing 6 choice cards, while the rest of the questions were same.

Prior to the surveying phase, a focus group was conducted with a small representation of tourists in the island. The meeting took place at a hotel in Nicosia on April 2019 and lasted for about two-and-a-half hours. A total of 11 tourists participated in the meeting. Nine of them were female and most of them were aged between 30 and 60 years old. Tourists' origin was from Italy (4), France (2), UK (2), Germany (1), Greece (1), Mozambique (1). The purpose was to ensure that the questions were going to be clearly understood by the respondents. Once the questionnaire was pre-tested and the pertinent corrections made to the items that raised comprehension difficulties, the interviews were conducted.

The most relevant contribution of this focus group meeting was to better understand how to present the climate change risks and related measures in the choice experiment. A graphical simplification of the description of the risks and the adaptation measures was required, joint to the explanation on how the risks could affect the tourists' holidays. For example, for the risk ¨*Temperature becomes uncomfortably hot for coastal tourism activities*¨, the tourist was briefly explained the future situation projected for the island.

Given the fact that the surveys were implemented in the summer season, tourists should consider that in a future scenario, their next holiday trip would be strongly affected by temperatures above 35°C. This means that if their stay will be 8 nights, more than 60% of the time spent in the destination would be under extreme temperatures. At the same time, tourists could also reflect about the potential measures that the destination could implement. First, they would be better informed about the new climatology of this season, and also climatisation in public indoor and outdoor places would increase, by the provision of green and watered areas. Finally, proper medical care for heat-related diseases would be in place.

3.5. Data collection and analysis

The target population of this study was defined as tourists visiting Cyprus mainly motivated by doing recreational activities in the coastal areas. The questionnaire was administered on-site along the coasts of the major tourist areas in Limassol, Larnaca and Ammochostos. The fieldwork was carried out between July and August 2019. The interviewers received training sessions prior to the fieldwork to ensure that the communication of the questions to the respondent was clear and accurate.

Participants in this research were randomly selected from the total population of tourists pursuing different activities in the selected beaches. Specifically, a convenience sampling technique was employed (Atzori et al., 2018). The survey was conducted at both weekdays and weekend days to capture different tourist groups. The percentage of tourists approached who did not agree to participate was around 20%. A filtering process was done in three phases. First, only people over 18 years old were interviewed. Second, tourists should have stayed at least one night near the coast of the island. Finally, they should have completed at least half of their stay at the moment of being interviewed.

The survey was implemented through face-to-face interviews, of approximately 20–25 minutes. At the beginning of the interview, a brief introduction was given to the tourist about the context of the study. First, a definition of climate change was provided to respondents. Second, respondents were presented with a description of the nine major potential climate change risks for the destination they were visiting, by using visual images. Third, the nine adaptation policies were explained to respondents. Finally, a detailed explanation of the price was given (Table 1). The final sample consisted of 258 tourists.

After coding the answers to the questionnaires, the frequency analysis was utilised to characterise the profile of respondents and the trip made to Cyprus, and also to analyse tourists' aversion to climate change risks. Data related to the importance attached by tourists to environmental aspects for travelling, the state of conservation and the perceived image of Cyprus was analysed by using descriptive analysis too. The econometric model mixed logit was used to analyse data resulting from the choice experiments. Since each tourist was asked to answer six choice questions, the number of potential choice observation is 1,548. After screening for protest responses and missing values the number of observations available for the mixed logit regression is 1,368.

Mixed logit is a highly flexible model that can approximate any random utility model (McFadden & Train, 2000). It obviates the three limitations of standard logit by allowing for random taste variation, unrestricted substitution patterns, and correlation in unobserved

factors over time (Train, 2003). All calculations were performed in STATA 14 econometric software (StataCorp. 2014).

4. Results

4.1. Socio-demographics/profile of respondents

Table 2 presents the demographic characteristics of tourists interviewed. It shows a balanced sample in terms of gender, while the average age of the respondents is 36 years old. The average size of the household is 2.2 members. The majority of respondents have a bachelor (62%) or Master/Doctorate degree (24%), while with respect to their employment status, most of them are employees for a wage (62%). Around one-third of the respondents earn less than 1,200€/month, while 35% earn around 1,201–2,000 €/month. The tourists interviewed come from 37 countries mostly from UK (24%), Greece (17%) and Russia (9%). Overall, the sample has great similarity to the total population of tourists visiting the island.

4.2. Trip characteristics

The majority of the respondents were visiting Cyprus for the first time (72%); around 11% and 10% of the tourists had visited Cyprus for a second and third time, respectively. The most common accommodation is a hotel (47%) and most of the tourists travel with their

Table 2. Tourists demographic characteristics.

Variable ($N = 258$)	Percentage
Gender	
Male	49.6
Female	50.4
Age	
Less than 35 years old	60.1
35–55 years old	24.8
More than 55 years old	15.1
Education	
Secondary school	4.7
Technical/vocational training	9.3
Bachelor degree	62.0
Master or Doctorate degree	24.0
Employment status	
Employee	62.4
Self-employed	12.0
Unemployed	1.6
Student	15.5
Retired	8.5
Individual net monthly income	
Less than 1,200€	32.9
1,201–2,000€	35.3
2,001–2,800€	22.5
More than 2,801€	9.3
Country of residence	
United Kingdom	24.0
Greece	17.1
Russia	8.5
Germany	7.8
Italy	4.7

partner (36%). The average number of people coming to the trip is 2.7 persons, and on average, tourists stay about one week in the island (7.4 days). The great majority of respondents organised the trip themselves (87%), while they mainly knew about Cyprus through friends and relatives (44%) and the internet (43%) (Table 3).

On average, tourists spent in total 919€ per person on their trip; around 275€ per person is spent on food and beverages and 271€ per person is spent on their plane ticket (Table 4). According to the official national tourism statistics, tourists in Cyprus for 2019 spent 744.5€ per person per visit (Cystat, 2020).

4.3. Importance of environmental attributes for travelling

Figure 2 presents the results of the importance of environmental attributes rated by tourists for their travelling decisions. The lack of infectious diseases is the top-ranked attribute

Table 3. Trip characteristics.

Variable ($N = 258$)	Percentage
Type of accommodation	
Hotel	46.5
Family/friends' house	31.0
Apartment	14.7
Rural accommodation	5.8
Hostel	1.9
Number of people coming to the trip	
1	14.0
2	41.9
3	20.2
4	15.9
More than 4	8.1
Average nights spent	7.4
Travelling with	
Alone	13.6
With partner	35.7
With children	19.8
With other relatives	5.8
With friends/work mates	25.2
Organisation of the trip	
Organise it myself	86.8
Travel agency/tour operator	13.2
Knowledge about Cyprus[a]	
Internet	43.4
Friends and relatives	43.8
Visited Cyprus before	21.3
Travel agency/tour operator	12.0
Advertisement on TV/radio/newspapers	4.3

[a]Tourists could select more than one option; percentages are expressed compared to the total number of tourists, $N = 258$.

Table 4. Average spending during the trip.

Tourist expenditure categories	Mean value (€)	SD value (€)
Flight/transport to Cyprus	270.9	149.1
Accommodation	178.2	172.8
Transport (in the island)	106.9	80.6
Food and drinks	274.9	135.7
Tours/excursions	52.5	64.0
Other expenses	132.2	74.4
Total spending	919.0	423.2

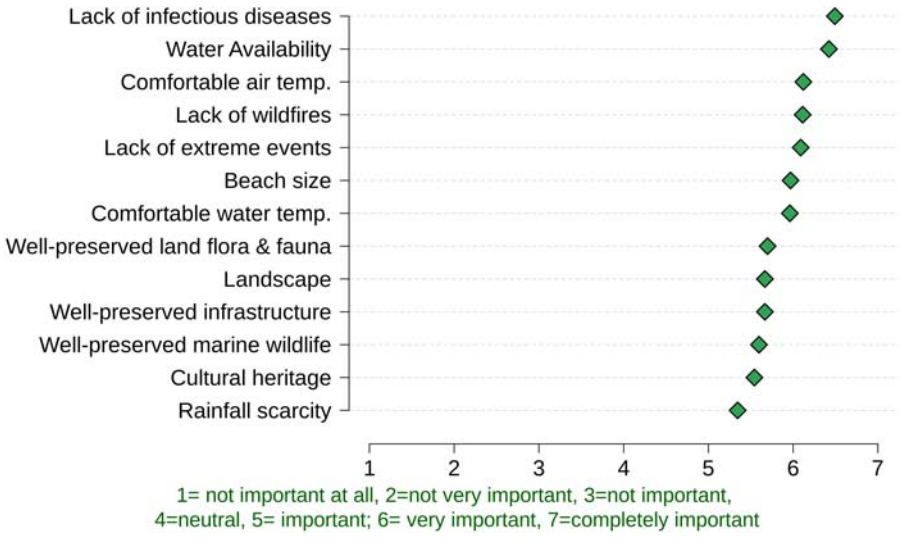

Figure 2. Importance of environmental attributes for travelling decisions in general.

by the respondents; around 62% of respondents perceive it as completely important, 27% as very important and 10% as important.

Overall, data reveal that those attributes with the potential to lead health risks (infectious disease, water, wildfires and temperature) have been rated with the highest importance on average.

4.4. Perception of Cyprus destination

The majority of the respondents (84%) have a very positive or quite positive perception of Cyprus. Similar positive perceptions are reported for the affective image of the island, e.g. 89% of the respondents consider Cyprus as a very pleasant or quite pleasant destination. Similarly, the majority of tourists rate the state of conservation of the natural environment in Cyprus as well preserved (42%). Results are shown in Figure 3.

4.5. Risk aversion and valuation of adaptation policies

Regarding tourists' behavioural responses to potential climate risks in Cyprus, data confirms that those risks (infectious disease, water scarcity, wildfires, and extreme temperatures) with potential impact on health security generate the greatest aversion (the majority of tourists do not want to stay in Cyprus if these risks are likely to occur). Besides, 85% of tourists stated that they would change to an alternative destination if Cyprus was exposed to beach surface losses due to climate change (Figure 4). On the contrary, more than 60% of tourists stated that they would stay in Cyprus if the cultural heritage and marine biodiversity (including coral reefs) is threatened by climate change impacts. According to these results, it can be anticipated that tourists may be willing to pay more for those policies that are related to the risks to which they are more averse than for the rest.

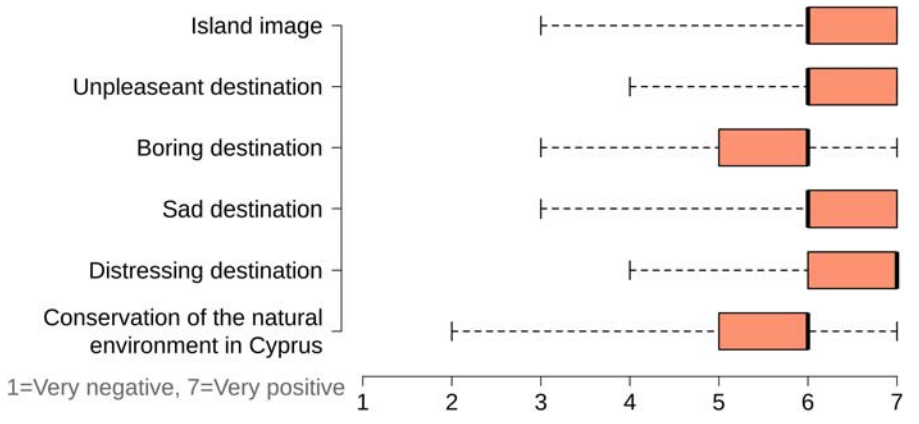

Figure 3. Tourists' perceptions about Cyprus image, affective image and status of conservation of the natural environment.

The results of the mixed logit regression models are presented in Table 5. Model in column (1) considers only the policy attributes as explanatory variables, while column (2) and final result utilised, incorporates the individual heterogeneity based on socioeconomic or trip behaviour characteristics of the tourists. A positive and significant coefficient indicates that the presence of a specific policy measure increases the likelihood of choosing the choice alternative containing that policy attribute. Significant standard error coefficients (SD) indicate the presence of unobserved heterogeneity in tourists' preferences across the sample.

The model allows to estimate the willingness to pay for a specific adaptation policy attribute keeping the other attributes constant. The results indicate that the gender

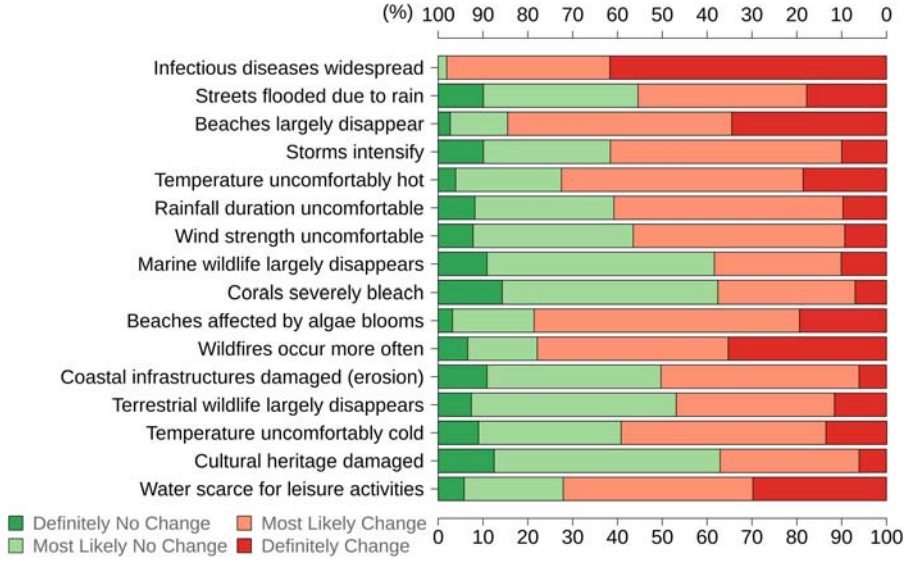

Figure 4. Change of travelling decisions under climate change impacts in Cyprus.

Table 5. Mixed logit regression estimates and willingness to pay (WTP) for climate change adaptation policies in Cyprus.

	(1)	(2)	WTP (€)
Beaches protection	1.834***	1.94***	**10.90**
	(0.19)	(0.21)	
Forest fires prevention	0.724***	0.796***	**4.47**
	(0.24)	(0.26)	
Heat waves amelioration	1.419***	1.529***	**8.59**
	(0.15)	(0.17)	
Water supply	1.440***	1.387***	**7.79**
	(0.26)	(0.27)	
Coastal infrastructures protection	0.629***	0.698***	**3.92**
	(0.20)	(0.21)	
Marine habitats restoration	0.975***	1.055***	**5.93**
	(0.22)	(0.24)	
Land habitats restoration	0.450*	0.489*	**2.75**
	(0.26)	(0.28)	
Infectious diseases prevention	1.066***	1.227***	**6.90**
	(0.24)	(0.27)	
Cultural heritage protection	0.386	0.464*	**2.61**
	(0.27)	(0.28)	
Price	−0.176***	−0.178***	
	(0.02)	(0.03)	
Alternative-specific constant (ASC)	0.724*	2.830	
	(0.39)	(1.81)	
Male		−0.685**	
		(0.30)	
Master degree		2.157***	
		(0.77)	
No. nights		−0.120***	
		(0.04)	
Conservation of the natural environment		0.241**	
		(0.13)	
Island Image		0.391**	
		(0.17)	
SD			
Heat waves amelioration	1.120***	1.181***	
	(0.16)	(0.16)	
Infectious diseases prevention	1.821***	1.911***	
	(0.19)	(0.20)	
Beaches protection	1.403***	1.577***	
	(0.15)	(0.20)	
Water supply	1.644***	1.537***	
	(0.28)	(0.26)	
Number of choice observations	1,368	1,368	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

and educational level of tourists determine their willingness to pay. Besides, the number of nights spent on the island, and the opinion about the image and conservation of the environment were also found to have a direct positive relation to willingness to pay. The rest of the variables were not significant. This means, for example, that the monthly income, the nationality of the tourist and the affective feelings towards the destination (affective image) do not influence the tourists' preferences for policy scenarios.

The highest ranked policy by tourists refers to beach protection. Tourists will be willing to pay up to 10.9€ per day of stay in Cyprus for this policy. In addition, policies related to heat waves amelioration (8.6€/day), water supply (7.8€/day) and infectious diseases protection (6.9€/day) are also of the most valued ones by tourists.

On the contrary, policies related to cultural heritage protection (2.61€/day) and land habitats restoration (2.75€/day) are the least valued ones by the respondents. In relative terms, the results suggest that the image and perceived value of Cyprus island are enhanced when all protection, prevention and response measures are in place, being the more positive impacts led by those measures addressing extreme disruptive events affecting health and security, from the perception of tourists.

5. Discussion

Cyprus is expected to experience adverse climate change effects compared to other regions. The predicting warming and drying of the island will have major consequences for coastal tourism. An on-site questionnaire survey was conducted on the coasts of the major tourist areas in Cyprus to reveal tourists' aversion to climate change risks and preferences for adaptation policies. These risks include events that emerge rapidly with little warning, such as infectious diseases and forest fires or slowly such as beach surface loss. The findings support and contrast previous empirical evidence, and also reveal new insights that represent a more holistic approach in the analysis of tourists' behavioural responses to climate change-related policies in the context of coastal tourism.

Most of the tourists who visited Cyprus stated that they would choose a different destination in a hypothetical scenario in which infectious diseases become more widespread on the island, as well as if beaches are largely reduced and affected by algae blooms. This supports previous evidence in other regions. Similar findings are reported for Florida, USA, where the majority of tourists responded that they would choose a different destination in a scenario of widespread tropical diseases such as Dengue or Zika and beach disappearance (Atzori et al., 2018). Tourists in Studland, a beach destination on the south coast of England, reported that less sand and reduced access to beaches would have the greatest effects on visitation (Schliephack & Dickinson, 2017). In Australia, empirical studies show that beach erosion scenarios will cause the drop of tourism revenues in a range between $20-$56 million per annum (Raybould et al., 2013).

A large share of the surveyed tourists in Cyprus (73%) indicated that if the temperature becomes uncomfortably hot, they would change the destination. This contrasts with evidence of Lemesios et al. (2016) that concluded that the warming projected for Cyprus will not adversely affect the island's beach tourism in the distant future (2071-2100). This contradiction was explained in the study of Moreno (2010), concluding that tourists will still travel to the Mediterranean coastal regions under warmer conditions this century, even if their preferred climatic conditions were available in Northern Europe. As tourists not always do what they say, their high aversion to be exposed to extremely hot conditions need to be considered as a possible future scenario of tourism for Cyprus.

In other words, warmer conditions may cause seasonal shifts in tourism demand for this destination and this should be a priority concern for the tourism policy. In this regard, destination managers may work in two directions; (i) to offer a greater combination of tourist products and services (i.e indoor, mountain, etc.) that complement beach-based activities, in quality and quantity levels that meet the expectations of the actual tourism demand in the warmest season (more extensive use of the destination by sea, sun and sand tourists), and (ii) to take advantage of the new conditions to redesign the tourism offer in the shoulder season, with the challenge that this represent for the

tourism planning. It is also necessary to improve the climatic-meteorological information of the destination, with the purpose of facilitating the tourist's choice processes and the planning of the trip in the new changing climate. This is, to generate reliable climate services that are capable of guiding the tourist at the appropriate moment to the area where beach-based activities can be carried out in the more pleasant and healthy possible conditions, and also to give visibility to other tourism environments, particularly mountain and micro-areas, that are underserviced.

The adverse effects of climate change, however, are not inevitable. Resilient capacities and adaptation policies need to be in place for Cyprus to cope with climate change effects (Seekamp et al., 2019). Apart from this, adaptation to climate change may also have the capacity to generate competitive advantages for the destination, and positive economic impact. In this regard, the present research has confirmed that tourists are willing to reward such initiatives, which is an indicator of the value they attach to the environmental attributes that can be potentially affected by climate change, and thus their preservation. The results indicate that those policies related to beach protection, heat waves early prevention, water supply security and infectious diseases prevention are the most valued ones by tourists visiting Cyprus. Hence there is a complementarity between tourist preferences for adaptation focus areas and the priority climate change risks for the island. Therefore, planning the sustainable tourism development in the country not only requires to work on the enhancement of coastal resilience, but also to incorporate the progress made on the destination' s communication plans.

This study has attempted to shed some light on the decision criteria considered by tourists in the context of a changing climate in coastal areas. Therefore, it can be useful for decision-makers of several coastal and island destinations in Europe that heavily rely on the tourism sector and are expected to face similar adverse climate change impacts, such as Malta, Crete and Sicily. It is important to note that although situations were hypothetical, the destination investigated is real and well-known to tourists interviewed, which is beneficial for avoiding response-biases. In addition, the island analysed is likely to experience many of the adverse climate change risks evaluated by tourists, and the proposed measures are a priority concern in the country.

Finally, while most of the studies in the literature are fragmented and analyse isolated climate change risks and adaptation programs, this paper investigates a wide range of measures that allows a policies' ranking according to their perceived social benefit and potential economic impact. Besides, the inclusion of the specific risks that mostly affect the studied destination is useful to propose more tailored recommendations for tourism management, but at the same time, can worsen the potential generalisation of results. To address this issue, the paper combines both approaches in a choice model; the current and potential climate change risks for Cyprus on the one hand, and other impacts and policies that are a common concern of all European coastal and island destinations, on the other hand.

6. Conclusion

This paper provides a working specification on tourists' aversion to climate change risks and their willingness to pay to reward adaptation policies at coastal destinations. Given the multiple ways in which climate change impacts destinations, the choice model was

designed to measure the potential economic impacts of adaptation initiatives through the demand perspective. This way, adaptation strategies can be seen as a means of reducing the environmental and economic risks of climate change, and at the same time, a vehicle to progress towards image enhancement and competitivity.

The main contributions of this article are that (i) it provides a better and wider understanding of tourists' aversion to climate change risks in coastal destinations, and (ii) it shows the policy areas to which tourists are more sensitive, with the challenges that this represents for coastal tourism management. From a policy perspective, this study assesses the potential economic impact that is generated in coastal destinations by increasing the adaptive and resilience capabilities to a changing climate. The island analysed, Cyprus, is likely to experience many of the adverse climate change risks evaluated by tourists, and the proposed measures are a priority concern in the country. Our findings may help tourism practitioners and policy-makers to identify and prioritise which adaptation efforts can improve tourists' perceived wellbeing and develop their recovery plans accordingly.

With adaptive management becoming increasingly dependent on funding to preserve coasts and beaches and with financial support from tourists being uncertain, the climate-related alteration of environmental attributes may pose significant threats to Cyprus tourism industry. Formal adaptation policies will need to be in place for Cyprus beach tourism sector to cope with climate change impacts and maintain its competitiveness. Such policies are costly, but ignoring adaptation strategies may lead to much higher losses (Darwin & Tol, 2001).

Although the measures evaluated by tourists were generic, to facilitate their interpretation, they come from extensive interactions with local stakeholders. Actually, (i) the construction of coastal protection structures, (ii) the diversification of tourist activities and products to combat the issue of seasonality, (iii) the implementation of an integrated drought management strategy, (iv) the upgrade of facilities for the re-use of grey water to irrigate lawns and gardens and fill swimming pools, and (v) the reinforcement of public health protocols and sanitary services and emergency medical care plans in coastal touristic areas, are programs under evaluation to be incorporated in the National Tourism Strategy 2020-2030. This requires close collaboration between the tourism authorities, the tourism industry and other public and private actors, posing a challenge for tourism governance.

Planning the sustainable development of tourism in Cyprus should take advantage of promotional campaigns about the progress made on preparedness and responsiveness to climate change. Both destination managers and tourism promoters should not only work towards the implementation of the best possible practices and emergency plans in response to health risks and coastal management, but also exploit this progress by including it in the promotion and communication campaigns. This is of crucial importance at the time of the health crisis (COVID-19) we are currently living through. It is the moment for tourist destinations to decide how they want to re-start their tourism systems. Some destinations will undoubtedly reconsider the nature of their tourism industry without substantial institutional and governmental interventions while for others this would be a limiting factor.

But climate change adaptation may also involve doing things that tourists do not like. Adaptive measures either based on engineering interventions, e.g. seawalls and

breakwaters or nature-based solutions, e.g. creating new wetlands, will lead to reduced access to beaches and reduction of associated facilities. These effects will be of higher magnitude for the popular tourist coastal destinations that already suffer from the "coastal squeeze". Although tourists' reactions to such climate change effects are not known, mitigation and adaptation solutions at destinations will supersede other drivers of tourist travel behaviour (Gössling et al., 2012). Tourists may avoid certain destinations based on how local policy-makers and destination managers cope with climate change or we might see a partial shift from coastal tourism to other locations (Jarratt & Davies, 2020). A better coordination and integration of tourism policies with environmental and climate change policies, joint to more multidisciplinary research on this subject, can contribute to the sustainable development of coastal destinations and underpin the tourist experience.

This study faces various limitations that substantially reduce the potential generalisation of results and the scope of its conclusions. First, it is based on a single destination of coastal tourism. Second, further evidence with much larger samples is required to definitively prove the robustness of the model. Third, this research has focused on coastal tourism, however, the extrapolation of results for other tourist segments and experiences is a matter of further research. Thus, future studies should consider the inclusion of a larger sample of several coastal and island destinations, together with various tourism segments. Finally, there might also be a need to include the importance-performance evaluation of tourists' response to the changes in climatic conditions.

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ORCID

Carmelo J. León http://orcid.org/0000-0001-9451-4093
Elias Giannakis http://orcid.org/0000-0002-1779-9811
George Zittis http://orcid.org/0000-0002-6839-5622
Yen E. Lam-González http://orcid.org/0000-0002-3239-9795
Carmen García http://orcid.org/0000-0003-2784-6455

References

Adloff, F., Somot, S., Sevault, F., Jordà, G., Aznar, R., Déqué, M., & Alvarez-Fanjul, E. (2015). Mediterranean sea response to climate change in an ensemble of twenty first century scenarios. *Climate Dynamics*, *45*(9–10), 2775–2802. https://doi.org/10.1007/s00382-015-2507-3

Alves, B., Rigall-I-Torrent, R., Ballester, R., Benavente, J., & Ferreira, Ó. (2015). Coastal erosion perception and willingness to pay for beach management (Cadiz, Spain). *Journal of Coastal Conservation*, *19*(3), 269–280. https://doi.org/10.1007/s11852-015-0388-6

Amelung, B., Nicholls, S., & Viner, D. (2007). Implications of global climate change for tourism flows and seasonality. *Journal of Travel Research*, *45*(3), 285–296. https://doi.org/10.1177/0047287506295937

Antonioli, F., Anzidei, M., Amorosi, A., Presti, V. L., Mastronuzzi, G., Deiana, G., & Marsico, A. (2017). Sea-level rise and potential drowning of the Italian coastal plains: Flooding risk scenarios for 2100. *Quaternary Science Reviews*, *158*, 29–43. https://doi.org/10.1016/j.quascirev.2016.12.021

Arabadzhyan, A. F., García, P., González, C., Lam-González, M. M., & León, Y. E. (2020). Climate change, coastal tourism, and impact chains – a literature review. *Current Issues in Tourism*. https://doi.org/10.1080/13683500.2020.1825351

Araña, J. E., & León, C. J. (2012). Scale-perception bias in the valuation of environmental risks. *Applied Economics*, *44*(20), 2607–2617. https://doi.org/10.1080/00036846.2011.566188

Araña, J. E., & León, C. J. (2013). Correcting for scale perception bias in tourist satisfaction surveys. *Journal of Travel Research*, *52*(6), 772–788. https://doi.org/10.1177/0047287513481271

Atzori, R., Fyall, A., & Miller, G. (2018). Tourist responses to climate change: Potential impacts and adaptation in Florida's coastal destinations. *Tourism Management*, *69*, 12–22. https://doi.org/10.1016/j.tourman.2018.05.005

Becken, S. (2010). The importance of climate and weather for tourism. Literature review. *Land Environment and People (LEaP) background paper* (pp. 4–13). Lincoln University.

Birdir, S., Ünal, Ö, Birdir, K., & Williams, A. T. (2013). Willingness to pay as an economic instrument for coastal tourism management: Cases from Mersin. *Turkey. Tourism Management*, *36*, 279–283. https://doi.org/10.1016/j.tourman.2012.10.020

Bonnieux, F., Carpentier, A., & Paoli, J. C. (2006). Development and protection of the Mediterranean forest: Implementation of choice modelling in Corsica. *INRA Sciences Sociales*, *6*(5).

Buzinde, C. N., Manuel-Navarrete, D., Yoo, E. E., & Morais, D. (2010). Tourists' perceptions in a climate of change: Eroding destinations. *Annals of Tourism Research*, *37*(2), 333–354. https://doi.org/10.1016/j.annals.2009.09.006

Cheablam, O., Shrestha, R. P., & Emphandhu, D. (2013). Does coral bleaching impact tourists' revisitation? A case of Mu Ko Surin marine national park, Thailand. *Journal of Food, Agriculture & Environment*, *11*(3&4), 2648–2654. https://www.wflpublisher.com/Abstract/5106

Clemente, F., Lopes, A., & Ambrósio, V. (2020). Tourists' perceptions on climate change in Lisbon region. *Atmosphere*, *11*(3), 297. https://doi.org/10.3390/atmos11030297

Cuttler, M. V. W., Hansen, J. E., Lowe, R. J., & Drost, E. J. F. (2018). Response of a fringing reef coastline to the direct impact of a tropical cyclone. *Limnology and Oceanography Letters*, *3*(2), 31–38. https://doi.org/10.1002/lol2.10067

Cystat. (2020). *Tourism statistics, 2017–2019*. Statistical Service of Cyprus. https://www.mof.gov.cy/mof/cystat/statistics.nsf/services_71main_en/services_71main_en?OpenForm&sub=1&sel=2

Darwin, R. F., & Tol, R. S. (2001). Estimates of the economic effects of sea level rise. *Environmental and Resource Economics*, *19*(2), 113–129. https://doi.org/10.1023/A:1011136417375

Galbraith, H., Jones, R., Park, R., Clough, J., Herrod-Julius, S., Harrington, B., & Page, G. (2002). Global climate change and sea level rise: Potential losses of intertidal habitat for shorebirds. *Waterbirds*, *25*(2), 173–183. https://doi.org/10.1675/1524-4695(2002)025[0173:GCCASL]2.0.CO;2

Giannakis, E., & Bruggeman, A. (2017). Economic crisis and regional resilience: Evidence from Greece. *Papers in Regional Science*, *96*(3), 451–476. https://doi.org/10.1111/pirs.12206

Giannakis, E., Serghides, D., Dimitriou, S., & Zittis, G. (2020). Land transport CO2 emissions and climate change: Evidence from Cyprus. *International Journal of Sustainable Energy*, *39*(7), 634–647. https://doi.org/10.1080/14786451.2020.1743704

Gómez-Martín, M. B., Armesto-López, X. A., & Martínez-Ibarra, E. (2014). The Spanish tourist sector facing extreme climate events: A case study of domestic tourism in the heat wave of 2003. *International Journal of Biometeorology*, *58*(5), 781–797. https://doi.org/10.1007/s00484-013-0659-6

Gössling, S., & Hall, C. M. (2006). Uncertainties in predicting tourist flows under scenarios of climate change. *Climatic Change*, *79*(3-4), 163–173. https://doi.org/10.1007/s10584-006-9081-y

Gössling, S., Scott, D., Hall, C. M., Ceron, J. P., & Dubois, G. (2012). Consumer behaviour and demand response of tourists to climate change. *Annals of Tourism Research*, *39*(1), 36–58. https://doi.org/10.1016/j.annals.2011.11.002

Grøntoft, T. (2017). Conservation-restoration costs for limestone façades due to air pollution in Krakow, Poland, meeting European target values and expected climate change. *Sustainable Cities and Society*, *29*, 169–177. https://doi.org/10.1016/j.scs.2016.12.007

Gutiérrez, C., Somot, S., Nabat, P., Mallet, M., Corre, L., van Meijgaard, E., & Gaertner, MÁ. (2020). Future evolution of surface solar radiation and photovoltaic potential in Europe: Investigating the role of aerosols. *Environmental Research Letters*, *15*(3), 034035. https://doi.org/10.1088/1748-9326/ab6666

Hall, C. M. (2006). Tourism, disease and global environmental change: The fourth transition? In S. Gössling & C. M. Hall (Eds.), *Tourism and global environmental change* (pp. 173–193). Routledge.

Hall, C. M., Amelung, B., Cohen, S., Eijgelaar, E., Gössling, S., Higham, J., & Aall, C. (2015). No time for smokescreen skepticism: A rejoinder to Shani and Arad. *Tourism Management*, *47*, 341–347. https://doi.org/10.1016/j.tourman.2014.08.008

Hall, C. M., Baird, T., James, M., & Ram, Y. (2016). Climate change and cultural heritage: Conservation and heritage tourism in the Anthropocene. *Journal of Heritage Tourism*, *11*(1), 10–24. https://doi.org/10.1080/1743873X.2015.1082573

Hanley, N., Mourato, S., & Wright, R. E. (2001). Choice modelling approaches: A superior alternative for environmental valuation? *Journal of Economic Surveys*, *15*(3), 435–462. https://doi.org/10.1111/1467-6419.00145

Hoa, T. V., Turner, L., & Vu, J. (2018). Economic impact of Chinese tourism on Australia: A new approach. *Tourism Economics*, *24*(6), 677–689. https://doi.org/10.1177/1354816618769077

Hoyos, D. (2010). The state of the art of environmental valuation with discrete choice experiments. *Ecological Economics*, *69*(8), 1595–1603. https://doi.org/10.1016/j.ecolecon.2010.04.011

Hystad, P. W., & Keller, P. C. (2008). Towards a destination tourism disaster management framework: Long-term lessons from a forest fire disaster. *Tourism Management*, *29*(1), 151–162. https://doi.org/10.1016/j.tourman.2007.02.017

Jarratt, D., & Davies, N. J. (2020). Planning for climate change impacts: Coastal tourism destination resilience policies. *Tourism Planning & Development*, *17*(4), 423–440. https://doi.org/10.1080/21568316.2019.1667861

Kopp, R. E., Horton, B. P., Kemp, A. C., & Tebaldi, C. (2015). Past and future sea-level rise along the coast of North Carolina, USA. *Climatic Change*, *132*(4), 693–707. https://doi.org/10.1007/s10584-015-1451-x

Kountouris, Y., & Remoundou, K. (2011). Valuing the welfare cost of forest fires: A life satisfaction approach. *Kyklos*, *64*(4), 556–578. https://doi.org/10.1111/j.1467-6435.2011.00520.x

Koutrakis, E., Sapounidis, A., Marzetti, S., Marin, V., Roussel, S., Martino, S., Fabiano, M., Paoli, C., Rey-Valette, H., Povh, D., & Malvárez, C. G. (2011). ICZM and coastal defence perception by beach users: Lessons from the Mediterranean coastal area. *Ocean & Coastal Management*, *54*(11), 821–830. https://doi.org/10.1016/j.ocecoaman.2011.09.004

Kovats, R. S., Campbell-Lendrum, D. H., McMichel, A. J., Woodward, A., & Cox, J. S. H. (2001). Early effects of climate change: Do they include changes in vector-borne disease? *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, *356*(1411), 1057–1068. https://doi.org/10.1098/rstb.2001.0894

Kragt, M. E., Roebeling, P. C., & Ruijs, A. (2009). Effects of great barrier reef degradation on recreational reef-trip demand: A contingent behaviour approach. *Australian Journal of Agricultural and Resource Economics*, *53*(2), 213–229. https://doi.org/10.1111/j.1467-8489.2007.00444.x

Lam-González, Y., Galindo, C. G., Hernández, M. M. G., & León, C. J. (2021). Understanding the heterogeneity of tourists' choices under climate change risks: A segmentation analysis. *Atmosphere*, *12*(1), 22. https://doi.org/10.3390/atmos12010022

Lam-González, Y. E., León, C. J., & de Leon, J. (2019). Assessing the effects of the climatic satisfaction on nautical tourists' on-site activities and expenditure decisions. *Journal of Destination Marketing & Management*, *14*, 100372. https://doi.org/10.1016/j.jdmm.2019.100372

Lau, C., Smythe, L., & Weinstein, P. (2010). Leptospirosis: An emerging disease in travellers. *Travel Medicine and Infectious Disease*, *8*(1), 33–39. https://doi.org/10.1016/j.tmaid.2009.12.002

Leatherman, S. P. (2018). Coastal erosion and the United States national flood insurance program. *Ocean & Coastal Management*, *156*, 35–42. https://doi.org/10.1016/j.ocecoaman.2017.04.004

Lee, C. K., Mjelde, J. W., Kim, T. K., Lee, E., & Choi, Y. (2019). Willingness-to-pay for whale tour attributes using a choice experiment. *Asia Pacific Journal of Tourism Research*, *24*(6), 606–617. https://doi.org/10.1080/10941665.2019.1610001

Lemesios, G., Giannakopoulos, C., Papadaskalopoulou, C., Karali, A., Varotsos, K. V., Moustakas, K., & Loizidou, M. (2016). Future heat-related climate change impacts on tourism industry in Cyprus. *Regional Environmental Change*, *16*(7), 1915–1927. https://doi.org/10.1007/s10113-016-0997-0

León, C. J., Araña, J. E., González, M., & De León, J. (2014). Tourists' evaluation of climate change risks in the Canary Islands: A heterogeneous response modelling approach. *Tourism Economics*, *20*(4), 849–868. https://doi.org/10.5367/te.2013.0310

León, C. J., de León, J., Araña, J. E., & González, M. M. (2015). Tourists' preferences for congestion, residents' welfare and the ecosystems in a national park. *Ecological Economics*, *118*, 21–29. https://doi.org/10.1016/j.ecolecon.2015.07.003

Loomis, J. B. (1993). An investigation into the reliability of intended visitation behavior. *Environmental and Resource Economics*, *3*(2), 183–191. https://doi.org/10.1007/BF00338784

Magnan, A., Hamilton, J., Rosselló, J., Billé, R., & Bujosa, A. (2013). Mediterranean tourism and climate change: Identifying future demand and assessing destinations' vulnerability. In A. Navarra & L. Tubiana (Eds.), *Regional assessment of climate change in the Mediterranean* (pp. 337–365). Springer.

Mariano, C., Marino, M., Pisacane, G., & Sannino, G. (2021). Sea level rise and coastal impacts: Innovation and improvement of the local urban plan for a climate-proof adaptation strategy. *Sustainability*, *13*(3), 1565. https://doi.org/10.3390/su13031565

Marshall, N. A., Marshall, P. A., Abdulla, A., Rouphael, T., & Ali, A. (2011). Preparing for climate change: Recognising its early impacts through the perceptions of dive tourists and dive operators in the Egyptian Red Sea. *Current Issues in Tourism*, *14*(6), 507–518. https://doi.org/10.1080/13683500.2010.512075

Martinez-Ibarra, E. (2015). Climate, water and tourism: Causes and effects of droughts associated with urban development and tourism in Benidorm (Spain). *International Journal of Biometeorology*, *59*(5), 487–501. https://doi.org/10.1007/s00484-014-0851-3

Mather, S., Viner, D., & Todd, G. (2005). Climate and policy changes: Their implications for international tourism flows. In C. M. Hall, & J. E. Higham (Eds.), *Tourism, recreation and climate change. Vol. 22. Tourism, recreation and climate change* (pp. 63–85). Channel View Publications.

McFadden, D., & Train, K. (2000). Mixed MNL models for discrete response. *Journal of Applied Econometrics*, *15*(5), 447–470. https://doi.org/10.1002/1099-1255(200009/10)15:5<447::AID-JAE570>3.0.CO;2-1

Michailidou, A. V., Vlachokostas, C., & Moussiopoulos, N. (2016). Interactions between climate change and the tourism sector: Multiple-criteria decision analysis to assess mitigation and adaptation options in tourism areas. *Tourism Management*, *55*, 1–12. https://doi.org/10.1016/j.tourman.2016.01.010

Moreno, A. (2010). Mediterranean tourism and climate (change): A survey-based study. *Tourism Planning and Development*, *7*(3), 253–265. https://doi.org/10.1080/1479053X.2010.502384

Mycoo, M. (2014). Sustainable tourism, climate change and sea level rise adaptation policies in Barbados. *Natural Resources Forum*, *38*(1), 47–57. https://doi.org/10.1111/1477-8947.12033

Mycoo, M., & Chadwick, A. (2012). Adaptation to climate change: The coastal zone of Barbados. *Proceedings of the Institution of Civil Engineers-Maritime Engineering*, *165*(4), 159–168. https://doi.org/10.1680/maen.2011.19

Nicholls, R. J., & Cazenave, A. (2010). Sea-level rise and its impact on coastal zones. *science*, *328*(5985), 1517–1520. https://doi.org/10.1126/science.1185782

Nilsson, J. H., & Gössling, S. (2013). Tourist responses to extreme environmental events: The case of Baltic Sea algal blooms. *Tourism Planning & Development*, *10*(1), 32–44. https://doi.org/10.1080/21568316.2012.723037

Noble, I. R., Huq, S., Anokhin, Y. A., Carmin, J., Goudou, D., Lansigan, F. P., & Villamizar, A. (2014). Adaptation needs and options. In C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, & L. L. White (Eds.), *Climate change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects. Contribution of Working group II to the fifth assessment report of the intergovernmental panel on climate change* (pp. 833–868). Cambridge University Press.

Ntoumos, A., Hadjinicolaou, P., Zittis, G., & Lelieveld, J. (2020). Updated assessment of temperature extremes over the Middle East–North Africa (MENA) region from observational and CMIP5 data. *Atmosphere*, *11*(8), 813. https://doi.org/10.3390/atmos11080813

Otrachshenko, V., & Nunes, L. C. (2019). *Fire takes no vacation: Impact of fires on tourism*. NOVA Working Papers, #632.

Pearlman, D., & Melnik, O. (2008). Hurricane Katrina's effect on the perception of New Orleans leisure tourists. *Journal of Travel & Tourism Marketing*, *25*(1), 58–67. https://doi.org/10.1080/10548400802164905

Philandras, C. M., Nastos, P. T., Kapsomenakis, J., Douvis, K. C., Tselioudis, G., & Zerefos, C. S. (2011). Long term precipitation trends and variability within the Mediterranean region. *Natural Hazards and Earth System Sciences*, *11*(12), 3235–3250. https://doi.org/10.5194/nhess-11-3235-2011

Poloczanska, E. S., Limpus, C. J., & Hays, G. C. (2009). Vulnerability of marine turtles to climate change. *Advances in Marine Biology*, *56*, 151–211. https://doi.org/10.1016/S0065-2881(09)56002-6

Prebensen, N., Chen, J. S., & Uysal, M. S. (2014). *Creating experience value in tourism*. CABI.

Proestos, Y., Christophides, G. K., Ergüler, K., Tanarhte, M., Waldock, J., & Lelieveld, J. (2015). Present and future projections of habitat suitability of the asian tiger mosquito, a vector of viral pathogens, from global climate simulation. *Philosophical Transactions of the Royal Society: B Biological Sciences*, *370*(1665), 1–16. https://doi.org/10.1098/rstb.2013.0554

Purcell, J. E. (2011). Jellyfish and ctenophore blooms coincide with human proliferations and environmental perturbations. *Annual Review of Marine Science*, *4*(1), 209–235. https://doi.org/10.1146/annurev-marine-120709-142751

Raybould, M., Anning, D., Ware, D., & Lazarow, N. (2013). *Beach and surf tourism and recreation in Australia: Vulnerability and adaptation*. Bond University.

Rodella, I., Madau, F., Mazzanti, M., Corbau, C., Carboni, D., Utizi, K., & Simeoni, U. (2019). Willingness to pay for management and preservation of natural, semi-urban and urban beaches in Italy. *Ocean & Coastal Management*, *172*, 93–104. https://doi.org/10.1016/j.ocecoaman.2019.01.022

Sagoe-Addy, K., & Addo, K. A. (2013). Effect of predicted sea level rise on tourism facilities along Ghana's Accra coast. *Journal of Coastal Conservation*, *17*(1), 155–166. https://doi.org/10.1007/s11852-012-0227-y

Sano, M., Gainza, J., Baum, S., Choy, D. L., Neumann, S., & Tomlinson, R. (2015). Coastal vulnerability and progress in climate change adaptation: An Australian case study. *Regional Studies in Marine Science*, *2*, 113–123. https://doi.org/10.1016/j.rsma.2015.08.015

Schleupner, C. (2008). Evaluation of coastal squeeze and its consequences for the Caribbean island Martinique. *Ocean & Coastal Management*, *51*(5), 383–390. https://doi.org/10.1016/j.ocecoaman.2008.01.008

Schliephack, J., & Dickinson, J. E. (2017). Tourists' representations of coastal managed realignment as a climate change adaptation strategy. *Tourism Management*, *59*, 182–192. https://doi.org/10.1016/j.tourman.2016.08.004

Schuhmann, P. W., Skeete, R., Waite, R., Lorde, T., Bangwayo-Skeete, P., Oxenford, H. A., Gill, H., Moore, W., & Spencer, F. (2019). Visitors' willingness to pay marine conservation fees in Barbados. *Tourism Management*, *71*, 315–326. https://doi.org/10.1016/j.tourman.2018.10.011

Scott, D. (2006). Global environmental change and mountain tourism. In S. Gössling & C. M. Hall (Eds.), *Tourism and global environmental change* (pp. 54–75). Routledge.

Scott, D., Gössling, S., & de Freitas, C. (2008). Preferred climates for tourism: Case studies from Canada, New Zealand and Sweden. *Climate Research*, *45*, 61–73. https://doi.org/10.3354/cr00774

Scott, D., Hall, C. M., & Stefan, G. (2012a). *Tourism and climate change: Impacts, adaptation and mitigation*. Routledge.

Scott, D., Simpson, M. C., & Sim, R. (2012b). The vulnerability of Caribbean coastal tourism to scenarios of climate change related sea level rise. *Journal of Sustainable Tourism*, *20*(6), 883–898. https://doi.org/10.1080/09669582.2012.699063

Seekamp, E., Jurjonas, M., & Bitsura-Meszaros, K. (2019). Influences on coastal tourism demand and substitution behaviors from climate change impacts and hazard recovery responses. *Journal of Sustainable Tourism*, *27*(5), 629–648. https://doi.org/10.1080/09669582.2019.1599005

Suckall, N., Tompkins, E. L., Nicholls, R. J., Kebede, A. S., Lázár, A. N., Hutton, C., Vincent, K., Allan, A., Chapman, A., Rahman, R., Ghosh, T., & Mensah, A. (2018). A framework for identifying and selecting long term adaptation policy directions for deltas. *Science of the Total Environment*, *633*, 946–957. https://doi.org/10.1016/j.scitotenv.2018.03.234

Thapa, B., Cahyanto, I., Holland, S. M., & Absher, J. D. (2013). Wildfires and tourist behaviors in Florida. *Tourism Management*, *36*, 284–292. https://doi.org/10.1016/j.tourman.2012.10.011

Train. (2003). *Discrete choice methods with simulation*. Cambridge University Press.

Uyarra, M. C., Cote, I. M., Gill, J. A., Tinch, R. R., Viner, D., & Watkinson, A. R. (2005). Island-specific preferences of tourists for environmental features: Implications of climate change for tourism-dependent states. *Environmental Conservation*, *32*(1), 11–19. https://doi.org/10.1017/S0376892904001808

Wilkins, E., de Urioste-Stone, S., Weiskittel, A., & Gabe, T. (2018). Weather sensitivity and climate change perceptions of tourists: A segmentation analysis. *Tourism Geographies*, *20*(2), 273–289. https://doi.org/10.1080/14616688.2017.1399437

Zittis, G. (2018). Observed rainfall trends and precipitation uncertainty in the vicinity of the Mediterranean, Middle East and North Africa. *Theoretical and Applied Climatology*, *134*(3-4), 1207–1230. https://doi.org/10.1007/s00704-017-2333-0

Zittis, G., Bruggeman, A., & Camera, C. (2020). 21st century projections of extreme precipitation indicators for Cyprus. *Atmosphere*, *11*(4), 343. https://doi.org/10.3390/atmos11040343

Zittis, G., Hadjinicolaou, P., Almazroui, M., Bucchignani, E., Driouech, F., El Rhaz, K., Kurnaz, L., Nikulin, G., Ntoumos, A., Ozturk, T., Proestos, Y., Stenchikov, G., Zaaboul, R., & Lelieveld, J. (2021). Business-as-usual will lead to super and ultra-extreme heatwaves in the Middle East and North Africa. *NPJ Climate and Atmospheric Science*, *4*(1), 20. https://doi.org/10.1038/s41612-021-00178-7

Zittis, G., Hadjinicolaou, P., Fnais, M., & Lelieveld, J. (2016). Projected changes in heat wave characteristics in the eastern Mediterranean and the Middle East. *Regional Environmental Change*, *16*(7), 1863–1876. https://doi.org/10.1007/s10113-014-0753-2

Zittis, G., Hadjinicolaou, P., Klangidou, M., Proestos, Y., & Lelieveld, J. (2019). A multi-model, multi-scenario, and multi-domain analysis of regional climate projections for the Mediterranean. *Regional Environmental Change*, *19*(8), 2621–2635. https://doi.org/10.1007/s10113-019-01565-w