International Journal of Islands Research

Volume 2 | Issue 1 Article 2

2021

Climate Change-induced Effects on Beach Degradation and Tourist Behaviour: A review of previous studies with potential in an island tourism context

Yen E. Lam González
Universidad de Las Palmas de Gran Canaria, yen.lam@ulpgc.es

Carmen Garcia
Universidad de las Palmas de Gran Canaria, carmen.garciagalindo@ulpgc.es

Matias M. González Hernández
Universidad de las Palmas de Gran Canaria, matiasmanuel.gonzalez@ulpgc.es

Carmelo J. Leon
Universidad de las Palmas de Gran Canaria, carmelo.leon@ulpgc.es

© International Journal of Islands Research
ISSN: 2737-7776
Available at: http://arrow.tudublin.ie/ijir/ Volume 2, 2021

Climate Change-induced Effects on Beach Degradation and Tourist Behaviour: A review of previous studies with potential in an island tourism context

Yen E. Lam González
Universidad de Las Palmas de Gran Canaria
yen.lam@ulpgc.es
Carmen Garcia
Universidad de las Palmas de Gran Canaria
carmen.garciagalindo@ulpgc.es
Matias M. González Hernández
Universidad de las Palmas de Gran Canaria
matiasmanuel.gonzalez@ulpgc.es
Carmelo J. Leon
Universidad de las Palmas de Gran Canaria
carmelo.leon@ulpgc.es

This article conducts a qualitative meta-analysis of papers addressing the topic of climate change impacts on beach loss and degradation, and its relation to tourist behaviour (destination choice, willingness to re-visit, expenditure and willingness to pay). The main aim is to identify values that can be used in future research works in the context of island tourism. We found that the strong specialisation and fragmentation of data and methods limit the transferability potential of previous research analysing climate-induced effects on beaches and tourist behaviour. Researchers from different fields bring their own conceptual models which often address similar problems but use different lenses and measurement units. Among the available studies, the ones with usable potential in a value transfer context are related to willingness to pay for adaptation measures. Overall, findings confirm that a greater transparency in the methodologies used to elicit values and a multidisciplinary approach are needed to ensure a more sustainable use of the information in order to fill knowledge gaps that still hinder the study of climate change.

Key Words: climate change, islands tourism, beach loss, beach degradation, tourist behaviour, value transfer

Introduction

Given the importance of the effects of climate change (CC) at global and local levels, analysis of the relationships between climate and tourism has been presented as an important research challenge in recent years (Denstadli & Jacobsen, 2014). For example, the morphological alterations to beaches and coastlines alert us to potential risks for the sustainability of a great part of the global tourism industry (Hemer *et al*., 2013). It could also mean the practical impossibility of carrying out tourist activities at beaches, with potential impacts on global tourism expenditure and the geographical movements of tourists (Anning *et al*., 2013), among other socio-economic implications.

Many works investigate the impacts of CC on tourism, but the strong heterogeneity in their methodology, focus, and area of investigation makes it difficult to achieve a comprehensive picture of the complex relationships at play (Hall *et al*., 2012). In other words, there is still a lack of a 'common language' so that CC research can move forward in a way that integrates different traditions in a coherent yet flexible fashion, allowing researchers to assess vulnerability and the potential for adaptation in a wide variety of contexts (Arabadzhyan, *et al*., 2020; Brooks, 2003).

As beaches are very significant landmarks in coastal tourism across the world, study cases on the economic valuation of CC on beaches have, *a priori*, potential for value transfer. However, very few investigations are dedicated to identifying and selecting these studies. The identification of values with transferability potential requires an analysis of different aspects, such as the uniformity between study and policy sites, the environmental attributes of the goods valued, the

motivational and behavioural profile of tourists involved in these studies, and the socioeconomic evaluation of these visitors.

Thus, the main objective of this paper is to develop a first step in the process of learning about the concept of value transfer. To do this end, a meta-analysis of available data in the literature has been conducted. Data have been extracted from the latest research advances with regard to the study of CC induced effects on beach loss, erosion and surface availability in relation to tourist behaviour. Moreover, an effort has been made to determine which of the results could potentially be transferred directly to an island tourism context.

The article is organised as follows. The next section provides a theoretical background to the research, and the subsequent section is devoted to a concise presentation of the methodology of benefit transfer. The following section is dedicated to presenting the literature review process undertaken for the compilation of the data analysed. The next section of findings is dedicated to integrating the outcomes of the selected manuscripts and interpreting their results. In this section the values with the highest suitability to be transferred are identified and presented. Finally, the last section is dedicated to concluding remarks and offers recommendations for further research.

Theoretical Background

The ***Benefit Transfers Method*** is a technique developed with the aim of estimating the economic value of environmental services when an original valuation is not viable or possible (Barbera, 2010). Therefore, it is a second-best approach. Environmental value transfer has been applied in a wide range of contexts, from water quality management (Luken *et al*., 1992) and associated health risks (Kask & Shogren, 1994) to waste (Brisson & Pearce, 1995) and forest management (Bateman *et al*., 1995).

Following Barbera (2010), we can distinguish two different approaches of benefit transfer: the function transfer and the value transfer. The former is more rigorous. It consists of transferring a benefit function from another study. These functions often relate people's willingness to pay (WTP) for aspects of the ecosystem, to their socioeconomic and personal characteristics. Some adjustment could be developed in order to take into account differences between locations when applying this approach to island locations. Boutwell and Westra (2013) affirm that function transfer requires the valuation function to be calibrated with the value that is being transferred. Moreover, they say that one of the advantages of this approach is that it allows the degree of similarity necessary for the transfer of benefits to be relaxed by allowing for differences in characteristics to be taken into account by a valuation function.

The second approach is easier to develop; one of the simplest types is the unit day approach. This uses the existing values for an activity to value the same activity in another place. Thus, a weighted measure of the value obtained by one or various studies is taken. These values are often given in US dollars and on a per unit basis (based on an activity, an outcome or a per-person basis).

Barbera (2010) presents some advantages and disadvantages of the benefit transfer technique. She highlights the costs and time required, and the fact that it is an easy and quick tool for assessing recreational values. On the other hand, these techniques can cause an increment of the likelihood and magnitude of valuation errors: availability of studies and values may be scarce, or it could even be that the existing studies are of low quality. Furthermore, these values become obsolete very quickly, either because society preferences change or new and high-quality studies are developed. The value transfer method is limited by the assumption that the benefit measure is a constant. Thus, she proposes looking for similarities between studies to develop a meta-analysis and to use calibration functions (that means using the values of the study case to calibrate and prove the parameters of the pre-determined utility function).

The most common method used for the compilation of data and its analysis is meta-analysis. This analyses a large number of studies with the aim of integrating the different results discovered. The meta-analysis method is widely used in environmental resource valuation literature, using a benefit transfer approach due to its allowance to incorporate a structural utility framework without the need for strict-economic information. The main limitation is that all the studies included in a meta-analysis should analyse/predict the same variables (Boutwell & Westra, 2013).

Since 2000, meta-analysis has become a stronger and more widespread tool in the benefit transfer literature (Bateman & Jones, 2003; Bergstrom & De Civita, 1999;

Gibson *et al*., 2016; Rosenberger & Loomis, 2000; Shrestha & Loomis, 2003; VandenBergh *et al*., 1997; Woodward & Wui, 2001), but its application to the study of climate change in tourism is still an under-investigated area (Arabadzhyan, *et al*., 2020).

In our study, meta-analysis is employed to analyse the extent to which previous research analysing CC-induced effects on beaches and tourist behaviour at several destinations can be utilised for estimating the same impacts in the context of island destinations. Thus, this research aims to identify potentially transferable economic values coming from the analysis of the CC risks of beach loss, erosion and reduction of beach surface, to understand and predict tourist behaviour in the context of island tourism.

Method

First, the collection of previous studies on CC related impacts on beaches was carried out, with the aim of compiling and classifying relevant environmental and economic values. A second analysis of studies was dedicated to classifying their usefulness - mainly based on the nature and the comparability potential of the values - and detecting limitations for their aggregation and transference to island tourism contexts. Finally, economic values with transferability potential in the context of an island destination were identified and classified by region of potential application (Mediterranean, Atlantic and North Europe). Regarding the location of the studies, it was assumed that those projects carried out in mainland located territories with geographical proximity to islands, in coastal areas, and in tourism-based economies would provide more reliable estimations for the context of islands.

Collection of studies

The review focused on a particular tourism segment (e.g., beach use or beach valuation) and a wide range of areas (e.g., tourist destinations all over the world with their micro destinations, protected areas, etc.), thus establishing a picture of current knowledge and issues in the area.

The process of collecting papers took place from August 2018 to February 2019, although it was later extended to August 2019. The first step consisted of establishing the criteria to select the relevant papers:

- They should be refereed journal articles, which implies some form of quality control (Zhang *et al*., 2014). The period was delimited in twenty years (publications from 2000 to 2019).
- The articles' main aim should be the study of economic impacts of CC in the tourism sector due to beach erosion or beach surface reduction. The analyses could include different scenarios of CC.
- The research should include the estimation of socio-economic impacts stemming from an analysis of tourist valuation and behaviour.

Articles were identified using various sources such as databases, Journal Citation Reports and Scopus; the research was limited to articles written in English. The selection of papers was undertaken via title or abstract. A non-exhaustive list of search keywords included: Climate Change, climate impacts, beach loss, beach erosion, beach availability, climate risk, tourist perception, benefit transfer, risk perception, environment management, environmental technical change, impact assessment, tourist behaviour, willingness to pay, climate policy, tourism expenditure, destination choice, etc.

Speed reading (abstract, first paragraph, and as much text from relevant sections as needed) was undertaken to classify the articles according to the following areas: research focus, theoretical foundations, conceptualisation, geographical scope, methodologies employed, values estimated, and management policies.

The collection procedure resulted in a sample of 24 publications being declared valid for the review. These papers were published more frequently in Hospitality and Tourism journals (38%), and in Environment and Ecological journals (22%). Table 1 presents a summary of the research works collected, classified by the studied impact.

Selection and classification

The second stage of the research corresponded to the revision, classification and validation of the materials collected. If an article sought to develop an in-depth understanding of concepts by building on existing knowledge, the article was considered conceptual. Conversely, if an article tested original research or theory by employing human subjects or textual samples and statistical techniques, it was classified as empirical. The articles that were exclusively conceptual were discarded.

Table 1. Summary of Papers Analysing the Impact of Climate Related Beach Degradation on Tourism

Impact Studied	Reference	Results
Beach erosion and damage to coastal infrastructure	Schleupner, 2008	25cm SLR poses a risk to 87% of beaches used for tourism (Martinique).
	Snoussi *et al*., 2008	24% of land loss in the case of 2m inundation (*best case*); 59% of land loss if 7m inundation (*worst case*) (Moroccan coasts).
	Scott *et al*., 2012	1m of SLR will result in 29% of resort properties partially or fully affected; or 60% of resort properties indirectly affected. Uneven spread: 50% of loss burden lying in 5 countries (Caribbean islands).
	Sagoe-Addy & Addo, 2013	13 tourism facilities may suffer from SLR impacts; 31% likely to be fully damaged (Accra, Ghana).
	Antonioli *et al*., 2017	Projections of SLR for 2100: 526-1010mm for IPCC scenario and 1430cm for Rahmstorf scenario will result in 5500 km^2 inundated (Italian coastal regions).
Tourist valuation and behaviour	Uyarra *et al*., 2005	77% of tourists unwilling to return in case of beach surface reduction (Barbados).
	Koutrakis *et al*., 2011	In the context of France, Greece and Italy, average visitors' WTP for beach defence amounts to €0.50-€1.49 per day.
	Raybould, 2013	17-23% of tourists would opt for alternative destinations under different beach erosion scenarios (Australia).
	Kragt *et al*., 2009	Effects of Great Barrier Reef degradation on recreational reef-trip demand: a contingent behaviour approach.
	Nilsson & Gössling, 2013	Algae bloom affects tourist demand: >75% consider algae bloom as something negative (health hazard, threat to bathing, aesthetic problem) and reduce visitor satisfaction. <25% have been affected by the algae: 81% could not take a swim and 40% changed activities; 17% shortened their stay and moved to another holiday area; 8% cancelled their holiday.
	Rulleau & Rey-Valette, 2013	Average WTP for beach protection measures is €36.40 per household per year (French Mediterranean).
	Kontogianni *et al*., 2014	WTP for adaptation measures for loss of beach surface in Greece €13.20-€16.40 (annual tax) per household.
	Castaño-Isaza *et al*., 2015	Tourists' experience value for San Andres Island beaches is estimated to be US$997,468 for all tourists, annually.
	Nunes *et al*, 2015	Associated reduction of jelly fish caused a decrease of €422.57 million, about 11.95% of tourism expenditure.
	Alliance, 2019	Average visitors' WTP of $20 to assist in the management of sargassum (Barbados)
Economic impacts (including tourists flows and world economy)	Darwin & Tol, 2001	If no protection measures are implemented, 0.5m of SLR in 2100 would have an annual cost of $7 billion in Europe and $36 billion in Asian region. The adoption of an optimal protection package would cost $10.5 billion, globally.
	Uyarra *et al*., 2005	Tourism revenues decrease by 46% because of less tourism arrivals due to beach reduction (Barbados).
	Bigano *et al*., 2008	25cm of SLR projected by 2050 would lead to GDP loss of 0.1% in South East Asia; no loss in Canada. Redistribution of tourist flows would produce GDP losses from 0.5% in Small Island States to 0.0004% in Canada.
	Wielgus *et al*., 2010	Hedonic prices model estimates that over the next 10 years beach erosion may induce losses of $52–$100 million for the hotel industry (Dominican Republic).
	Ghartey, 2013	Increased numbers of hurricanes may cause a fall in the exchange rate and a decrease in tourism arrivals in the short term, with a negative impact on tourists' expenditures in the long run (Jamaica).
	Raybould, 2013	Drop of revenues around $20-$56 million per year because of less tourism arrivals due to beach reduction (Australia).
	NOAA, 2016; Barnard *et al*, 2017	The immediate economic impacts of events such as El Niño can be quite considerable, reaching US$11.5 billion globally.
	Siddiqui & Imran, 2019	Climate effects have been discussed for different case studies and regions, in terms of tourism arrivals and receipts

SLR – sea level rise
IPCC – Intergovernmental Panel on Climate Change
WTP – willingness to pay
GDP – gross domestic product.

Only studies assessing beach-related indicators that mostly impact coastal and marine tourism activity, such as beach erosion, beach loss, beach surface availability reduction caused by CC, etc., were considered. These risks affect both the value of the recreational experience and the decision-making process of tourists before, during and after visiting the coastal destination. On the demand side, only those publications focused on tourists' behavioural responses to this problem were considered (past visits, arrivals, repetition, future intentions, willingness to pay, expenditure).

For this reason, some of the previously collected publications were discarded. This included papers considering the analysis of damage to infrastructure, economic losses, biodiversity degradation, and environmental management. However, if a study analysed tourists' willingness to pay for beach nourishment at the destination, it was included; if the analysis referred to the economic losses derived from changes in tourism arrivals, it was also included. Finally, a total of 17 papers were considered for the meta-analysis.

Following Finn *et al*. (1997), a qualitative oriented meta-evaluation was undertaken, aiming to assess the extent to which - regardless of the internal consistency and validity of the methods - the findings have any broader utility (Paterson *et al*., 2001; Pike, 2004). To do so, the articles were further classified into quantitative and qualitative streams based on the predominant methodologies. Methods and models employed in quantitative studies were also identified. Other categories were created for the location of the study, the environmental services under threat, the socio-economic characteristics of the sample of tourists, and the explanatory and dependent variables with their measurement units.

The seventeen manuscripts were classified according to three levels of potential usefulness for value transfer (Low –L, Medium –M and High-H). To do this, the following criteria were employed:

- High usefulness is related to research conducted in areas with similar spatial and socioeconomic characteristics to islands (i.e., coastal destinations, outermost regions, etc.).
- Recent publications are more suitable to be used for benefit transfer.
- Price elasticity functions and macroeconomic indicators are the most useful measures to transfer economic values to other contexts.
- Unitary terms have the greatest potential to be transferred (i.e., willingness to pay per tourist/day per 1 meter of beach restoration)

The assessment was carried out independently by three different researchers to avoid discretional bias. Cross-checking of information was periodically conducted through internal meetings. A high concordance level was obtained - representing around 97% of total items. Finally, the process was checked by four experts of the European Commission, as part of the quality review process established by the European Union (funder of this research), and one doctoral researcher specialising in climate change and tourism. Table 2 presents a description of the 18 papers included in the meta-analysis, with the results of their usefulness for value transfer.

Findings

The meta review conducted both sheds light and casts doubt. On the side of illumination, the review has allowed values for the specific risk analysed to be gathered. However, these values are represented very differently: some papers look at the destination image or the choice of destination, while others focus on either beach use, beach protection or beach erosion. Overall, the studies confirm that beach degradation would imply large reductions in the number of tourists visiting tourist destinations and the corresponding amount of monetary damages.

With respect to the behavioural effect, some relevant information was found, even if the variables in which it is expressed show dispersion in nature and treating them jointly requires some operations to give them enough homogeneity. They differ from each other either on the variable selected to refer to the behaviour (willingness/unwillingness to revisit, choice of alternative destination, number of visitors, etc.) or on the criterion followed to delimiter the tourist destination.

Studies range from very specific economic valuations in terms of changes in willingness to pay for tourism and for a unit change in a particular environmental service (i.e., beach width), to very general economic evaluations referring to a percentage of change in GDP (gross domestic product). Generally speaking, the former-type data are more useful than latter-type. In some other cases, the obtained information focuses on the cost of some adaptation policies implemented to reduce tourism vulnerability to CC. This information may be useful in

Table 2. Journal articles selected for the analysis and level of utility

Hazard/ Physical Impact	Behavioural Effect / Economic Impact	Method/ Model	Location	Source	Usefulness
Negative impact of CC on coral reefs and beaches	80% of tourists unwilling to re-visit for same price; Wealthy tourists contribute 40% GDP (Bonaire)	Survey – Principal Component Analysis	Bonaire and Barbados	Uyarra *et al*, 2005	(H)
Jellyfish blooms	Negative impacts on tourism expenditure 1) WTP average €3.20/beach visit 2) Gains associated reduction of jelly fish €422.57 million, 11.95% tourism expenditures	Survey-choice model	Catalonia	Nunes *et al*., 2015	(H)
Coral reefs degradation	1) CS/recreational trip $184.84 @ current reef quality. 2) Visit rate ↓ 80% if reef quality ↓. 3) CS ↓ by 80% (from $285 million/year to $56million/year). 4) Estimated total expenditure ↓ from $250 million	Contingent valuation Changes in trip demand GBR due to ↓ in reef quality	Mallorca (Spain)	Kragt *et al*., 2009	(H)
Beach erosion	17-23% tourists opting for alternative destinations; Loss of tourism receipts imply losses of $20m-$56million	Survey	Australia	Raybould *et al*., 2013	(H)
Beach degradation	Tourists would choose a different destination (39%). Protecting beaches from erosion and inundation is among the most preferred policies. Beach size among the most important environmental attributes determining destination choice.	Survey	Florida	Atzori *et al*., 2018	(L-to-M)
Beach replenishment (protection and adaptation measures)	Tourists express positive sentiment towards changed image of the beaches. Others have concerns from aesthetic points of view, but are aware of the necessity of protection measures.	Survey – Hypothetical scenarios	Playacar, Mexico	Buzinde *et al*., 2010	(L)
SLR, 25 cm by 2050	Redistribution of tourists flows triggers GDP loss ranging from 0.5% in Small Island States to almost no loss in Canada	CGE GTAP-EF (Global Trade Analysis Project) model.	Different countries	Bigano *et al*., 2008	(M)
SLR 0.5 m by 2100, no protection measures	Annual Direct Costs (no protection): 1) Europe: 7 billion; 2) Asia: 36 billion; 3) Rest of the world:10.5 billion	Computable General Equilibrium (CGE) model	Global	Darwin & Tol, 2001	(L-to-M)
SLR, IPCC projections-shoreline will retreat about 13m by 2020 and 52m by 2060.	31% of tourism facilities highly physically vulnerable to SLR; Beaches will lose on average GHC 227,500 per year; ↓ 2000 visitors per beach facility per holiday.	Historical orthophotos and topographic maps	Accra, Ghana	Sagoe-Addy & Addo, 2013	(M)
Coral reef decline generates erosion of 65%-100% after 10 years.	1) Implicit price of beach width was $1.57/m/person/night (2009US$) 2) revenue losses to the resorts of $52-$100 million over the next 10 years	Hedonic prices (properties around)	Dominican republic	Wielgus *et al*., 2010	(M-to-H)

Table 2. Journal articles selected for the analysis and level of utility

Hazard/ Physical Impact	Behavioural Effect / Economic Impact	Method/ Model	Location	Source	Usefulness
Coastal Erosion – Beachrock processes	Assesses beach users' willingness to pay for protecting European beaches WTP an annual tax in the range of €13.20-€16.40/household	Contingent valuation	Greece	Kontogianni *et al.*, 2014	(L-to-M)
Coastal Erosion & Adaptation	Visitors WTP for beach defence: 1) Mean WTPs €0.50-€1.49/day. 2) Willing to donate on average €1.10 every 5 years for beach defence	Contingent valuation	France Greece Italy	Koutrakis *et al.*, 2011	(L-to-M)
7cm SLR by 2030 and, depending on the hypotheses, 35cm, or even 1m, by 2100	Mean WTP for beach protection is €36.40 per household per year	Contingent valuation	France	Rulleau & Rey-Valette, 2013	(M)
Sea level rise and adaptation measures	Beach protection - significant attention because beach tourism is economically significant. Additionally, beach nourishment is popular in alleviating erosion.	Case study	Barbados	Mycoo & Chadwick, 2012	(L)
SLR 50cm by 2050, Rounded up to 50% reduction in beach width	>50% visitors willing to pay to reduce beach erosion and improve beaches; Annual total WTP to avoid erosion: $997,468 (2011 US Dollars); Annual loss of revenue in tourism sector: $73m (reduced by 66.6%).	Contingent valuation	Colombia	Castaño-Isaza *et al.*, 2015	(M-to-H)
Beach erosion	Mean WTP per household for a 5 years period: $78-$124. Estimates for beach protection: $62 million-$257 million to reduce impact of beach erosion at 75km of beach (approx. $2.1million/km)	Contingent Valuation	Southeast Queensland, Australia	Windle & Rolfe, 2014	(H)
El Niño events ↑ 76% erosion in winter	Economic losses estimated at over US$11.5 billion (in 2016 dollars).	Aerial Light Detection and Ranging (Lidar) & Global positioning system-based (GPS)	6 regions of US West Coast in winter 2015-2016	Barnard *et al.*, 2017; NOAA, 2016	(L)
Algae blooms	Piles of stranded sargassum significantly reduce the attractiveness of popular tourist beaches: - Mean visitors' WTP for sargassum management is $20 - Visitors are willing to drive an average of 10-15 mins from where they are staying to find a clean beach - Smell along shoreline has led tourists to cancel hotel and restaurant reservations	Choice experiments	Barbados	Alliance, 2019	(M)

GDP – gross domestic product
WTP – willingness to pay
CS – consumer surplus
GHC – Ghanian cedi (currency of the Republic of Ghana)

the context of island tourism in order to make estimations of the economic value of CC impacts based on avoided cost-type methodologies.

The heterogeneity of the sources added complexity to the task. The review shows that some observed differences in economic valuation are intrinsic to the methodologies used to elicit the values. In the information mined from the literature, most of the cases used contingent valuation - or its evolved version, discrete choice experiments - to estimate the average willingness to pay, or accept charges, for environmental changes that bring improved / worsened recreational experiences related to beaches. The minority of collected values come from the application of travel costs and hedonic price methodologies, while in some cases, these three methodologies are combined to elicit economic values.

Just a few studies are carried out at an island scale. The economies of the European islands are mostly tourism-based, which is the chief activity in terms of GDP and employment, and highly significant in terms of land occupancy and environmental impacts. Additionally, the European islands have developed mostly coastal and marine tourism modalities, extraordinarily sensitive to a wide range of climate change related hazards. They also possess highly vulnerable ecosystems, representing an important proportion of European biodiversity. Taking all these specificities into account, the transference of economic values of CC events on islands are the most suitable in this research. Other studies from mainland territories should be modulated for this set of island specificities.

Destination choice

Bigano *et al*. (2008) estimated the impacts of SLR on tourist flows. The results suggest that 25 cm of sea level rise projected by 2050 would lead to a GDP loss ranging from 0.1% in South East Asia to almost no loss in Canada, while redistribution of tourist flows would correspond to GDP losses ranging from 0.5% in Small Island States to 0.0004% in Canada. Therefore, the study highlights that both SLR and the redistribution of tourism flows would have different impacts in different parts of the world.

In Barbados, 77% of tourists declared an unwillingness to return in case of beach surface reduction. This would translate into tourism revenues decreasing by as much as 46% (Uyarra *et al*., 2005). In Australia, where under different beach erosion scenarios the share of tourists opting for alternative destinations is estimated to be 17-23%, the drop in revenues would be as large as $20-$56 million p.a. (Raybould *et al*., 2013). However, many tourists claim they would reconsider their choice if coastal protection measures were taken (Atzori *et al*., 2018). Buzinde *et al*. (2010) investigated the case of Playacar, Mexico, which was hit by severe beach erosion and undertook some protective measures, since these were expected to have a strictly negative impact on tourist perception.

For the case of the Balearic Islands, 25cm SLR is estimated by the middle of the century, which will pose a risk to 87% of beaches used for tourism (Schleupner, 2008). The studies on this location also highlight that perceptions, as well as behaviour, are heterogeneous across respondents of different ages: younger generations are less susceptible than the elderly.

Finally, studies focused on extreme weather events such as El Niño (Barnard *et al*., 2017) revealed that the shoreline retreat among the six regions of the US West Coast in the winter of 2015-2016 was 76% above the normal winter erosion rates. Similarly, the stormy winter of 2013-2014 along the Atlantic coast of Europe was found to have dramatically changed the equilibrium state (beach gradient, coastal alignment, and nearshore bar position) of the beaches (Masselink *et al*., 2016). The effects were found to vary depending on the obliqueness of the waves, and led not only to beach erosion, but also to beach rotation (Burvingt *et al*., 2016). The immediate economic impacts of El Niño can be quite considerable, reaching US$11.5 billion globally (NOAA, 2016). Regarding the effects on the demand side, the literature consistently finds a negative impact on tourist arrivals.

Adaptation measures

The analysis carried out by Buzinde *et al*. (2010) revealed that tourists adapt their views and attitudes when protection measures are used at beaches: some express positive sentiment towards the changed image of the beaches while others, although expressing concerns from aesthetic points of view, are aware of the necessity of protection measures and are willing to accept them in the light of Climate Change. Consequently, some countries have begun to invest in a variety of adaptation initiatives such as beach protection and artificial beach nourishment (Mycoo & Chadwick, 2012). Such measures are costly, but ignoring mitigation and adaptation strategies may lead to much higher losses.

Darwin and Tol (2001) estimate that if no protection measures take place, a 0.5-metre SLR in 2100 would incur an annualised total cost of about US$43 billion, with severe differences across regions: US$7 billion in Europe and US$36 billion in the Asian region. However, adopting an optimal protection package would reduce the total cost, thus resulting in US$10.5 billion for the whole world. Importantly, the authors find that international trade will smoothen disparities in losses by redistributing from regions with relatively high to regions with relatively low damage.

Unfortunately, literature referring to the relationship between climate-induced impacts and their effects on destination image is almost non-existent. We sought this potential relationship as changes in destination image are good predictors of tourists' destination choice, expenditure and satisfaction.

Selected values

Some research exhibits a medium-high potential for transferability to the context of island tourism. Studies by Uyarra *et al*. (2005) and Raybould *et al*. (2013) provide relatively accurate information for building dose-response functions between reductions in beach surface and tourism demand, expressed in terms of both unwillingness to revisit the location and tourism revenue.

The study by Wielgus *et al*. (2010), although using a different approach (hedonic prices), interestingly delivers economic values for changes in beach width that can be used for any location. Finally, the studies by Castano, Isaza, Newball, Roach and Lau (2015) and Windle and Rolfe (2014) present relevant values. Namely, results are provided in terms of WTP (willingness-to-pay) to mitigate beach erosion and changes in provision for environmental good (beach availability).

Some values were identified and adapted so that other researchers can utilise them for future studies. In tables 3 and 4 these values are shown in unitary terms and for the specific regions of suitable application. In table 3, the values represent the WTP per day of stay for tourists - above the current expenditure - to reward specific interventions in three areas. In table 4, the CC impacts are compatible with the RCP 8.5 scenario (i.e. 'business as usual' / high emissions scenario), meaning severe impacts. An important weakness of all the studies is that they do not propose particular adaptation measures, nor quantify their possible impacts.

Conclusions

The meta-analysis conducted allows an overview of what has been published in the last two decades regarding the impact of beach degradation through Climate Change on the decision making of tourists. It was possible to identify gaps within the topic that serve as an inspiration for future work. The high level of specialisation and fragmentation of studies should be noted here. That is to say, very few publications offer an integrated approach, and instead range from the analysis of physical impacts to economic or behavioural impacts.

Table 3: Tourists' Willingness to Pay (WTP) for Adaptation Policies Above the Current Expenditure (€/day)

Variable	Estimates for Mediterranean Islands	Estimates for Atlantic Islands	References
Marine habitat restoration	0.50 to 1.49	1.00 to 5.00	Koutrakis *et al*., 2011 Uyarra *et al*., 2005
Beach protection	1.68 to 2.76	3.20	Nunes *et al*., 2015

Table 4: Decrease in Tourism Arrivals and Expenditure (% average)

Variable	Estimates for North European islands	Estimates for Mediterranean Islands	Estimates for Atlantic Islands	References
Jelly fish blooms	-	-11.95 (exp)	-	Nunes *et al*., 2015
Damage to coral reefs	-80.00 (arrivals)	-	-	Kragt *et al*., 2009
Beach flooding	-	-	-77.0 (arrivals)	Uyarra *et al.,* 2005

Greater multidisciplinary methods are needed, directing research at giving more consideration to the development of knowledge in the area as a whole. Moreover, the available data does not deal with all of the potential impacts that can result from beach alterations due to CC. It is therefore unsuitable for an integrated approach to risk assessment. Among the potential available socio-economic impacts, those with highest potential to be utilised in a value transfer context are those related to willingness to pay and tourism expenditure.

The transferability of the identified economic values was strongly conditioned by the extraordinary heterogeneity in the nature of the data provided, the different locations studied, and the methodology used to elicit them. This means that value transfer is far from a simple, direct attribution of values from various places to be applied in the context of island destinations; rather, this requires quite a laborious data refining process. Notwithstanding this, at this time it is recommended that values mined from the literature be subject to a more profound examination with empirical studies. Thus, a future research avenue may be to apply benefit functions to assess the transferability potential of these results by comparing them with data gathered from tourists at different islands.

As a first step in the process of learning about the concept of ***Benefit Transfer Methods***, this study has taken advantage of the great heterogeneity of climate research to extract some works that are of great value to be used to complement future studies on the macroeconomic modelling of climate change impacts on the whole economy of islands. Conclusions of this paper need to be confirmed by extending the search both to a longer time period and to a greater variety of research resources such as books, project reports, doctoral dissertations, etc.

Funding

Research for this paper has been supported by the European Union's, through the Horizon 2020 research and innovation Programme under grant agreement No. 776661, SOCLIMPACT project, and the Interreg MAC (INTERREG VA Spain-Portugal) Programme 2014-2020 under the contract MAC CLIMA (MAC2/3.5b/254).

References

Alliance, D.C.N. (2019) Prevention and clean-up of Sargassum in the Dutch Caribbean.

Anning, D., Ware, D., Raybould, M. and Lazarow, N. (2013) Valuing beach and surf tourism and recreation in Australian sea change communities, *In 4th Queensland Coastal Conference*, 1-7. Queensland: Bond University.

Antonioli, F., Anzidei, M., Amorosi, A., Presti, V.L., Mastronuzzi, G., Deiana, G. and 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.

Arabadzhyan, A., Figini, P., García, C., González, M.M., Lam-González, Y.E. and León, C.J. (2020). Climate change, coastal tourism, and impact chains–a literature review. *Current Issues in Tourism*, 1-36.Atzori, R., Fyall, A. and Miller, G. (2018). Tourist responses to climate change: Potential impacts and adaptation in Florida's coastal destinations, *Tourism Management*, 69, 12-22.

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.

Barbera, M. (2010) Benefit transfer approaches. *Research Investigations and Monitoring Unit. Auckland council.*

Barnard, P.L., Hoover, D., Hubbard, D.M., Snyder, A., Ludka, B.C., Allan, J. and McCandless, D. (2017) Extreme oceanographic forcing and coastal response due to the 2015–2016 El Niño, *Nature Communications*, 8, 14365.

Bateman, I.J., Brainard, J.S. and Lovett, A.A. (1995) *Modelling woodland recreation demand using geographical information systems: a benefit transfer study*. Centre for Social and Economic Research on the Global Environment.

Bateman, I.J. and Jones, A.P (2003) Contrasting conventional with multi-level modelling approaches to meta-analysis: expectation consistency in UK woodland recreation values, *Land Economics*, 79(2), 235-258.

Bergstrom, J.C. and De Civita, P. (1999) Status of benefits transfer in the United States and Canada: a review, *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, 47(1), 79-87.

Bigano, A., Bosello, F. and Roson, R. (2008) Economy-wide impacts of climate change: a joint analysis for sea level rise and tourism, Mitigation and Adaptation Strategies for Global Change, 13(8), 765-791.

Boutwell, J.L. and Westra, J.V. (2013) Benefit transfer: A review of methodologies and challenges. *Resources*, *2*(4), 517-527.

Brisson, I. and Pearce, D. (1995) *Benefits transfer for disamenity from waste disposal*. Centre for Social and Economic Research on the Global Environment, Norwich (RU).

Burvingt, O., Masselink, G., Russell, P. and Scott, T. (2016) Beach response to consecutive extreme storms using LiDAR along the SW coast of England, *Journal of Coastal Research*, 75(sp1), 1052-1056.

Buzinde, C.N., Manuel-Navarrete, D., Yoo, E.E. and Morais, D. (2010) Tourists' Perceptions in a Climate of Change: Eroding Destinations, *Annals of Tourism Research*, 37(2), 333-354.

Castaño-Isaza, J., Newball, R., Roach, B. and Lau, W.W. (2015) Valuing beaches to develop payment for ecosystem services schemes in Colombia's Seaflower marine protected area, *Ecosystem services*, 11, 22-31.

Darwin, R.F. and Tol, R.S. (2001) Estimates of the economic effects of sea level rise, *Environmental and Resource Economics*, 19(2), 113-129.

Denstadli, J.M. and Jacobsen, J.K.S. (2014) More clouds on the horizon? Polar tourists' weather tolerances in the context of climate change, *Scandinavian Journal of Hospitality and Tourism*, *14*(1), 80-99.

Ghartey, E.E. (2013) Effects of tourism, economic growth, real exchange rate, structural changes and hurricanes in Jamaica. *Tourism Economics*, *19*(4), 919-942.

Gibson, F., Pannell, D., Boxall, P., Burton, M., Johnston, R., Kragt, M., Rogers, A. and Rolfe, J. (2016) Non-market valuation in the economic analysis of natural hazards. Working Papers 236941, University of Western Australia, School of Agricultural and Resource Economics.

Finn, C.E., Stevens, F.I., Stufflebeam, D.L. and Walberg, H. (1997) The New York City public schools integrated learning systems project: Evaluation and meta-evaluation, *International Journal of Educational Research*, 27(2), 159–174.

Hall, C.M., Gössling, S. and Scott, D. (2012) *Tourism and climate change: Impacts, adaptation and mitig*ation. Routledge.

Hemer, M.A., Fan, Y., Mori, N., Semedo, A. and Wang, X.L. (2013) Projected changes in wave climate from a multi-model ensemble. *Nature Climate Change*, *3*(5), 471-476.

Kask, S.B. and Shogren, J.F. (1994) Benefit transfer protocol for long-term health risk valuation: A case of surface water contamination. *Water Resources Research*, *30*(10), 2813-2823.

Kontogianni, A., Damigos, D., Tourkolias, C., Vousdoukas, M., Velegrakis, A., Zanou, B. and Skourtos, M. (2014) Eliciting beach users' willingness to pay for protecting European beaches from beachrock processes, *Ocean & Coastal Management*, 98, 167-175.

Koutrakis, E., Sapounidis, A., Marzetti, S., Marin, V., Roussel, S., Martino, S. and 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.

Kragt, M.E., Roebeling, P.C. and 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.

Luken, R.A., Johnson, F.R. and Kibler, V. (1992) Benefits and costs of pulp and paper effluent controls under the Clean Water Act. *Water Resources Research*, *28*(3), 665-674.

Masselink, G., Castelle, B., Scott, T., Dodet, G., Suanez, S., Jackson, D. and Floch, F. (2016) Extreme wave activity during 2013/2014 winter and morphological impacts along the Atlantic coast of Europe, *Geophysical Research Letters*, 43(5), 2135-2143.

Mycoo, M. and Chadwick, A. (2012) Adaptation to climate change: the coastal zone of Barbados, *In Proceedings of the Institution of Civil Engineers-Maritime Engineering*, Vol. 165(4), 159-168.

NOAA (2016) The 2015-16 El Niño, Science and Technology Infusion Climate Bulletin NOAA's National Weather Service 41st NOAA Annual Climate Diagnostics and Prediction Workshop Orono, ME, 3-6 October 2016.

Nunes, P.A., Loureiro, M.L., Piñol, L., Sastre, S., Voltaire, L. and Canepa, A. (2015) Analyzing beach recreationists' preferences for the reduction of jellyfish blooms: Economic results from a stated-choice experiment in Catalonia, Spain. PloS one, 10(6), e0126681.

Paterson, B.L., Thorne, S.E., Canam, C. and Jilings, C. (2001) *Meta-study of qualitative health research*. Thousand Oaks, CA: Sage.

Pike, S. and Ryan, C. (2004) Destination positioning analysis through a comparison of cognitive, affective and conative perceptions, *Journal of Travel Research*, *42*, 333–342.

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

Rulleau, B. and Rey-Valette, H. (2013) Valuing the benefits of beach protection measures in the face of climate change: a French case-study, *Journal of Environmental Economics and Policy*, 2(2), 133-147.

Rosenberger, R.S. and Loomis, J.B. (2000) Using meta-analysis for benefit transfer: In-sample convergent validity tests of an outdoor recreation database. *Water Resources Research*, *36*(4), 1097-1107.

Sagoe-Addy, K. and 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.

Schleupner, C. (2008) Evaluation of coastal squeeze and its consequences for the Caribbean island Martinique, *Ocean & Coastal Management*, 51(5), 383-390.

Scott, D., Simpson, M.C. and Sim, R. (2012) The vulnerability of Caribbean coastal tourism to scenarios of climate change related sea level rise, *Journal of Sustainable Tourism*, 20(6), 883-898.

Shrestha, R.K. and Loomis, J.B. (2003) Meta-analytic benefit transfer of outdoor recreation economic values: testing out-of-sample convergent validity. *Environmental and resource economics*, *25*(1), 79-100.

Siddiqui, S. and Imran, M. (2019) Impact of climate change on tourism. In *Environmental Impacts of Tourism in Developing Nations* (pp. 68-83). IGI Global.

Snoussi, M., Ouchani, T. and Niazi, S. (2008) Vulnerability assessment of the impact of sea-level rise and flooding on the Moroccan coast: the case of the Mediterranean eastern zone. *Estuarine, Coastal and Shelf Science*, 77(2), 206-213.

Uyarra, M.C., Cote, I.M., Gill, J.A., Tinch, R.R., Viner, D. and 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.

Van den Bergh, J.C.J.M., Button, K.J., Nijkamp, P. and Pepping, G.C. (1997) Review of Meta-Analysis with Applications to Economics. In *Meta-Analysis in Environmental Economics*, Springer, Dordrecht: 35-57 .

Wielgus, J, Cooper, E., Torres, R. and Burke, L. (2010) Coastal capital: Dominican Republic. Case studies on the economic value of coastal ecosystems in the Dominican Republic. Washington DC, USA: World Resources Institute.

Windle, J. and Rolfe, J. (2014) Estimating the nonmarket economic benefits of beach resource management in southeast Queensland, Australia, *Australasian Journal of Environmental Management*, 21(1), 65-82.

Woodward, R.T. and Wui, Y.S. (2001) The economic value of wetland services: a meta-analysis. *Ecological economics*, *37*(2), 257-270.

Zhang, M., Sun, H., Fei, Z., Zhan, F., Gong, X. and Gao, S. (2014, November) Fastq_clean: An optimized pipeline to clean the Illumina sequencing data with quality control. In *2014 IEEE International Conference on Bioinformatics and Biomedicine (BIBM)* IEEE: 44-48.