

Article

Knowledge, Attitudes, and Practices (KAP) Towards Climate Change Among Tourists: A Systematic Review

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Abstract: Climate change has profound impacts on tourists' travel demands, travel decisions, travel experiences, and the development of the tourism industry. Consequently, understanding tourists' knowledge, attitudes, and practices (KAP) towards climate change is important to the future development of tourism. This study aimed to identify and evaluate the existing literature concerning tourists' KAP towards climate change through a systematic review. A total of 76 articles were included to provide a comprehensive overview of tourists' KAP towards climate change since the 1950s. This study identified a significant increase in relevant research output in recent years; however, it also found a noticeable geographical bias, with a concentration in Europe and North America. While tourists generally demonstrated a good understanding of climate change and its impact on tourism, they showed a lack of awareness regarding the environmental consequences of air travel and were reluctant to reduce air travel. Most tourists believed that governments should take the lead in addressing climate change, with only a minority recognizing their individual responsibility. Furthermore, the perceived threats of climate change directly influenced tourists' travel decisions, prompting them to modify their travel plans, posing a challenge for tourist destinations. These findings can guide the development of policies related to climate education and sustainable tourism practices.

Academic Editor: Lewis Ting
On Cheung

Received: 4 January 2025

Revised: 7 February 2025

Accepted: 13 February 2025

Published: 17 February 2025

Citation: Guo, C., Lyu, Y., Li, P., & Kou, I. E. (2025). Knowledge, Attitudes, and Practices (KAP) Towards Climate Change Among Tourists: A Systematic Review. *Tourism and Hospitality*, 6(1), 32. <https://doi.org/10.3390/tourhosp6010032>

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Keywords: global warming; sustainable tourism; systematic review; carbon footprint; climate education

1. Introduction

Climate change and tourism have interactions with each other in various ways. On one hand, tourism heavily relies on fossil fuels, contributing significantly to global carbon emissions (Stefan Gössling & Dolnicar, 2023; Reis & Higham, 2017). Tourism has been identified as one of the major contributors to climate change (Susanne Becken & Wilson, 2013; Hares et al., 2010). According to United Nations estimates, transport-related carbon emissions from tourism are expected to account for 5.3% of all man-made carbon emissions by 2030, up from 5.0% in 2016 (UNWTO & ITF, 2019). In developed countries, it is approximated that more than a third of carbon emissions come from private travel and residential energy use (Cornejo-Ortega et al., 2014). Hares et al. (2010) pointed out that by 2050, carbon emissions from air travel may exceed 15% of all carbon emissions. These underscore the escalating impact of tourism on climate change as the industry continues to expand. On the other hand, tourism is vulnerable to the effects of climate change and will

encounter increasing challenges as weather patterns and the climate evolve (Tervo-Kankare et al., 2013). For instance, climate change may cause inundation of islands due to sea-level rise and reduce snowfall in winter tourism destinations, which can diminish the appeal of destinations, negatively affect tourist experiences, and impede tourism development (Qiao & Gao, 2017). Many destinations have already experienced severe effects of climate change, affecting travel behavior (Böcker et al., 2013; Paris et al., 2011), travel habits (Susanne Becken & Wilson, 2013; Reis & Higham, 2017), tourism activities, and experiences (Brownlee et al., 2013; Gajić et al., 2023; Jopp et al., 2015).

In addressing how tourism can respond to climate change, Dube and Nhamo (2020) highlighted that one of the biggest challenges for tourism is the lack of research on the knowledge, perceptions and response to climate change among different stakeholders, which has created a significant knowledge gap in tourism and hindered the development of appropriate adaptation measures. Among all stakeholders, tourists are uniquely positioned as they can decide when, where, and exactly how to take a trip, making them highly adaptable to the effects of climate change (Jopp et al., 2015). Therefore, studying tourists' knowledge and understanding is essential for designing effective policies and strengthening research in tourism (De Urioste-Stone et al., 2015a). Additionally, comprehending tourists' insights and reactions to the impacts of climate change (Clemente et al., 2020) can aid in developing appropriate environmental adaptation measures (Cholakova & Dogramadjeva, 2019). Hence, a comprehensive overview of knowledge, perception, and response to climate change from tourists' perspective is necessary for any kinds of adaptation measures.

The knowledge attitude practice (KAP) model, which originated in the field of population studies in the 1950s, has become a widely recognized strategy in multidisciplinary research and can be conducted to represent specific populations (Andrade et al., 2020). The KAP model has been utilized in various tourism studies, such as residents' support for tourism amidst the COVID-19 (Shen & Yang, 2022). However, KAP towards climate change among tourists has not yet received significant attention. This research adopts the KAP model to review tourists' knowledge, understanding, and response to climate change.

In general, this research aimed to conduct a systematic review and analysis of the literature to summarize the existing findings on tourists' KAP towards climate change since the 1950s. Specifically, it explores: (i) the characteristics of research on tourists' KAP towards climate change, including spatial and temporal distribution and research design; and (ii) the topics and outcomes covered in these studies. The insights gained from this research can assist tourism operators in making adjustments and enhancements to mitigate the impacts of climate change at destinations by addressing identified issues from the tourists' perspective, thereby fostering sustainable tourism development. Furthermore, it provides valuable guidance for developing effective educational programs and interventions to encourage sustainable behaviors. In terms of policy implications, the findings of this research can contribute to formulating policies related to climate change education and sustainable tourism practices.

2. Methods

2.1. Searching Strategies, Inclusion and Exclusion Criteria

The literature searching strategy involved using subject terms "climat* chang*", "touris*", "knowledge", "attitude*", and "practice*" and their synonyms to identify the articles from six databases: Scopus, Web of Science, PubMed, IEEE, Science Direct, and Eric. The search covered the period from 1950 to 2023. All search attempts focused on the KAP of tourists towards climate change, including keywords related to specific impacts of climate change such as sea level rise, heat waves, typhoons, and other extreme weather events. Search strategies in detail and results are presented in Appendix A.

The inclusion criteria for the literature were: (a) studies focused on any one of KAP components towards climate change among tourists; (b) full-text peer-reviewed studies published in English; (c) published between 1950 to 2023. The exclusion criteria included: (a) inability to access the full text (e.g., conference abstracts were excluded); (b) full text not available in English; (c) failure to address tourism scenarios.

2.2. Searching Process

In the first step, a total of 16,212 relevant publications were collected, including 9484 records from Scopus, 5208 from Web of Science, 857 from PubMed, 393 from IEEE, 230 from Science Direct, and 40 from Eric (Figure 1). Duplicate records from different databases were identified and removed using Endnote, resulting in 12,555 unique publications. Following a thorough review of titles and abstracts, 144 articles remained. Finally, the eligibility assessment of the full text of the articles yielded 76 articles for inclusion in the analysis (Appendix B).

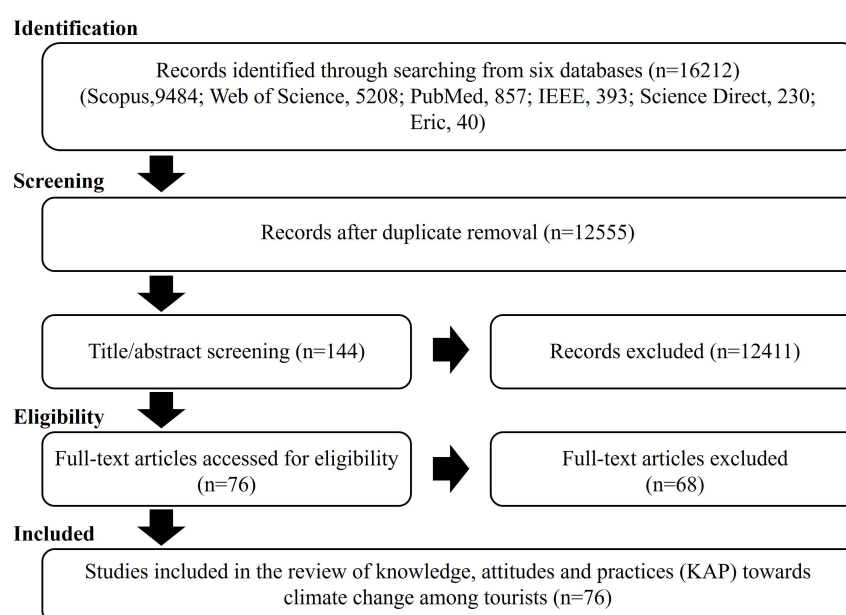


Figure 1. The flow of the literature search process to identify knowledge, attitudes, and practices towards climate change among tourists.

2.3. Data Analysis

A qualitative descriptive analysis was performed on the 76 articles that were included through the search on the topic of KAP towards climate change among tourists (Appendix B). Moreover, thematic analysis was adopted to systematically organize and examine the included articles to uncover recurring ideas, concepts, and topics that provide insight into KAP towards climate change among tourists. Thematic analysis is a qualitative research method used to identify, analyze, and interpret patterns of themes within qualitative data (Clarke & Braun, 2016; Nowell et al., 2017). The method is characterized by its flexibility (Nowell et al., 2017), allowing the research team to adapt it according to our specific research questions and contexts. In addition, ArcGIS 10.4 was used to generate maps to visualize the spatial distribution of the included research in global society.

3. Results

3.1. Geographical Distribution

Study sites: The study sites identified in the included literature were categorized by country/region and are visualized in Figure 2. Publications that covered multiple countries

or regions were counted separately for each area they covered. The numbers of study sites by continent were 28 in Europe (34.5%), 19 in North America (23.5%), 12 in Asia (14.8%), 9 in Africa (11.1%), 8 in Oceania (9.9%), and 5 in South America (6.2%). At the country level, a total of 39 countries or regions were studied, with the United States being the most frequently studied country (15, 18.5%), followed by Australia (6, 7.4%), Germany (4, 4.9%), and Taiwan (4, 4.9%). One research addressed the global scale (Vestola, 2023).

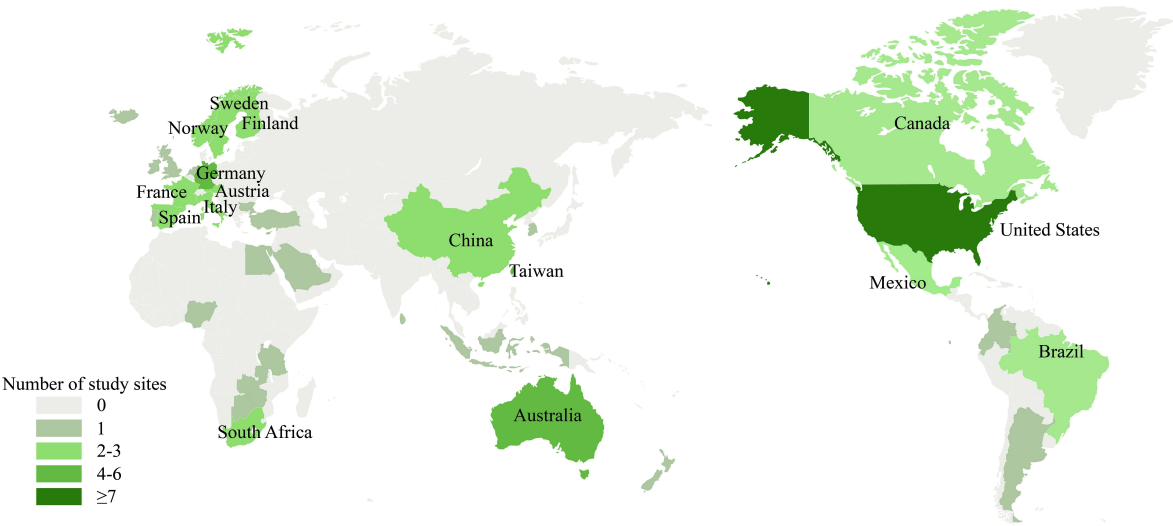


Figure 2. Study sites of KAP research towards climate change among tourists by country/region. Note: The names of countries/regions with two or more studies are labeled on the map.

Author affiliations: Figure 3 presents the distribution of first author affiliations by country/region. Publications involving multiple authors were counted by using the affiliation of the lead author. The numbers of affiliations by continent were 29 in Europe (38.2%), 18 in North America (23.7%), 12 in Asia (15.8%), 9 in Oceania (11.8%), 5 in Africa (6.6%), and 3 in South America (3.9%). The United States reported the largest number of studies (16, 21.1%), followed by Australia (6, 7.9%), the United Kingdom (6, 7.9%), Sweden (5, 6.6%), and Spain (5, 6.6%).

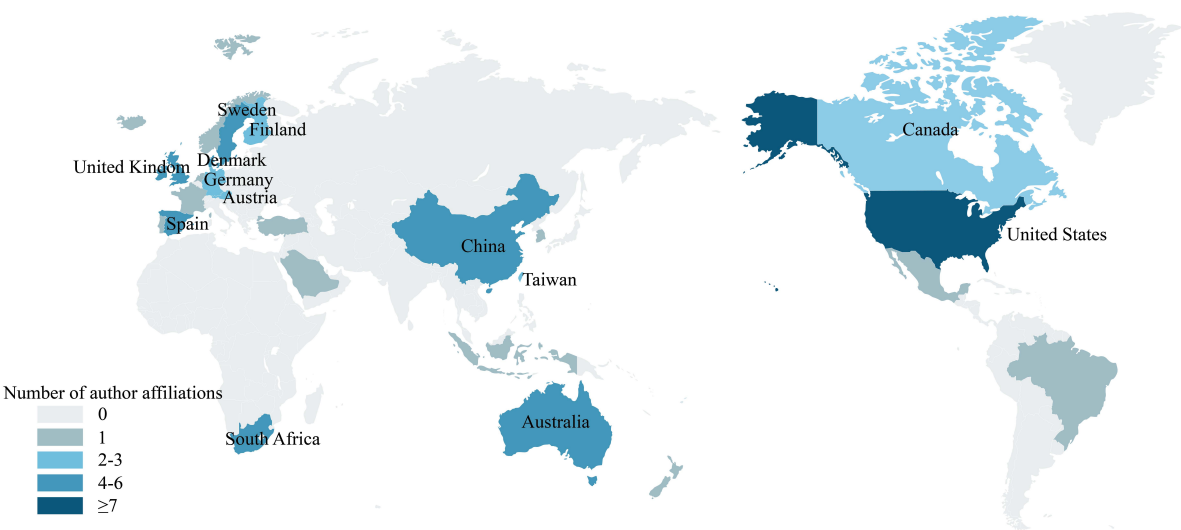


Figure 3. First author affiliations of KAP research towards climate change among tourists by country/region. Note: The names of countries/regions with two or more articles are labeled on the map.

3.2. Temporal Patterns

The systematic review of tourists' KAP towards climate change covered publications from 1950 to 2023. However, the first relevant article on this topic was published in 1999 by [Braun et al. \(1999\)](#), which examined how climate change impacted the destination preferences of German tourists. In 2000, Heney published an article on tourists' perceptions of climate change. There was a lack of relevant publications from 2001 to 2005, but starting in 2006, there was a gradual increase in the number of articles published, with slight declines in certain years. Overall, there was an upward trend, peaking in 2017 with 9 articles followed by 8 articles in 2023 (Figure 4).

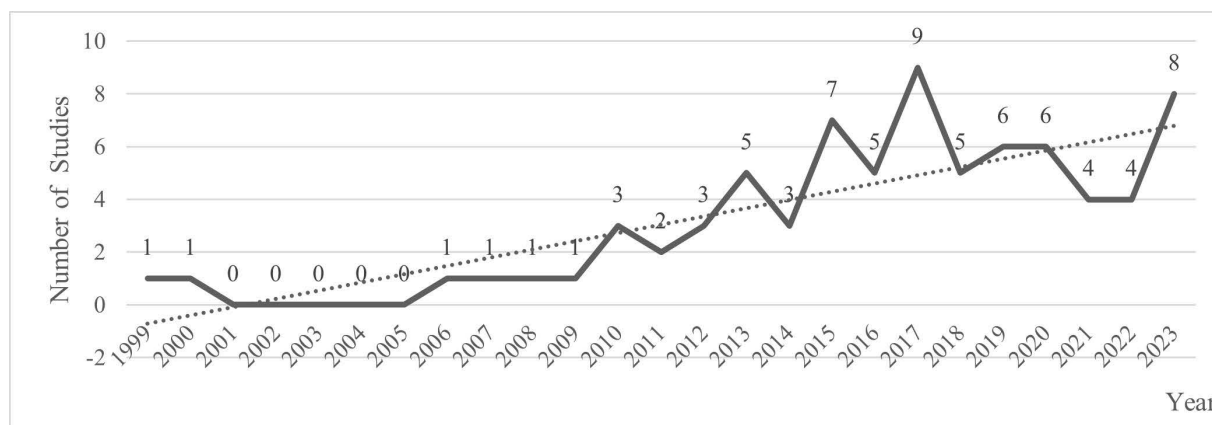


Figure 4. Number of KAP studies towards climate change among tourists by years.

3.3. The Distribution of Journals

A total of 45 different journals were identified for the included 76 articles on the topic of KAP towards climate changes among tourists (Appendix C). Journal of Sustainable Tourism published the highest number of papers on this topic with 11 articles, representing 14% of the total, followed by the Journal of Outdoor Recreation and Tourism (7 articles, 9%), Sustainability (5 articles, 7%), and Current Issues in Tourism (5 articles, 7%). Moreover, the journals covered a wide range of categories, with “hospitality, leisure, sport & tourism” emerging as the most prominent category. Additionally, significant contributions were noted from the categories of “environmental sciences”, “environmental studies”, “geography”, and “sociology”.

3.4. Study Design

(1) Types of research and data collection

About two-thirds of the 76 studies employed quantitative methods (67%), 18% utilized qualitative methods, and 14% used a mixed method combining both qualitative and quantitative data (Appendix B). Among the quantitative studies, the most used method was the cross-sectional questionnaire, often incorporating Likert scale measurements. For qualitative studies, 11 studies used interviews while two used focus groups. In addition, 68% of the studies collected data through face-to-face interactions, 26% gathered data online, and 6% utilized a hybrid approach combining face-to-face and online methods to optimize sample size and enhance the study's credibility.

(2) Frequent variables

In addition to assessing knowledge, attitudes, and practices towards climate change, the studies typically included the variables of: (i) sociodemographic factors, (ii) travel experience, (iii) travel behaviors, and (iv) environmental attitudes (Table 1).

Sociodemographic factors included individuals' age, gender, ethnicity, education level, income, origin, household size, political affiliation, marital status, occupation, and

particular sport skills in the past studies towards climate change among tourists (Table 1). Among these 11 variables, gender was the most frequently investigated with 57 articles utilizing it (75%), followed by age (55 articles, 72%) and education level (41, 54%).

Table 1. Frequently used variables by KAP research towards climate change among tourists.

Domain	Variable	N (%)
Sociodemographic factors	Gender	57 (75%)
	Age	55 (72%)
	Education level	41 (54%)
	Origin	
	Nation (which country tourists from)	32 (42%)
	Local or non-local	22 (29%)
	Income	
	Annual income	9 (12%)
	Monthly income	6 (8%)
	Household income	1 (1%)
	Occupation	7 (9%)
	Household size	5 (7%)
	Particular sports skills (e.g., experienced ski tourists)	5 (7%)
Travel experience	Ethnicity	4 (5%)
	Marital status	4 (5%)
	Political affiliation	4 (5%)
Travel behavior	Frequency of specific destination visit	32 (42%)
	Times of travel	8 (11%)
	Before trip	
	Travel motivations	19 (25%)
	Travel attractiveness	7 (9%)
	Reasons for natural tourism selection (particularly in nature-based tourism)	5 (7%)
	Importance of travel	3 (4%)
	Travel destinations preference (e.g., preference in nature-based destinations)	2 (3%)
	Acquire knowledge about specific landscapes (e.g., glaciers)	2 (3%)
	Information source about the destination (e.g., by internet, television, newspaper)	2 (3%)
	Ideal temperature range (temperature tourists expected in the destination)	2 (3%)
	Trip organizer (e.g., travel agency)	1 (1%)
	Importance of weather	1 (1%)
	During trip	
	Length of stay in a specific destination	16 (21%)
	The most popular activity (e.g., hiking in the mountain area)	16 (21%)
	Accompanying persons (e.g., with friends, family)	8 (11%)
	Common travel time in a specific destination (e.g., holiday, winter)	4 (5%)
	Transportation (e.g., by public transportation, private cars)	4 (5%)
	Accommodations (e.g., hotel)	3 (4%)
	Expense for tourism activity	3 (4%)
	After trip	
	Likelihood of a return visit (tourists' willingness to revisit this destination)	7 (9%)
	Satisfaction of a specific destination after traveling	6 (8%)
	Dissatisfaction with a specific destination after traveling (e.g., services, activities)	4 (5%)
	Emotion responses after traveling (e.g., sad, anxiety, concerns)	2 (3%)
Environmental attitudes	Place connection (the attachment individual feel towards a specific destination)	6 (8%)
	Animal/plant connection	3 (4%)
	Nature connection (individuals' psychological affinity with natural environments)	3 (4%)
	Environmental awareness (an understanding of the environment and the protection)	2 (3%)

Note: the number of articles that include the specific variables were listed in the above table.

Travel experiences were commonly evaluated based on the frequency of specific destination visits (32 articles, 42%). In addition, eight studies examined the overall number of trips taken by tourists in the past, usually addressing air travels (Becken, 2007; Dillimono, 2015) and international travels (Dillimono, 2015; Jacobson et al., 2020; Kroesen, 2013).

Travel behaviors were typically categorized into pre-trip, during-trip, and post-trip phases. Regarding pre-trip behaviors, the included studies primarily focused on travel motivations (19 articles, 25%) and travel attractiveness (7 articles, 9%). During the trip, studies commonly examined the length of stay in a specific destination (16 articles, 21%), the most popular activities in a specific destination (16 articles, 21%) and the accompanying persons (8 articles, 11%). Post-trip behaviors included the likelihood of a return visit (7 articles, 9%), satisfaction (6 articles, 8%), and dissatisfaction with a specific destination (4 articles, 5%).

Environmental attitudes referred to the connection between tourists and the environment and were measured by place connection (6 articles, 8%), animal/plant connection (3 articles, 4%), nature connection (3 articles, 4%), and environmental awareness (2 articles, 3%).

3.5. Knowledge of Climate Change

(1) Causes of climate change

Many studies have shown that tourists generally acknowledge the impact of human activities on global climate change (e.g., [Cornejo-Ortega et al., 2014](#); [Dube et al., 2018](#); [Gössling et al., 2006](#); [Groulx et al., 2017](#); [Hares et al., 2010](#); [Jopp et al., 2015](#); [Kroesen, 2013](#); [Lin & Wang, 2023](#); [Lo et al., 2013](#); [Luebke et al., 2015](#); [Qiao & Gao, 2017](#); [Said, 2022](#); [Salim et al., 2022](#); [Song et al., 2023](#); [Zhang et al., 2023](#)). For instance, the vast majority (83.8%) of whale-watching tourists in Mexico agreed that humans were contributing to global climate change ([Cornejo-Ortega et al., 2014](#)). However, when it came to the impact of air travel on climate change, studies indicated that many tourists were unaware of its effects (e.g., [Becken, 2007](#); [Hares et al., 2010](#); [Reis & Higham, 2017](#)). Even among those who were aware, there was a reluctance to reduce air travel frequency due to the convenience and benefits it offers ([Becken, 2007](#)). Reasons for this gap included the lack of alternative transportation infrastructure, making flying the fastest and most convenient option for many travelers ([Hares et al., 2010](#); [Jacobson et al., 2020](#); [Reis & Higham, 2017](#)). Some individuals even chose to fly more, anticipating potential future restrictions on air travel by governments ([Hares et al., 2010](#); [Reis & Higham, 2017](#)).

Meanwhile, some tourists believed climate change was caused by both human activities and natural factors (e.g., [Demiroglu et al., 2018](#); [Welling et al., 2020](#)). For example, 43% of the summer glacier visitors in Norway supported it ([Demiroglu et al., 2018](#)) but 32.6% of tourists in Taiwan attributed climate change to La Niña ([Lo et al., 2013](#)). However, the studies by [Ghilardi-Lopes et al. \(2015\)](#), [Hemstock and Capstick \(2019\)](#) and [Henry \(2000\)](#) reported that tourists had a weak understanding of the relationships between human activities and climate change, and some tourists even misunderstood the link between climate change and the ozone layer ([Dillimono, 2015](#)). It was found that education level positively affected the knowledge of the causes of climate change and usually well-educated tourists tend to have a better understanding of the issue ([Zhang et al., 2023](#)).

(2) Impacts of climate change

The majority of studies focused on the physical consequences of climate change, including sea-level rise (e.g., [Beard & Thompson, 2012](#); [De Urioste-Stone et al., 2015a, 2015b](#); [Hübner & Gössling, 2012](#); [Hoogendoorn et al., 2016](#); [Lo et al., 2013](#); [Wang et al., 2019](#)), extreme weather (e.g., [De Urioste-Stone et al., 2015a](#); [Lo et al., 2013](#); [Mosia et al., 2022](#)), changes in the weather patterns (e.g., [Dillimono, 2015](#); [C. H. Lin et al., 2021](#); [Wang et al., 2019](#)), temperature changes (e.g., [Dillimono, 2015](#); [Hübner & Gössling, 2012](#); [Lin & Wang, 2023](#); [Nilsson & Gössling, 2013](#); [Reis & Higham, 2017](#)), coral reef degradation and destruction (e.g., [Gössling et al., 2006](#); [Marshall et al., 2011](#)), glacier melting (e.g., [Hübner & Gössling, 2012](#); [Wang et al., 2019](#)), landscape changes (e.g., [Said, 2022](#)) and shifts in the snow pattern (e.g., [Lin et al., 2021](#); [Xiao et al., 2020](#)).

Most respondents in studies were almost certain that climate change had affected their destinations (e.g., [Bombana et al., 2023](#); [Brownlee et al., 2013](#); [Cornejo-Ortega et al., 2014](#); [Dube et al., 2018](#); [Groulx et al., 2017](#); [Mosia et al., 2022](#)). However, different areas perceived different levels of impacts of climate change on tourism. In the study by [Huebner \(2012\)](#), 25% of the tourists identified the Polar regions as being affected by climate change, 18% chose Oceania, 15% Asia, and 13% Europe.

When asked about the specific threats of climate change that they perceived, tourists typically mentioned the most apparent threats related to their activities at their destinations.

For example, tourists engaged in winter sports, such as skiing, were highly aware of climate change due to global warming's adverse effects on ski resorts (Landauer et al., 2009). Their perceived threats were predominantly related to snow and winter conditions, such as shorter winters and poor snow quality (Cholakova & Dogramadjeva, 2019), decreasing snow depth (Demiroglu et al., 2018) and changes in snowfall patterns (Xiao et al., 2020). Meanwhile, tourists traveling for urban beaches, whose activities relied more on the city's infrastructure and the sun, sea, and sand (3S), primarily perceived threats like freshwater availability (Gössling et al., 2006), beach erosion (Bombana et al., 2023), and higher temperature (Lin & Wang, 2023; Nilsson & Gössling, 2013). Additionally, dive tourists noted changes in coral conditions (Marshall et al., 2011). In addition, 90.5% of tourists traveling for whale watching agreed that climate change would impact whales (Cornejo-Ortega et al., 2014).

In addition to the natural impacts of climate change on tourism, Meo et al. (2021) found that 64.7% of tourists were also concerned about the impacts of climate change on society. Lo et al. (2013) noted that 86.8% of tourists in the study believed climate change could increase crop production. Regarding the effects of climate change on individuals, Song et al. (2023) and Zhang et al. (2023) found that most respondents noted the increase in tick-borne and mosquito-borne diseases in destinations could negatively impact their health. Meanwhile, a small percentage of tourists still thought climate change was unlikely to affect physiological and safety needs (De Urioste-Stone et al., 2015a).

A connection to the destination influenced the perception and understanding of the threats of climate change. For example, zoo and aquarium visitors with a strong sense of animal connection were more knowledgeable about threats of climate change than other visitors (Clayton et al., 2014). Local tourists perceived the threats of climate change more acutely than foreign tourists, likely because they visited the destination more often (Dube & Nhamo, 2020; Han et al., 2016).

(3) Information acquisition channels

Information acquisition channels referred to the sources from which tourists obtained information and knowledge about climate change. The majority of tourists were found to receive their information about climate change primarily through television (Hübner & Gössling, 2012; Huebner, 2012; Lin et al., 2021; Wang et al., 2019), followed by newspaper (Hübner & Gössling, 2012; Huebner, 2012; Wang et al., 2019), Internet (Hübner & Gössling, 2012; Huebner, 2012; Lin et al., 2021; Wang et al., 2019), and then radio (Hübner & Gössling, 2012; Huebner, 2012). Additionally, a small percentage of tourists learned about climate change through friends and relatives (Nilsson & Gössling, 2013). The utilization pattern of different information acquisition channels might correlate with the tourists' political affiliation. For instance, in the United States, instead of social media, scientists, and politicians, conservative tourists usually were more likely to trust the information from their friends and family (Clayton et al., 2014).

3.6. Attitudes Towards Climate Change

(1) Belief towards the occurrence of climate change

Belief towards the occurrence of climate change referred to whether tourists believed that climate change is happening. Studies conducted across various countries and regions indicated that a majority of tourists recognized the reality of climate change (e.g., Beard & Thompson, 2012; Cholakova & Dogramadjeva, 2019; Grajal et al., 2017; Groulx et al., 2016; Groulx et al., 2017; Hoogendoorn et al., 2016; Hoogendoorn et al., 2021; Jopp et al., 2015; Luebke et al., 2015; McCreary et al., 2019; Pröbstl-Haider et al., 2016; Pröbstl et al., 2008; Qiao & Gao, 2017; Said, 2022; Salim et al., 2022; Seekamp et al., 2019; Tarinc et al., 2023; Welling et al., 2020). Additionally, a significant number of tourists viewed climate

change as a global threat (Henry, 2000). However, there was still a smaller segment of tourists who remained skeptical or outright disbelieved in climate change (Font & Hindley, 2017; Hares et al., 2010; Hindley & Font, 2018; Reis & Higham, 2017). For some individuals, the effects of climate change may not be immediately visible in their daily lives, leading them to question its existence. Moreover, some tourists may lack direct experience of extreme weather or environmental changes, especially those who are living in urban areas with good infrastructure, and may find it difficult to perceive the urgency of addressing climate change.

Meanwhile, beliefs about climate change could vary based on factors such as gender, age, political affiliation, and education level. Typically, women were more likely than men to believe in climate change (De Urioste-Stone et al., 2015b). Younger tourists tended to acknowledge climate change more frequently than older tourists (De Urioste-Stone et al., 2015b). Political affiliation could also have an impact on the belief. For instance, in the United States, conservative tourists were less likely to accept the reality of climate change compared to their liberal counterparts (Clayton et al., 2014).

(2) Emotional reactions towards climate change

Tourists often expressed significant worry and concern about climate change, particularly for the group of tourists who visited nature-based destinations where the effects of climate change were directly observable (Groulx et al., 2017; McCreary et al., 2019). For instance, tourists who witnessed glacier degradation firsthand tended to be more concerned about climate change (Groulx et al., 2016; Welling et al., 2020). Similarly, Wilkins et al. (2018) discovered that tourists engaged in nature-related activities often feel more anxious about climate change, likely due to their direct observations of its impacts. In line with this, Curnock et al. (2019) noted that tourists visiting the Great Barrier Reef region became significantly more aware of climate change as a threat after experiencing its effects firsthand.

Exhibitions on climate change and interaction with animals have been shown to significantly influence attitudes towards climate change (Grajal et al., 2017). Hemstock and Capstick (2019) discovered that visitors expressed increased concern after attending a climate change exhibit. Also, Clayton et al. (2014) observed that zoo visitors were considerably more concerned about climate change than the general public. Furthermore, DeGregoria Kelly et al. (2014) reported that nearly two-thirds of zoo and aquarium visitors expressed concern about climate change.

These concerns and worries about climate change often prompted visitors to reflect on their own behavior. For instance, Wormbs and Söderberg (2021) conducted interviews with individuals who had ceased flying due to climate change concerns. These interviewees shared feelings of guilt about their previous habits and expressed concern for future generations, which motivated them to stop flying. Additionally, tourists who were worried about climate change were more likely to adopt coping behaviors to protect their destinations (Groulx et al., 2016; McCreary et al., 2019).

(3) Responsibility

Several studies have highlighted varying perspectives among tourists regarding climate change responsibility (e.g., Dube et al., 2018; Hares et al., 2010; Jacobson et al., 2020; Luebke et al., 2015). While some believe that governments should take the lead in addressing climate change (Jacobson et al., 2020; Luebke et al., 2015), others mentioned the roles of the United Nations Framework Convention on Climate Change (UNFCCC), businesses, the tourism industry, and local communities. Research in the United Kingdom suggested that many tourists did not consider climate change when planning their holidays (Hares et al., 2010). Furthermore, only a minority of tourists felt personally responsible for addressing climate change causes and impacts (Dube et al., 2018). Encouraging tourists to take respon-

sibility for climate change action and transitioning the tourism industry to a sustainable emission path remained challenging, as it might require changes to current lifestyles and air travel habits (Hares et al., 2010).

Many tourists believed that since they paid significant taxes, government should primarily address climate change (Hares et al., 2010). They also argued that individual pollution was minimal compared to industrial pollution, suggesting that government intervention should target the real “big polluters” first (Dube et al., 2018). Han et al. (2016) noted that responsible tourists were more likely to engage in pro-environmental behaviors, emphasizing the importance of enhancing the sense of responsibility to promote behavioral change. Clayton et al. (2014) found that visitors to zoos and aquariums often reported a sense of responsibility due to their connection with animals.

3.7. Practices Towards Climate Change

(1) Learning more about climate change

Research by Beard and Thompson (2012) found that guided tours in parks, which highlighted the threats of climate change, significantly boosted tourists’ interest, with half of the participants expressing a desire to learn more. This result suggested that tourists’ knowledge of climate change impacts could influence their willingness to learn about climate change to some extent. Becken (2007) utilized focus group interviews to explore this phenomenon and discovered that although there was a general eagerness among respondents to learn more about climate change, this curiosity did not translate into pro-environmental behavior. This suggests that the desire to learn does not necessarily lead to behavioral changes regarding environmental conservation. Further, a study by Clayton et al. (2014) demonstrated that tourists who felt a stronger connection with animals were more inclined to educate themselves about climate change. The research also highlighted women, frequent visitors, and those with liberal views were found to have a stronger affinity with animals, and thus, a heightened interest in learning about climate change (Clayton et al., 2014).

(2) Adaptation practices

There were primarily three distinct adaptation practices influenced by climate change. The first one involved activity adaptive substitution, where tourists opted for alternative activities at their destinations. For example, in ski resorts impacted by global warming, diminishing snow levels might prompt tourists to switch to hiking, rock climbing, or other mountain activities (Cholakova & Dogramadjeva, 2019; Gilaberte-Búrdalo & López-Moreno, 2020; Liu et al., 2017; Pickering et al., 2010). Notably, the majority of these tourists engaging in activity substitution were not professional skiers, making it easier for them to choose other activities. The second adaptation practice affected by climate change was time adaptive substitution, where tourists adjust their visitation schedules. For instance, in areas where climate change had delayed and shortened the winter season, tourists might postpone their trips to align with the new climatic patterns (Landauer et al., 2009). The third adaptation practice was spatial adaptive substitution (Demiroglu et al., 2018), where tourists opt for alternative destinations that offer similar activities when their usual choices are compromised by climate change (Clemente et al., 2020; Gilaberte-Búrdalo & López-Moreno, 2020). Typically, these tourists were often international visitors with no strong ties to the original location (Groulx et al., 2017) or were highly specialized in their activities, such as expert skiers (Landauer et al., 2009). Factors such as infrequent visits, weak connection to the place, higher income, and specific skill requirements in sports generally promoted the choice of spatial substitution (Seekamp et al., 2019).

In addition to the three response behaviors, there was a phenomenon known as “last chance tourism”, which compelled tourists to visit destinations under significant threat from climate change before they potentially disappear. Dube and Nhamo (2020) found

that approximately 75% of tourists visiting Victoria Falls expressed intentions to return before it potentially dried up. This study indicated that such motivation could result in over-tourism and further ecological degradation. A similar finding was reported by [Font and Hindley \(2017\)](#), where nearly all interviewed tourists expressed a desire to revisit destinations perceived as vanishing, driven by the urge to experience these “last-chance” locations. However, [Groulx et al. \(2016\)](#) identified additional motivations for last-chance tourism, such as a desire to learn about climate change and its impacts on these destinations. They suggested that last-chance tourism might foster personal awareness of climate change issues, prompting deeper reflection and encouraging more environmentally responsible behaviors among tourists.

(3) Mitigation practices

Mitigation practices referred to tourists engaging in pro-environmental actions to mitigate the impacts of climate change, which had been actively promoted as a way for individuals to contribute to climate change mitigation. Research showed that tourists who were more aware of climate change were more inclined to adopt pro-environmental behaviors (e.g., [Brownlee et al., 2013](#); [Clemente et al., 2020](#); [Dushani et al., 2023](#); [Qiao & Gao, 2017](#); [Song et al., 2023](#)). [Font and Hindley \(2017\)](#) discovered that individuals were more willing to adopt pro-environmental behaviors when they had a better understanding of the fragility of destinations threatened by climate change. This might cause them to select travel options that produce low carbon emissions ([Song et al., 2023](#)). Moreover, a robust understanding of climate change could foster a sense of moral responsibility among tourists, encouraging them to modify their behaviors accordingly ([Han et al., 2016](#)). For example, almost all dive tourists showed a preference for environmentally friendly operations ([Marshall et al., 2011](#)). [Dushani et al. \(2023\)](#) also observed that tourists visiting wetlands were more likely to provide financial support after witnessing the impacts of climate change on these areas.

Additionally, tourists who felt worried about climate change were most likely to engage in environmentally friendly actions ([Clemente et al., 2020](#); [DeGregoria Kelly et al., 2014](#); [Wormbs & Söderberg, 2021](#)). Specifically, [Wormbs and Söderberg \(2021\)](#) revealed that tourists who ceased flying often embraced eco-conscious actions after experiencing guilt over their past lifestyle choices. These studies suggested that a deeper understanding of environmental issues, especially when accompanied by negative emotions like worry, could drive individuals to change their behaviors ([Wormbs & Söderberg, 2021](#)). Furthermore, emotional connections with animals or plants have been shown to influence behavioral changes. For instance, [Luebke et al. \(2015\)](#) observed that visitors to zoos and aquariums were more inclined to educate themselves about climate change and alter their habits when they felt a strong bond with the animals and expressed concerns about climate issues. Similarly, [Zhang et al. \(2023\)](#) found that park visitors who witnessed the effects of climate change on plants experienced heightened levels of worry, which in turn motivated them to adopt more sustainable adaptive behaviors.

(4) Barriers to climate change mitigation

The barriers to climate change mitigation, identified from the 76 included articles, could be categorized into social, political, and personal aspects. Social barriers, such as the perception of inadequate funding for climate change adaptation strategies ([Zhang et al., 2023](#)), might stem from governments not prioritizing the threat of climate change and thus failing to allocate sufficient funds for mitigation efforts.

Political barriers referred to the absence of strong political leadership and international policies ([Dube et al., 2018](#)), compounded by the inherent political controversy surrounding climate change ([Groshong et al., 2018](#)). For instance, in regions like the United States, as

highlighted [Groshong et al. \(2018\)](#), the political landscape has made climate change a divisive issue, potentially discouraging guides from engaging with tourists on the topic.

According to the research by [Vestola \(2023\)](#), personal barriers included limited knowledge about climate change, uncertainty or skepticism towards the issue, distrust of information sources, externalization of responsibility, reliance on science and technology, reluctance to modify lifestyle, fatalistic attitudes, a sense of insignificance in making a difference, and the emerging concept of fantasy thinking. Barriers hindered tourists from prioritizing climate change mitigation. For instance, some tourists shifted responsibility for climate change onto the government, using it as justification for their unsustainable actions. Additionally, those with limited knowledge about climate change tended to underestimate its severity, placing undue faith in science and technology to address the issue. Notably, a lack of comprehension regarding climate change resulted in a diminished sense of personal accountability among tourists, leading to a stagnant behavior change ([Font & Hindley, 2017](#)).

4. Discussion

4.1. KAP Towards Climate Changes Among Tourists

The research provided a systematic review of the literature of KAP towards climate change among tourists published from 1950 to 2023 (Figure 5). It was found that the topic received growing interest and emphasis with an increasing number of publications. However, the distribution of study sites and author affiliations of reviewed literature demonstrated a significant geographical bias with a concentration in Europe and North America especially in the United States, which was also a trend observed in studies across various climate change topics, such as general public's climate change adaptation effectiveness ([Owen, 2020](#)), the relationship between climate change and tourism ([Pan et al., 2024](#)) and the impact of climate change on mountain tourism ([Steiger et al., 2022](#)). This disparity can be attributed to the concentration of research institutions, economic strength, and well-established tourism industries in Europe, North America, and Asia ([Pan et al., 2024](#); [Steiger et al., 2022](#)). To address this imbalance, we recommend that the global society and countries lacking in research infrastructure take proactive steps. Encouraging funding bodies, both governmental and non-governmental, to allocate resources specifically for climate change research in underrepresented regions, can involve setting aside dedicated grants or scholarships that target researchers and institutions in these areas. Moreover, promoting and facilitating international research collaborations that include institutions from less-represented regions, can help in building capacity and transferring knowledge to these areas, ultimately leading to more balanced research outputs. Furthermore, supporting local universities and research institutions through training, infrastructure development, and access to global research networks is important for building research capacity in underrepresented regions such as South America and Africa.

After reviewing 76 included articles, it is evident that this issue is now being explored across a broader spectrum of disciplines, as also noted in other reviews of tourism under the impact of climate change ([Pan et al., 2024](#)). This multidisciplinary approach underscores the necessity for future research on climate change to embrace interdisciplinary collaborations. Such collaborations are essential to thoroughly analyze the diverse factors influencing tourists from various perspectives since the effects of climate change on tourism are not confined to the tourism sector alone; they also span economic downturns, ecological disruptions, and psychological influences on tourist behavior, among other factors. In addition to the research that has explored the impacts of climate change on winter tourism and winter sports which have been studied by some research (e.g., [Cholakova & Dogramadjeva, 2019](#); [Demiroglu et al., 2018](#); [Landauer et al., 2009](#); [Xiao et al., 2020](#)), there is potential to broaden the scope of studies to encompass various other forms of tourism, such as forest tourism

(Korcz et al., 2024), while forests are an important store of carbon within the global carbon cycle and play a role in climate change adaptation and mitigation (Hall et al., 2011).

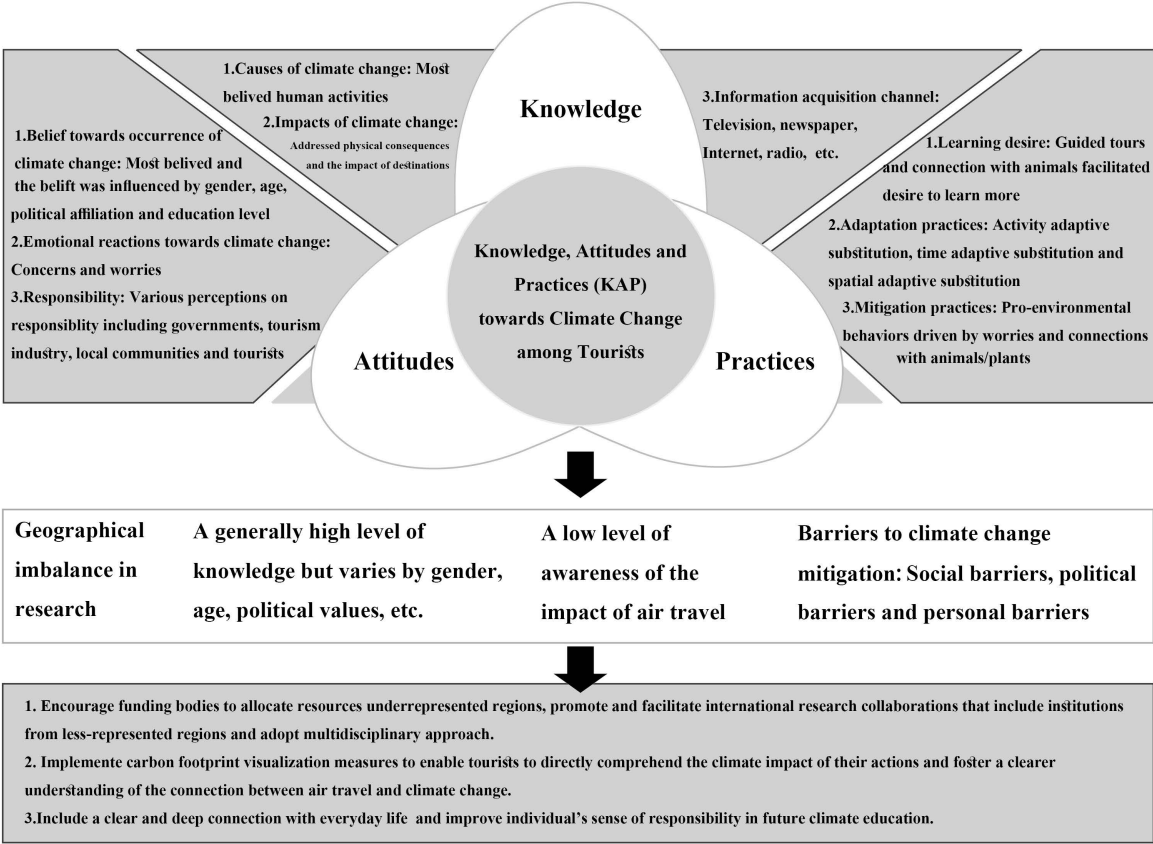


Figure 5. Knowledge, attitudes, and practices towards climate change among tourists.

Generally, tourists exhibited a high level of knowledge of climate change especially regarding the causes of climate change and its impacts. Their information and knowledge were acquired from multiple channels and television was the most frequently used channel followed by newspapers, the internet and radio. Moreover, research across various countries and regions supported most tourists believed in climate change. However, at the same time, most of them believed that governments should take the lead in addressing climate change, with only a minority recognizing their individual responsibility. When assessing the influencing factors of KAP towards climate change among tourists, gender emerged as one of the significant factors, which was consistent with other studies on climate change (Eastin, 2018; Moosa & Tuana, 2014; Pearse, 2017). Specifically, women were found to be more vulnerable to the effects of climate change, leading to higher awareness and belief in climate change compared to men (Pearse, 2017). Additionally, age was identified as another influencing factor on KAP towards climate change among tourists. Although the elderly were among the most vulnerable to the direct effects of natural disasters in the general population (Bayraktar & Dal Yilmaz, 2018), Stevenson et al. (2014) found that this demographic group tends to resist changes that challenge the status quo, resulting in a generally negative attitude toward climate change. Furthermore, research by Cornelis et al. (2009) indicated that attitudes towards climate change tend to become more conservative with age. In addition, the interplay of political values in shaping attitudes towards climate change was also highlighted in various studies (e.g., Bliuc et al., 2015; Jamieson, 2007; Ziegler, 2017).

We found that the awareness of the impact of air travel on climate change among tourists is currently limited through the systematic review, and even those who are aware

tend to show low support for restricting air travel. In addition to traditional strategies such as market-based or command-and-control approaches (Stefan Gössling & Dolnicar, 2023), McKercher et al. (2010) suggest that emphasizing the meaningful contribution individuals can make may increase the willingness to change behavior. Therefore, we advocate for the implementation of carbon footprint visualization measures. For instance, airlines could present passengers with their personal carbon footprints at the time of ticket purchase, enabling them to directly comprehend the climate impact of their actions and fostering a clearer understanding of the connection between air travel and climate change.

The practices towards climate change mainly included learning more about climate change, adaptation, and mitigation practices. However, there might be social, political, and personal barriers, especially in terms of climate change mitigation. How can tourists overcome these barriers? Clayton et al. (2014) noted that tourists' understanding of the threat of climate change and observing its effects might make them view climate change as a relevant threat, consequently increasing their concerns. Research suggested several strategies to address this issue, including providing explanations in areas where the effects of climate change are visible (DeGregoria Kelly et al., 2014; Groshong et al., 2018).

Furthermore, raising awareness of climate change via social media or events at destinations concerning sustainability can be effective method (Brownlee et al., 2013; Cornejo-Ortega et al., 2014; Dushani et al., 2023; Ghilardi-Lopes et al., 2015; Lin & Wang, 2023). Ghilardi-Lopes et al. (2015) pointed out that individuals' understanding of climate change was influenced more by their real-life experiences than by their education degree. Therefore, we suggest that environmental education, as a means of cultivating pro-environmental attitudes and emphasizing the significance of ecosystem benefits, should have a clear and deep connection with everyday life. One approach is to create emotionally engaging social media content that conveys scientific concepts in simple language to reach a wider audience. Education materials should also strive to go beyond simply presenting scientific facts about the mechanisms of climate change and improve individuals' sense of responsibility, as emphasized by Grajal et al. (2017). Furthermore, integrating digital tools can advance environmental and climate education by improving data collection, enhancing visitor experience and providing valuable insights, as demonstrated in an empirical study of utilizing digital tools in forest tourism and recreation in Poland (Korcz et al., 2024).

In politically charged environments like the United States, differing political views can lead tourists to feel skeptical about environmental issues, potentially discouraging them from participating in pro-environmental behaviors (DeGregoria Kelly et al., 2014). Grajal et al. (2017) propose that zoos and aquariums can serve as politically neutral spaces where tourists can engage in discussions about climate change. By focusing on animal-based exhibits and programs, these venues may encourage visitors to set aside their political beliefs, fostering a deeper reflection on their connection to animals and motivating them to adopt environmentally friendly behaviors.

4.2. Limitation and Future Research

There were certain limitations in the systematic review of KAP towards climate change among tourists, which might affect the applicability of the findings. Firstly, the review was restricted to articles published in English, which might have excluded relevant studies published in other languages. Additionally, the exclusion of grey literature such as books, reports, and conference proceedings might have led to a gap in capturing the full spectrum of existing knowledge, attitudes, and practices regarding climate change among tourists. The selection of databases also posed a limitation. The review was confined to specific databases: Web of Science, Scopus, IEEE, Science Direct, PubMed, and Eric. This limited range might have omitted relevant studies available in other academic databases or

platforms, thus affecting the overall findings. Therefore, expanding the linguistic scope, including multilingual studies, broadening the database, exploring alternative keywords and searching terms could uncover more literature not identified in this review, potentially leading to new insights and a deeper understanding of the subject matter. This expanded approach would also help in developing a more robust and comprehensive body of knowledge concerning the attitudes and behaviors of tourists towards climate change.

5. Conclusions

This research provides a thorough overview of tourists' KAP towards climate change over the decades by successfully analyzing 76 pertinent articles. The findings highlight that while knowledge and concern about climate change among tourists has grown, there remains a significant gap in proactive practices and sustainable behaviors. This discrepancy underscores the need for more targeted educational initiatives and policy interventions designed to bridge the gap between knowledge and action. The theoretical implications of this research suggest that tourists' knowledge, attitudes, and practices towards climate change play a crucial role in shaping travel demand, decisions, and overall tourism experiences. Understanding tourists' KAP towards climate change is essential for the future development of the tourism industry, as climate change has significant impacts on various aspects of tourism. Practically, the study proposes several recommendations for tourism management and destination authorities. These include implementing carbon footprint visualization measures for air travelers, integrating a clear and deep connection between everyday life and climate change and improving tourists' individual sense of responsibility in future climate education. Moving forward, it is imperative that stakeholders in the tourism industry consider these insights and recommendations seriously. By doing so, they can play a pivotal role in mitigating the adverse effects of climate change on global tourism, ensuring its sustainability for future generations. This study not only contributes to a deeper understanding of tourists' KAP regarding climate change but also sets a foundation for future research and action in this increasingly crucial area.

Author Contributions: Conceptualization, C.G.; methodology, C.G. and Y.L.; software, Y.L.; validation, C.G., Y.L., P.L. and I.E.K.; formal analysis, Y.L.; investigation, C.G. and Y.L.; resources, C.G.; data curation, Y.L.; writing—original draft preparation, Y.L.; writing—review and editing, C.G., Y.L., P.L. and I.E.K.; visualization, C.G. and Y.L.; funding acquisition, C.G.; All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the National Natural Science Foundation of China (42101241).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The original contributions presented in this study are included in the article. Further inquiries can be directed to the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

Statement: While drafting the manuscript, ChatGPT and Grammarly were utilized for language correction, enhancing English presentation, and improving writing quality. After using these tools/services, the authors thoroughly reviewed and edited the content as needed and take full responsibility for the content of the published article.

Appendix A. Searching Strategies and Results

Database	Strategies	Results
Web of Science	((TS = (climat* OR weather OR warming OR temperature OR carbon OR "green house*" OR "glacial* melt*" OR "sea level " OR "el ni*" OR "la ni*" OR "hazard" OR "disaster" OR "drought" OR "flood" OR "wildfire*" OR "heat wave*" OR "cold wave*" OR storm)) AND TS = (tourist* OR trave* OR visitor* OR "inbound" OR "outbound")) AND TS = ("knowledge" OR "attitude" OR "practice" OR "KAPs" OR belie* OR awareness OR perception) AND DOP = 1950-01-01/2023-12-31	5208
Scopus	(TITLE-ABS-KEY (climat* OR weather OR warming OR temperature OR carbon OR "green house*" OR "glacial* melt*" OR "sea level " OR "el ni*" OR "la ni*" OR "hazard" OR "disaster" OR "drought" OR "flood" OR "fire*" OR "heat wave*" OR "cold wave*" OR storm) AND TITLE-ABS-KEY (tourist* OR trave* OR visitor* OR "inbound" OR "outbound") AND TITLE-ABS-KEY ("knowledge" OR "attitude" OR "practice" OR "KAPs" OR belie* OR awareness OR perception)) AND PUBYEAR > 1950 AND PUBYEAR > 1950 AND PUBYEAR < 2024	9484
IEEE	("All Metadata":climat* OR "All Metadata":weather OR "All Metadata":warming OR "All Metadata":temperature OR "All Metadata":carbon OR "All Metadata": "green house*" OR "All Metadata": "glacial* melt*" OR "All Metadata": "sea level" OR "All Metadata": "el nino" OR "All Metadata": "la nino" OR "All Metadata": "EI Niño" OR "All Metadata": "NI Niño" OR "All Metadata": "hazard" OR "All Metadata": "disaster" OR "All Metadata": "drought" OR "All Metadata": "flood" OR "All Metadata": "wildfire*" OR "All Metadata": "heat wave*" OR "All Metadata": "cold wave*" OR "All Metadata":storm) AND ("All Metadata":tourist* OR "All Metadata":trave* OR "All Metadata":visitor* OR "All Metadata":inbound" OR "All Metadata":outbound") AND ("All Metadata":knowledge" OR "All Metadata":attitude" OR "All Metadata":practice" OR "All Metadata":KAPs OR "All Metadata":belie* OR "All Metadata":awareness OR "All Metadata":perception)	393
Science Direct	Year. 1950–2023 Title,abstract,keywords:(climate OR weather OR warming OR "disaster" OR temperature) (tourist OR traveler OR visitor) ("knowledge" OR "attitude" OR "practice")	230
PubMed	((climat*[Title/ Abstract] OR weather[Title/ Abstract] OR warming[Title/ Abstract] OR temperature[Title/ Abstract] OR carbon[Title/ Abstract] OR "green house"[Title/ Abstract] OR "glacial* melt"[Title/ Abstract] OR "sea level "[Title/ Abstract] OR "el ni"[Title/ Abstract] OR "la ni"[Title/ Abstract] OR "hazard"[Title/ Abstract] OR "disaster"[Title/ Abstract] OR "drought"[Title/ Abstract] OR "flood"[Title/ Abstract] OR "wildfire"[Title/ Abstract] OR "heat wave"[Title/ Abstract] OR "cold wave"[Title/ Abstract] OR storm[Title/ Abstract]) AND (tourist*[Title/ Abstract] OR trave*[Title/ Abstract] OR visitor*[Title/ Abstract] OR "inbound"[Title/ Abstract] OR "outbound"[Title/ Abstract])) AND ("knowledge"[Title/ Abstract] OR "attitude"[Title/ Abstract] OR "practice"[Title/ Abstract] OR "KAPs"[Title/ Abstract] OR belie*[Title/ Abstract] OR awareness[Title/ Abstract] OR perception[Title/ Abstract])) AND (("1950/01/01"[Date - Publication]; "2023/12/31"[Date - Publication]))	857
Eric	AB (climat* OR weather OR warming OR temperature OR carbon OR "green house*" OR "glacial* melt*" OR "sea level " OR "el nino" OR "la nino" OR "NI Niño" OR "EI Ni ño" OR "hazard" OR "disaster" OR "drought" OR "flood" OR "wildfire*" OR "heat wave*" OR "cold wave*" OR storm) AND AB (tourist* OR trave* OR visitor* OR " inbound" OR "outbound") AND AB ("knowledge" OR "attitude" OR "practice" OR "KAPs" OR belie* OR awareness OR perception) AND DT 1950–2023	40

Appendix B. The List of 76 Included Articles on KAPs Towards Climate Change Among Tourists

No.	Title	Year	Journal	Country/Area of Data Collection	First Affiliation and Country	Research Type	Data Collection Approach	Mode	Sample Size
1	Potential impact of climate change effects on preferences for tourism destinations. A psychological pilot study	1999	Climate Research	Germany	Universität Koblenz-Landau (Germany)	Quantitative	Cross-sectional questionnaire survey	Online	160
2	Public perceptions of global warming	2000	Human Ecology Review	United States	Washington and Lee University (United States)	Qualitative	Interview	Face-to-face	150

3	Tourist perceptions of climate change: A study of international tourists in Zanzibar	2006	Current Issues in Tourism	Tanzania	Lund University (Sweden)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	252
4	Tourists' perception of international air travel's impact on the global climate and potential climate change policies	2007	Journal of Sustainable Tourism	New Zealand	Lincoln University (New Zealand)	Qualitative	Focus group	Face-to-face	32
5	Climate change in winter sport destinations—transdisciplinary research for implementing sustainable tourism	2008	Sustainable Tourism	Austria	University of Natural Resources and Applied Life Sciences (Austria)	Quantitative	Mixed method	Face-to-face	456
6	Adaptation of Finnish cross-country skiers to climate change	2008	Fennia-International Journal of Geography	Finland	University of Lapland (Finland)	Quantitative	Cross-sectional questionnaire survey	Online	744
7	Tourists' Perceptions in a Climate of Change Eroding Destinations	2010	Annals of Tourism Research	Mexico	Penn State University (United States)	Qualitative	Interview	Face-to-face	44
8	Climate change and the air travel decisions of UK tourists	2010	Journal of Transport Geography	United Kingdom	Bournemouth University (United Kingdom)	Qualitative	Focus group	Face-to-face	34
9	Skiing Less Often in a Warmer World: Attitudes of Tourists to Climate Change in an Australian Ski Resort	2010	Geographical Research	Australia	Griffith University (Australia)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	351
10	Preparing for climate change: recognizing its early impacts through the perceptions of dive tourists and dive operators in the Egyptian Red Sea	2011	Current Issues in Tourism	Egypt	CSIRO (Australia)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	188
11	Tourists perceptions of climate change in Cairns, Australia	2011	e-Review of Tourism Research	Australia	Middlesex University Dubai (Dubai)	Qualitative	Interview	Face-to-face	81
12	Engaging Visitors in Climate Change Communication: A Case Study of Southern Florida's National Parks and Wildlife Refuges	2012	Applied Environmental Education and Communication	United States	Northern Michigan University (United States)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	66
13	Tourist perceptions of extreme weather events in Martinique	2012	Journal of Destination Marketing & Management	France	Aalborg University (Denmark)	Mixed method	Mixed method	Face-to-face	240
14	Public perceptions of destination vulnerability to climate change and implications for long-haul travel decisions to small island states	2012	Journal of Sustainable Tourism	Germany	Aalborg University (Denmark)	Mixed method	Cross-sectional questionnaire survey	Online	98
15	Botanical garden visitors' perceptions of local climate impacts: awareness, concern, and behavioral responses	2013	Managing Leisure	United States	Clemson University (United States)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	306

16	Exploring people's viewpoints on air travel and climate change: understanding inconsistencies	2013	Journal of Sustainable Tourism	Netherlands	Delft University of Technology (Netherlands)	Quantitative	Cross-sectional questionnaire survey	Online	491
17	The Cognition of Climate Change and Green Hotel	2013	Seventh International Conference on Complex, Intelligent, and Software Intensive Systems	Taiwan	Asia University (Taiwan)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	304
18	Tourist Responses to Extreme Environmental Events: The Case of Baltic Sea Algal Blooms	2013	Tourism Planning & Development	Sweden	Lund University (Sweden)	Quantitative	Cross-sectional questionnaire survey	Online	3217
19	Christmas Tourists' Perceptions to Climate Change in Rovaniemi, Finland	2013	Tourism Geographies	Finland	University of Oulu (Finland)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	246
20	Connecting to nature at the zoo: implications for responding to climate change	2014	Environmental Education Research	United States	The College of Wooster (United States)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	7182
21	Climate change and whale watching: Tourist's perception in islas marietas, nayarit, Mexico	2014	International Journal of Sustainable Development and Planning	Mexico	University of Guadalajara (Mexico)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	136
22	Climate change attitudes of zoo and aquarium visitors: Implications for climate literacy education	2014	Journal of Outdoor Recreation and Tourism-Research Planning and Management	United States	Chicago Zoological Society (United States)	Quantitative	Cross-sectional questionnaire survey	Online	3594
23	Measuring outdoor recreationists' beliefs in climate change: Testing the Occurrence and Anthropogenic Causation Scale (OC-AN)	2015	Journal of Outdoor Recreation and Tourism-Research Planning and Management	United States	Clemson University (United States)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	1141
24	Nature-based tourism and climate change risk: Visitors' perceptions in mount desert island, Maine	2015	Journal of Outdoor Recreation and Tourism	United States	The University of Maine (United States)	Quantitative	Mixed method	Face-to-face	169
25	Exploring visitor perceptions of the influence of climate change on tourism at Acadia National Park, Maine	2015	Journal of Outdoor Recreation and Tourism-Research Planning and Management	United States	University of Southern Denmark (Denmark)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	506
26	Travel, tourism, climate change, and behavioral change: travelers' perspectives from a developing country, Nigeria	2015	Journal of Sustainable Tourism	Nigeria	Bournemouth University (United Kingdom)	Qualitative	Interview	Face-to-face	19

27	On the perceptions and conceptions of tourists with regard to global environmental changes and their consequences for coastal and marine environments: A case study of the northern São Paulo State coast, Brazil	2015	Marine Policy	Brazil	Universidade Federal do ABC (Brazil)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	183
28	Climate Change Adaptation: Destination Management and the Green Tourist	2015	Tourism Planning & Development	Australia	Business and Enterprise (Australia)	Mixed method	Mixed method	Face-to-face	268
29	Global climate change attitudes and perceptions among south American zoo visitors	2015	Zoo Biology	Argentina/ Brazil/ Colombia/ Ecuador	Chicago Zoological Society (United States)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	2359
30	Behavioural adaptation to climate change among winter alpine tourists: an analysis of tourist motivations and leisure substitutability	2016	Journal of Sustainable Tourism	Australia	University of Queensland (Australia)	Quantitative	Cross-sectional questionnaire survey	Online	231
31	Motivations to engage in last chance tourism in the Churchill Wildlife Management Area and Wapusk National Park: the role of place identity and nature relatedness	2016	Journal of Sustainable Tourism	Canada	University of Waterloo (Canada)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	238
32	Tourists' Environmentally Responsible Behavior in Response to Climate Change and Tourist Experiences in Nature-Based Tourism	2016	Sustainability	South Korea	Kyung Hee University (South Korea)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	415
33	Disjunct perceptions? Climate change threats in two-low lying South African coastal towns	2016	Bulletin of Geography-Socio-Economic Series	South Africa	University of Johannesburg (South Africa)	Qualitative	Interview	Face-to-face	52
34	Risk perception and preferences of mountain tourists in light of glacial retreat and permafrost degradation in the Austrian Alps	2016	Journal of Outdoor Recreation and Tourism-Research Planning and Management	Austria	University of Natural Resources and Life Sciences (Austria)	Quantitative	Cross-sectional questionnaire survey	Online	302
35	Understanding tourists' reactance to the threat of a loss of freedom to travel due to climate change: a new alternative approach to encouraging nuanced behavioural change	2017	Journal of Sustainable Tourism	Italy/Norway	Leeds Beckett University (United Kingdom)	Qualitative	Interview	Face-to-face	23
36	The complex relationship between personal sense of connection to animals and self-reported proenvironmental behaviors by zoo visitors	2017	Conservation Biology	United States	Woodland Park Zoo (United States)	Quantitative	Cross-sectional questionnaire survey	Online	3588

37	Understanding consumer behaviour and adaptation planning responses to climate-driven environmental change in Canada's parks and protected areas: a climate futurescapes approach	2017	Journal of Environmental Planning and Management	Canada	University of Waterloo (Canada)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	240
38	Ethics and influences in tourist perceptions of climate change	2017	Current Issues in Tourism	Italy	Leeds Metropolitan University (United Kingdom)	Mixed method	Mixed method	Face-to-face	31
39	Effects of Climate Change on Outdoor Skating in the Bei Hai Park of Beijing and Related Adaptive Strategies	2017	Sustainability	Mainland China	Sichuan University (Mainland China)	Qualitative	Interview	Face-to-face	49
40	Chinese tourists' perceptions of climate change and mitigation behavior: An application of norm activation theory	2017	Sustainability (Switzerland)	Mainland China	Zhejiang International Studies University (Mainland China)	Quantitative	Cross-sectional questionnaire survey	Online	557
41	Climate change perceptions among Australian non-frequent flyers	2017	Tourism Recreation Research	Australia	Western Sydney University (Australia)	Qualitative	Interview	Face-to-face	20
42	Adaptation of future travel habits to climate change: A microeconomic analysis of tourists from Germany	2017	Tourism Economics	Germany	University of Hamburg (Germany)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	6602
43	Coastal Tourism and Climate-Related Disasters in an Archipelago Country of Indonesia: Tourists' Perspective	2017	Procedia Engineering	Indonesia	Bandung Institute of Technology (Indonesia)	Quantitative	Cross-sectional questionnaire survey	Online	115
44	Climate change acknowledgement and responses of summer (glacier) ski visitors in Norway	2018	Scandinavian Journal of Hospitality and Tourism	Norway	Umeå University (Sweden)	Quantitative	Cross-sectional questionnaire survey	Online	224
45	Tourists' knowledge and perceptions on the impact of climate change on tourism in Okavango Delta, Botswana	2018	African Journal of Hospitality, Tourism and Leisure	Botswana	Vaal University of Technology (South Africa)	Mixed method	Cross-sectional questionnaire survey	Face-to-face	155
46	Climate change impacts in Missouri State Parks: Perceptions from engaged park users	2018	Journal of Outdoor Recreation and Tourism-Research Planning and Management	United States	University of Missouri (United States)	Mixed method	Interview	Face-to-face	18
47	Values and motivations in tourist perceptions of last-chance tourism	2018	Tourism and Hospitality Research	Italy	University of Chester (United Kingdom)	Qualitative	Interview	Face-to-face	12
48	Weather sensitivity and climate change perceptions of tourists: a segmentation analysis	2018	Tourism Geographies	United States	University of Maine (United States)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	704

49	Climate change and ski industry in Pamporovo resort, Bulgaria: An exploratory study on the tourists' perceptions	2019	Annals of Tourism Research	Bulgaria	Sofia University (United States)	Mixed method	Mixed method	Face-to-face	126
50	Shifts in tourists' sentiments and climate risk perceptions following mass coral bleaching of the Great Barrier Reef	2019	Nature Climate Change	Australia	James Cook University (Australia)	Quantitative	Cross-sectional questionnaire survey	Online	4681
51	Communicating Climate Change: Reactions to Adapt and Survive Exhibition and Visitors' Thoughts About Climate Change in the Pacific Islands Region	2019	Springer Nature	Fiji	Bishop Grosseteste University (United Kingdom)	Mixed method	Mixed method	Face-to-face	19
52	Predictors of visitors' climate-related coping behaviors in a nature-based tourism destination	2019	Journal of Outdoor Recreation and Tourism-Research Planning and Management	United States	Western Kentucky University (United States)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	2250
53	Influences on coastal tourism demand and substitution behaviors from climate change impacts and hazard recovery responses	2019	Journal of Sustainable Tourism	United States	North Carolina State University (United States)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	370
54	When destination attractiveness shifts in response to climate change: tourists' adaptation intention in Taiwan's Kenting National Park	2019	Current Issues in Tourism	Taiwan	Sun Yat-Sen University (China)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	333
55	Tourists' Perceptions on Climate Change in Lisbon Region	2020	Atmosphere	Portugal	Universidade de Lisboa (Portugal)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	1181
56	Tourist perceptions and attitudes regarding the impacts of climate change on Victoria Falls	2020	Bulletin of Geography-Socio-Economic Series	Zambia and Zimbabwe	Vaal University of Technology (South Africa)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	370
57	Skier demand and behavioural adaptation to weather, snow conditions and climate change in central pyrenees	2020	Pirineos	France, German	Universidad San Jorge (Spain)	Quantitative	Cross-sectional questionnaire survey	Online	205
58	Tipping to Staying on the Ground: Internalized Knowledge of Climate Change Crucial for Transformed Air Travel Behavior	2020	Sustainability	Sweden	Stockholm University (Denmark)	Qualitative	Interview	-	26
59	Implications of Climate Change on Nature-Based Tourism Demand: A Segmentation Analysis of Glacier Site Visitors in Southeast Iceland	2020	Sustainability	Iceland	University of Iceland (Iceland)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	565

60	Winter tourism and climate change: Exploring local and non-local snowmobilers' perceptions of climate change and adaptation behaviors	2020	Journal of Outdoor Recreation and Tourism	United States	Arizona State University (United States)	Quantitative	Cross-sectional questionnaire survey	Online	1450
61	Adapting to climate change: the case of snow-based tourism in Afriski, Lesotho	2021	African Geographical Review	South Africa	University of Johannesburg (South Africa)	Mixed method	Cross-sectional questionnaire survey	Face-to-face	170
62	Impact of comparative climate change perceptions on antecedents of tourists' adaptation intentions for a coastal destination in Taiwan	2021	Journal of Hospitality and Tourism Management	Taiwan	National Formosa University (Taiwan)	Quantitative	Cross-sectional questionnaire survey	Online	376
63	The resident and visitor gaze: A comparison of coastal social values at risk due to sea-level rise	2021	Environmental Science & Policy	Spain	Universitat Autònoma de Barcelona (Spain)	Mixed method	Mixed method	-	133
64	Knowledge, Fear, and Conscience: Reasons to Stop Flying Because of Climate Change	2021	Urban Planning	Sweden	KTH Royal Institute of Technology (Sweden)	Qualitative	Mixed method	Face-to-face	673
65	Tourist Perceptions of the Impacts of Climate Variability and Change on Botanical Gardens	2022	African Journal of Hospitality, Tourism and Leisure	South Africa	Vaal University of Technology (South Africa)	Quantitative	Cross-sectional questionnaire survey	Online	324
66	Visitors' Knowledge, Awareness, and Perception (KAPs) of Climate Change in Mashar National Park, Hail-Saudi Arabia	2022	Engineering Technology & Applied Science Research	Saudi Arabia	University of Hail (Saudi Arabia)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	120
67	Does witnessing the effects of climate change on glacial landscapes increase pro-environmental behaviour intentions? An empirical study of a last-chance destination	2022	Current Issues in Tourism	France	Université Savoie Mont Blanc (France)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	284
68	Beach Users' Perceptions of Coastal Regeneration Projects as An Adaptation Strategy in The Western Mediterranean	2022	Journal of Hospitality & Tourism Research	Spain	Universitat Politècnica de Catalunya–Barcelona Tech (Spain)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	230
69	Will Climate Change Affect the Attractiveness of Beaches? Beach Users' Perceptions in Catalonia (NW Mediterranean)	2023	Sustainability	Spain	Autonomous University of Barcelona (Spain)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	867
70	Willingness to pay for mangrove restoration to reduce the climate change impacts on ecotourism in Rekawa coastal wetland, Sri Lanka	2023	Journal of Environmental Economics and Policy	Sri Lanka	Norwegian College of Fishery Science (Norway)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	365
71	Tourists' Preferences for Adaptation Measures to Build Climate Resilience at Coastal Destinations. Evidence from Cyprus	2023	Tourism Planning & Development	Cyprus	University of Las Palmas de Gran Canaria (Spain)	Mixed method	Mixed method	Face-to-face	258

72	Impacts of climate change knowledge on coastal tourists' destination decision-making and revisit intentions	2023	Journal of Sustainable Tourism	Taiwan	National Formosa University (Taiwan)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	510
73	Can nudging affect tourists' low-carbon footprint travel choices?	2023	International Journal of Contemporary Hospitality Management	Hong Kong	The Hong Kong Polytechnic University (Hong Kong)	Quantitative	Cross-sectional questionnaire survey	Online	958
74	Effect of Climate Change Belief and the New Environmental Paradigm (NEP) on Eco-Tourism Attitudes of Tourists: Moderator Role of Green Self-Identity	2023	International Journal of Environmental Research and Public Health	Turkey	Akdeniz University (Turkey)	Quantitative	Cross-sectional questionnaire survey	Online	458
75	Perceptions of climate change and tourism: A deep dive into the forums of Reddit	2023	Tourism and Hospitality Research	Reddit	Luleå University of Technology (Sweden)	Qualitative	Mixed method	Online	35031
76	Urban park visitor perceptions of climate change: beliefs, concerns and support for action	2023	Landscape Research	United States	Hunan Normal University (China)	Quantitative	Cross-sectional questionnaire survey	Face-to-face	429

Appendix C. Number of Articles by Journals

	Journal	N	Share	Subject Category	2023 Journal Impact Factor
1	Journal of Sustainable Tourism	11	14%	Hospitality, Leisure, Sport & Tourism Green & Sustainable Science & Technology	6.9
2	Journal of Outdoor Recreation and Tourism	7	9%	Hospitality, Leisure, Sport & Tourism	3.6
3	Sustainability	5	7%	Green & Sustainable Science & Technology Environmental Sciences Environmental Studies	3.3
4	Current Issues in Tourism	5	7%	Hospitality, Leisure, Sport & Tourism	5.7
5	Tourism Planning & Development	3	4%	Hospitality, Leisure, Sport & Tourism	2.1
6	African Journal of Hospitality, Tourism and Leisure	2	3%	-	-
7	Bulletin of Geography-Socio-Economic Series	2	3%	Geography	0.7
8	Tourism and Hospitality Research	2	3%	Hospitality, Leisure, Sport & Tourism	3.0
9	Tourism Geographies	2	3%	Hospitality, Leisure, Sport & Tourism	4.1
10	Nature Climate Change	1	1%	Environmental Sciences Meteorology & Atmospheric Sciences Environmental Studies	30.3
11	Annals of Tourism Research	1	1%	Hospitality, Leisure, Sport & Tourism Sociology	10.4
12	Applied Environmental Education and Communication	1	1%	-	-
13	International Journal of Contemporary Hospitality Management	1	1%	Hospitality, Leisure, Sport & Tourism Management	9.1
14	Journal of Destination Marketing & Management	1	1%	Hospitality, Leisure, Sport & Tourism Management	8.9
15	Journal of Hospitality and Tourism Management	1	1%	Hospitality, Leisure, Sport & Tourism Management	7.6

16	Journal of Transport Geography	1	1%	Transportation Economics Geography	5.7
17	Conservation Biology	1	1%	Ecology Environmental Sciences Biodiversity Conservation	5.2
18	Environmental Science & Policy	1	1%	Environmental Sciences	4.9
19	International Journal of Environmental Research and Public Health	1	1%	Public, Environmental & Occupational Health	4.614
20	Journal of Environmental Planning and Management	1	1%	Regional & Urban Planning Development Studies	4.4
21	Journal of Hospitality & Tourism Research	1	1%	Hospitality, Leisure, Sport & Tourism	4.4
22	Tourism Economics	1	1%	Economics Hospitality, Leisure, Sport & Tourism	3.6
23	Marine Policy	1	1%	Environmental Studies International Relations	3.5
24	Tourism Recreation Research	1	1%	Hospitality, Leisure, Sport & Tourism	3.4
25	Scandinavian Journal of Hospitality and Tourism	1	1%	Sociology Hospitality, Leisure, Sport & Tourism	3.1
26	European Journal of Tourism Research	1	1%	Hospitality, Leisure, Sport & Tourism	2.9
27	Geographical Research	1	1%	Geography	2.9
28	Environmental Education Research	1	1%	Education & Educational Research Environmental Studies	2.6
29	Atmosphere	1	1%	Environmental Sciences Atmospheric Sciences	2.5
30	Journal of Environmental Economics and Policy	1	1%	Environmental Studies	1.9
31	Managing Sport and Leisure	1	1%	Management	1.9
32	Landscape Research	1	1%	Environmental Studies Geography	1.7
33	Urban Planning	1	1%	Urban Studies	1.7
34	Fennia-International Journal of Geography	1	1%	Geography	1.3
35	Climate Research	1	1%	Meteorology & Atmospheric Sciences Environmental Sciences	1.2
36	Zoo Biology	1	1%	Zoology Veterinary Sciences	1.2
37	African Geographical Review	1	1%	Geography	0.9
38	Human Ecology Review	1	1%	Environmental Studies Sociology	0.8
38	Engineering Technology & Applied Science Research	1	1%	Engineering, Multidisciplinary	0.55
39	e-Review of Tourism Research	1	1%	-	-
40	Journal of Geoscience Education	1	1%	-	-
41	International Journal of Sustainable Development and Planning	1	1%	-	-
42	Pirineos	1	1%	-	-
43	Procedia Engineering	1	1%	-	-
44	Springer Nature	1	1%	-	-

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