

Research Article

## Determinants of visitor climate change risk perceptions in Acadia National Park, Maine, USA



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ABSTRACT

Nature-based tourism is one of the most economically important industries in the state of Maine, USA. Climate change impacts are projected to affect important tourism assets in Maine, which could result in behavioral shifts related to destination selection, seasonal visitation, and activity participation. Risk perceptions can be important predictors in visitor travel decisions. Recent tourism studies have focused on the effects of climate impacts on risk perceptions, but few have examined the social-psychological drivers of climate change risk perceptions. Drawing on social-psychological theories, we address this gap by understanding visitor climate change risk perceptions in Maine. We surveyed visitors to Acadia National Park in the summer of 2018 to assess the impact of socio-demographics, cognition, experience, and socio-cultural factors on visitor climate change risk perceptions. We used two-stage cluster probability sampling and intercepted 1317 visitors on site; 480 participants completed the online follow-up survey. Using hierarchical regression, we explained 45.5% of the variance in visitors' climate change risk perceptions at a nature-based tourism destination. Visitors identifying as female, having higher levels of belief in climate change, more first-hand experience with climate impacts, and a higher altruistic values orientation amplified risk perceptions. Understanding determinants of climate change risk perceptions within an outdoor recreation setting has implications for offering high quality visitor experiences while maintaining the integrity of the natural resource base upon which visitation relies.

**Management implications:** Risk perceptions can be important predictors of visitor travel behavior. Climate change is expected to impact nature-based tourism visitor experiences and travel decisions, natural and cultural resources that serve as attractions, and visitor safety in protected areas. Understanding the drivers of climate change risk perceptions are important for managing visitors and their recreation behaviors while providing satisfactory tourism experiences. If park managers and other tourism stakeholders want to convey information about climate change with the goal of influencing perceptions and behaviors, we suggest that they focus on visitors' past experiences with climate change impacts and appeals to altruistic values, rather than solely providing climate change facts. Understanding how to motivate visitor compliance with park policies and visitor resource use guidelines will be critical in maintaining positive visitor experience in nature-based tourism settings and protecting the integrity of natural and cultural resources from changes in visitation, such as increased tourist numbers.

### 1. Introduction

The effects of climate change are already being felt in the tourism

industry worldwide, with regional impacts requiring adaptation by stakeholders. Coastal, mountain, and winter tourism destinations are especially vulnerable to climate and weather impacts (UNEP, 2008).

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Climate change will affect tourism demand and seasonality in many destinations, which is expected to shift based on different climate change scenarios (Amelung, Nicholls, & Viner, 2007; Gossling, Scott, Hall, Ceron, & Dubois, 2012; Kanazawa, Wilson, & Holmberg, 2018; McCreary, Seekamp, Larson, Smith, & Davenport, 2019; Perry, Manning, Xiao, & Valliere, 2018; Smith et al., 2016). Visitor experiences in protected areas, such as national parks, can influence climate change perceptions and may vary depending on the type of visitor experience (e.g., terrestrial versus marine environment) and visitor demographics (Brownlee, Hallo, & Krohn, 2013; Brownlee, Hallo, Wright, Moore, & Powell, 2013).

Risk perceptions of climate change can influence travel behaviors of tourists. For example, Huebner found a strong association between climate change risk perceptions and visitors' changes in travel behavior, such as destination selection, activities pursued, and spending (Huebner, 2012). Additionally, a recent study in Acadia National Park (ANP) found that visitors perceived the area to be vulnerable to climate change effects that are likely to impact the natural environment and infrastructure, particularly sea level rise, extreme weather, and disruption to island access (De Urioste-Stone, Le, Scaccia, & Wilkins, 2016). De Urioste-Stone et al. (2016) found that visitors concerned with changes that might put their personal well-being at risk were more likely to mention potential changes in their future travel behavior.

The goal of this paper is to examine what factors shape climate change risk perceptions of visitors to ANP. Climate change risk perceptions can be an important predictor of shifts in visitation to and in tourism destinations, though not all visitor segments will respond in the same manner (Dawson, Havitz, & Scott, 2011; Pröbstl-Haider, Dabrowska, & Haider, 2016; Wilkins, De Urioste-Stone, Weiskittel, & Gabe, 2018). Understanding these shifts in visitation is crucial for tourism planners and managers to cope with the negative impacts of climate change on visitation while also helping stakeholders adapt and take advantage of emerging opportunities (Haegeli & Pröbstl-Haider, 2016). With emerging evidence of a changing climate, it is essential to understand how changes in climate trends may impact visitation so that tourism managers can adapt to these shifts while continuing to meet visitor expectations and resource management goals.

### 1.1. Risk perceptions and tourism

Risk has been defined as the “things, forces, or circumstances that pose danger to people or to what they value,” and risk is typically described in terms of a likelihood or probability of loss occurring (McComas, 2006, p. 215). This definition of risk led early analysts to undervalue the complex, subjective way that audiences internalize and interpret information, leading to an “all we have to do is tell them the numbers” mentality when communicating risk (Fischhoff, 1995). More recently, the field of risk perception and communication has focused on understanding the nature and antecedents of subjective risk assessments (Bodemer & Gaissmaier, 2015; Slovic, Finucane, Peters, & MacGregor, 2004). Climate change risk perceptions specifically refer to subjective evaluation of climate change as a hazard, threat, or phenomenon (Shakeela & Becken, 2015).

Understanding visitors' risk perceptions of climate change are especially important for nature-based tourism destinations and other areas that are sensitive to climate change impacts (Gossling et al., 2012). In relation to tourism, risk perceptions can be an important predictor of visitor behaviors, such as destination selection, seasonal visitation patterns (i.e., when tourists choose to visit a destination), and the activities in which visitors choose to participate (De Urioste-Stone, Scaccia, & Howe-Poteet, 2015; Kanazawa et al., 2018; Karl, 2018; Perry et al., 2018). Conversely, some studies found that tourists' perceptions of climate change risks are unlikely to alter visitor travel decisions (Hestetun et al., 2018; Lise & Tol, 2002; Seekamp, Jurjonas, & Bitsura-Meszaros, 2019). Awareness of climate change can impact tourist behavior due to shifts in climatic appeal and the image of the

destination (Atzori, Fyall, & Miller, 2018; Csete & Szécsi, 2015; Dillimono & Dickinson, 2015; Karl, 2018). In some cases, perceptions of climate conditions or environmental changes are just as important to consumer choices as the actual conditions (Huebner, 2012). It is therefore important to understand how tourists to climate sensitive destinations perceive their risk to climate change and what factors shape those risk perceptions.

### 1.2. Conceptual foundations

Previous risk perceptions theories have described the influence of socio-demographics, cognition, experience, and socio-cultural factors on visitor climate change risk perceptions (Dunwoody & Griffin, 2015; Kasperson et al., 1988; van der Linden, 2015), and we focus on a combination of social and psychological predictors. In past studies, socio-demographic factors that influence risk perceptions include gender, political affiliation, and sometimes age. Identifying as female and being affiliated with a liberal political party often increases climate change risk perception (Safi, Smith, & Liu, 2012; van der Linden, 2015; Ziegler, 2017). A recent study conducted among visitors to Mount Desert Island (MDI) in Maine revealed that younger visitors (18–30 years of age) are more likely to believe that climate change will impact tourism in ANP compared to visitors older than 60 years (De Urioste-Stone et al., 2015), though other studies find age to be an insignificant predictor of risk perceptions (Safi, James, & Liu, 2012; van der Linden, 2015).

Cognitive factors influence risk perceptions, including knowledge of climate change, belief in anthropogenic climate change, and perceived self-efficacy. Higher levels of climate change knowledge are often associated with higher levels of concern and perceived risk (Milfont, 2012; Pidgeon, 2012; van der Linden, 2015); however, Kellstedt's team found that knowledge was negatively associated with climate change risk perceptions (Kellstedt, Zahran, & Vedlitz, 2008). A range of cognitive barriers prevent the public from understanding climate change. These include, but are not limited to, lacking knowledge on the cause and extent of climate change, environmental numbness (feeling emotionally indifferent due to the sheer size of the problem), uncertainty of impacts and appropriate actions and the relative benefits of such actions, perceived control (how capable people feel to act in a certain way), and optimism bias, the belief you will be less likely to experience negative events (Gifford, 2011; Horne, De Urioste-Stone, & Daigle, in review; Slovic, 2007; Stern, 2018; Weinstein, 1989). Belief in anthropogenic climate change can also increase risk perceptions (Safi et al., 2012). Leiserowitz found that 62% of Americans believed climate change was caused mostly by human actions (Leiserowitz et al., 2020). Despite belief in climate change, climate change can often be perceived as something impacting geographically and temporally distant peoples, a phenomenon referred to as psychological distancing (Leiserowitz, 2005; Zwickle & Wilson, 2014).

Experiential processes include personal experiences and affect, and these factors shape risk perceptions. Experiencing an event that is the result of climate change first hand usually equates to higher risk perceptions, though there are challenges measuring experiences using self-reporting instruments and the attribution of impacts to climate change (Milfont, 2012; Pidgeon, 2012; Spence, Poortinga, & Pidgeon, 2012; van der Linden, 2014). The type of environmental impact may play an important role in determining risk perceptions as not all first-hand experience with climate impacts results in higher risk perceptions. For example, winter tourism stakeholders in Western Maine who experienced local climate change impacts were more likely to have higher risk perceptions than interview participants who did not feel they were experiencing climate change impacts (Horne et al., in review). In contrast, Safi et al. (2012) found that drought in Nevada did not contribute to higher perceptions of risk among farmers and ranchers, possibly because drought was viewed as a natural occurrence in the area and was thus not cognitively linked to climate change. In another instance, experience with extreme storm and flooding increased risk

perceptions in UK residents (Demski, Capstick, Pidgeon, Sposato, & Spence, 2017). The type of environmental impact may play an important role in determining risk perceptions and whether or not the event is perceived as natural. In addition to personal experiences with climate change, emotions are experiential processes that determine risk perceptions. Information processing is guided by affect and emotions, and affect was the most important predictor of personal risk perceptions of climate change in van der Linden's study of social-psychological determinants of risk (2015). Affect incorporates morals and reason to form risk perceptions that could lead to mitigation actions through altruistic emotions (Roeser, 2012).

Values can also impact risk perceptions. Cultural frameworks shape risk perceptions at a societal level, while values shape risk perceptions on an individual level (van der Linden, 2015). A value is a "transsituational goal varying in importance, which serves as a guiding principle in the life of a person" (Schwartz, 1994). Values are relatively stable and related to the core of one's identity (Heberlein, 2012). Values orientation have been traditionally divided into two dimensions, (a) openness to change versus conservatism and (b) social/self-transcendent versus egoistic/self-enhancement; however, more recent studies have distinguished three value orientations: biospheric, altruistic, and egoistic (DeGroot & Steg, 2007). Biocentric and altruistic worldviews are often associated with higher concern for environmental issues, including climate change and support for ecofriendly action (Dietz, Dan, & Shwom, 2007; Stern, 2018; Wynne & Sutton, 2015). For example, an analysis of US citizens found that environmental values played a significant role in climate change beliefs and attitudes (Ziegler, 2017). A recent study of UK citizens revealed altruism, not environmental values, and concern for poorer people suffering from climate impacts had a strong influence in adopting low carbon lifestyles (Howell, 2013).

### 1.3. Tourism and climate change in Maine

Tourism is one of Maine's most important industries, generating nearly 110,000 jobs (16% of employment in Maine) and \$6.2 billion USD in revenue (Maine Office of Tourism, 2019). Tourism expenditures have increased in recent years, and spending associated with outdoor recreation is also increasing (Maine Office of Tourism, 2019). Almost half of overnight visitors to Maine engaged in some nature-based tourism activity, while 23% indicated that outdoor recreation was their primary reason for visiting the state (Maine Office of Tourism, 2019). Much of Maine's visitation is concentrated along the coast, with the highest numbers during summer months (Maine Office of Tourism, 2019). Maine is divided into eight tourism regions, with Downeast and Acadia, Mid-Coast, Greater Portland and Casco Bay, and the Maine Beaches covering the coastline. ANP is located in the Downeast and Acadia region. Visitation to Downeast and Acadia is increasing as 18% of 2018 visitors indicated that this region was their primary destination in Maine, an increase from 15% in 2017 (Maine Office of Tourism, 2019). The Downeast and Acadia region is tied with the Maine Highlands as the most popular destination for first-time visitors (Maine Office of Tourism, 2019). ANP is a key attraction within the Downeast and Acadia region, attracting 3.4 million visitors in 2019 (NPS, 2020b).

With a heavy economic reliance on outdoor recreation, Maine's nature-based tourism industry is – and will continue to be – altered by climate change. Since 1895, the average annual temperature in Maine has increased by 1.67 °C and is expected to increase another 1.67–2.78 °C by 2050. The summer season has increased by two weeks since the early 1900s and is likely to increase another two weeks by 2050 (Fernandez et al., 2020). Maine is expected to receive more precipitation in the form of rain, mainly in fall and summer, as a result of climate change (Fernandez et al., 2020). Additionally, rising sea levels, ocean acidification, rising ocean temperatures, species and ecozone shifts, changing fisheries, disappearing salt marshes, beach erosion, and increased flooding events are all impacting coastal destinations in the state (Birkel & Mayewski, 2018; Horton et al., 2014). Previous research

indicates that a third of visitors to Maine will alter their plans in response to weather conditions, though visitors to ANP indicated they would not be deterred from visiting in spite of negative environmental changes due to high levels of place attachment (Wilkins & De Urioste-Stone, 2018; Wilkins et al., 2018). This is consistent with a previous study predicting increased visitation to ANP under climate change conditions (Fisichelli, Schuurman, Monahan, & Ziesler, 2015).

### 1.4. Aim and hypotheses

Our study aims to evaluate what factors determine ANP visitor climate change risk perceptions. Our hypotheses are as follows:

**H.1.** Female, younger, more politically liberal visitors will have higher risk perceptions than older, male, more politically conservative visitors.

**H.2.** Visitors with higher levels of climate change knowledge will have higher climate change risk perceptions than visitors with lower levels of knowledge.

**H.3.** Visitors who have more experience with climate change impacts will have higher risk perceptions than visitors with little experience with climate change impacts.

**H.4.** Visitors with higher biospheric values and higher altruistic values will perceive their risk from climate change as higher than visitors who have lower biospheric and altruistic values.

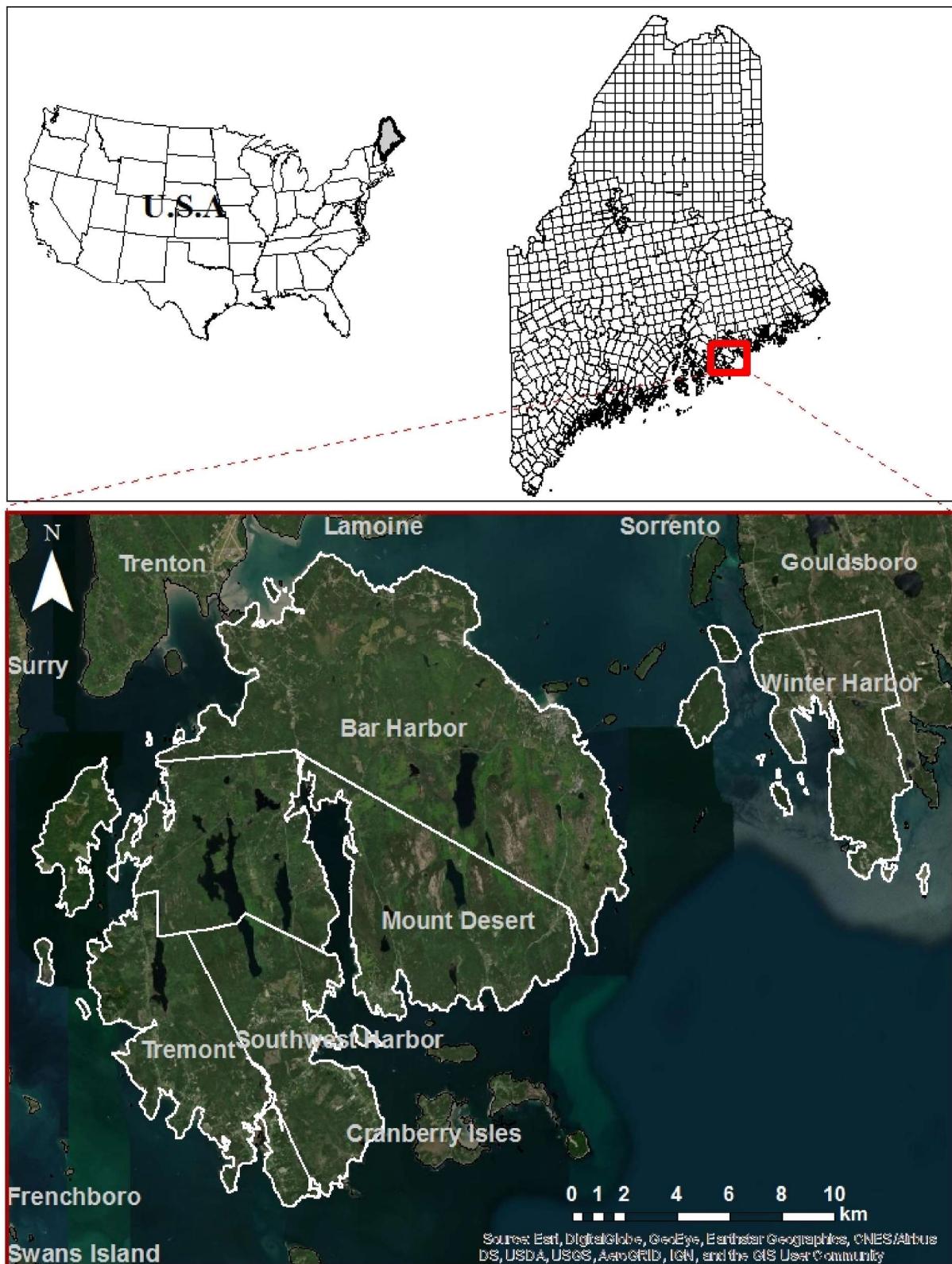
## 2. Methods

### 2.1. Study site

Mount Desert Island (MDI) is the largest island off the coast of Maine with a year-round population of approximately 10,000 (Census, 2012). The location and extent of the study area are presented in Fig. 1. ANP is the main attraction on the island, attracting over 3.4 million visitors annually (NPS, 2020b). Visitors to ANP contributed \$388 million to nearby gateway communities, supporting 5600 jobs (NPS, 2019). Key attractions in ANP include scenic coastal and mountain views, nature-based recreational activities such as hiking, biking, boating, swimming, climbing, camping, and many cultural and historical attractions, such as the carriage roads, Park Loop Road, and Jordan Pond House. Though ANP is one of the National Park Service's smallest parks, it is ranked among the top 10 in visitor numbers (NPS, 2020a). The highest visitation occurs between May and October (NPS, 2020a). Due to the seasonal influx of tourists, MDI becomes very busy between May and October but remains relatively quiet during the winter months.

### 2.2. Instrument development, sampling, and data collection

To identify factors contributing to tourist climate change risk perceptions, we used a two-stage probability cluster sampling strategy whereby survey dates were chosen at random, as were visitor groups using interval sampling once on site (Scheaffer, Mendenhall, Ott, & Gerow, 2012; Wilkins et al., 2018). Throughout the summer and early fall of 2018, we approached tourists at visitor centers, trail heads, and key outdoor recreation attractions within the study site asking them to participate in an online survey after their visit, while conducting a short intercept survey to help increase response rate (Dillman, Smyth, & Christian, 2014). Upon making contact with participants, we asked questions related to their travel behavior and then handed them a postcard with a more detailed project description and a link to the online follow-up survey. We also asked participants for contact information so that we could send up to two follow-up postcards or e-mails to encourage survey participation (Dillman et al., 2014). To increase response rate, participants had the opportunity to enter themselves into a giftcard drawing at the end of the study (Dillman et al., 2014). The online survey was completed by visitors after their trip to ANP and



**Fig. 1.** Acadia National Park located on Mount Desert Island, including the towns of Mount Desert, Bar Harbor, Southwest Harbor, and Tremont, and Schoodic Peninsula, including Winter Harbor.

consisted of close-ended questions with previously tested scales that measured socio-demographics, cognitive factors, experiential processes, and socio-cultural factors to assess risk perceptions among tourists (van der Linden, 2015).

We recoded scales such that higher numbers corresponded to higher levels of agreement or higher threat levels. Then, we used factor analysis to determine subconstructs associated with cognition, socio-cultural values, and risk perceptions, with varimax rotation and threshold

values set to 0.50 (Herve, 2003; Tabachnick & Fidell, 2013). Once subconstructs were identified, we tested each scale's reliability using Cronbach's alpha (See Table 1 for instrument description and Cronbach's alphas). Next, we created composite measures for each subconstruct by averaging item scores (non-weighted). We also included a randomized experiment in the survey to test the effects of different message frames (health message, weather message, no message) on risk perceptions. Survey participants were randomly assigned to groups that received one of three treatments: no message (control), a message about increasing tick-borne illness as habitat becomes more suitable due to climate change, and a message about increasing extreme weather events affecting visitor safety as a result of climate change. The results of the messaging experiment are not reported here, but we controlled for these experimental groups in the analysis.

This table describes the variables used in our hierarchical regression analysis, including the number of questions (items) used to assess each sub-construct, their reliability for our sample, whether the variables were continuous or dichotomous, and the number of scale points, including whether or not there were scale options for "I don't know" and "Unsure," which were treated as missing data. For our risk construct, 9.1% indicated they were unsure. For all other constructs there was a less than 1% response rate for the "I don't know" option.

### 2.3. Analysis overview

We analyzed visitor survey responses in IBM SPSS Statistics 25. Descriptive statistics were generated for socio-demographic, cognitive, experiential, socio-cultural, and risk variables. We calculated response bias using Pearson's chi-square test to compare demographics, cognitive, experiential, and values between early respondents and later respondents from the online follow-up survey (De Urioste-Stone et al., 2016). We calculated total scores for all scales (for descriptive statistics, see Tables 1–3), winsorized univariate outliers with z-scores  $\pm 3.29$  and transformed data that were skewed to meet the assumption of normality (Tabachnick & Fidell, 2013). Models were run with transformed (log transformation) and non-transformed variables and results were not significantly different; therefore, reported results use non-transformed variables for ease of interpretation. We used hierarchical regression analysis to determine the significance of independent variables and the variance in climate change risk perceptions explained by socio-demographics, cognitive, experiential, and socio-cultural independent variables.

We present the range of the scales for each variable and descriptive statistics, including the mean, standard deviation, minimum and maximum values, and the N for each variable.

## 3. Results

### 3.1. Visitor profile

We intercepted 1317 visitor groups to ANP and 480 of those intercepted took the online follow-up survey, giving us a response rate of 36.45% (See Table 4 for participant demographics). Of those who participated in the follow-up survey, 84% were traveling as a family on vacation, with a mean size of 3.30. Top visitor activities included walking, sightseeing/driving for pleasure, hiking/backpacking, and eating lobster. Our sample was 59.44% women and our sample had a mean age of 51.98. Our sample was highly educated and identified as mostly politically liberal. When testing for response bias, there were no significant differences in cognitive, experiential, and socio-demographics between early and later respondents. While there was no significant difference between altruistic or egoistic values, the chi-square test revealed a difference in biospheric values orientation. Later respondents had higher biospheric values compared to earlier respondents.

### 3.2. Regression results

The hierarchical regression analysis resulted in five models that included the messaging experiment, socio-demographics, cognition, experience, and socio-cultural factors. Model five explained the most variance (adjusted  $R^2 = 0.455$ ) in visitor climate change risk perceptions (see Table 5 for regression results). Model 1 controlled for an experiment that is not included as part of this paper. Model 2 established a baseline with socio-demographic variables. Gender ( $\beta = 0.179$ ,  $p < 0.01$ ) and political affiliation ( $\beta = 0.186$ ,  $p < 0.01$ ) were significant predictors of risk perceptions. Identifying as female and having a liberal political affiliation significantly increased visitor climate change risk perceptions. Age was not a significant predictor ( $\beta < 0.01$ ,  $p = 0.773$ ). Model 2 explained 21.9% of the variance in visitor climate change risk perceptions ( $F(5,292) = 17.625$ , adjusted  $R^2 = 0.219$ ,  $\Delta$  adjusted  $R^2 = 0.214$ ,  $p < 0.01$ ).

Model 3 incorporated three cognitive predictors, belief in climate change, actual knowledge, and perceived knowledge, to determine if additional variance in risk perceptions could be explained. Gender ( $\beta = 0.174$ ,  $p < 0.01$ ) remained a significant predictor. Belief in climate change ( $\beta = 0.269$ ,  $p < 0.01$ ) was the only significant cognitive predictor, meaning that participants with higher belief in climate change perceived their risk from climate change as higher. Actual knowledge ( $\beta = 0.060$ ,  $p = 0.120$ ) and perceived knowledge ( $\beta = -0.012$ ,  $p = 0.645$ ) were not significant predictors of visitor climate change risk perceptions. Model 3 significantly explained more variance in climate change risk perceptions than model 2 ( $F(8,289) = 22.567$ , adjusted  $R^2 = 0.367$ ,  $\Delta$  adjusted  $R^2 = 0.148$ ,  $p < 0.01$ ).

Model 4 added experience as a predictor of climate change risk perceptions. Gender ( $\beta = 0.195$ ,  $p < 0.01$ ) and belief in climate change ( $\beta = 0.229$ ,  $p < 0.01$ ) remained significant predictors. Experience was also a significant predictor of visitor risk perceptions ( $\beta = 0.044$ ,  $p < 0.01$ ). This means that as a visitor's level of experience with climate change impacts increased, their climate change risk perceptions also increased. As in the previous models, identifying as female and having higher belief in climate change increased visitor risk perceptions. This model explained significantly more variance in visitor climate change risk perceptions than the previous model ( $F(9,288) = 23.803$ , adjusted  $R^2 = 0.409$ ,  $\Delta$  adjusted  $R^2 = 0.042$ ,  $p < 0.01$ ).

Model 5 incorporated value orientations (biospheric, altruistic, and egoistic). Gender ( $\beta = 0.172$ ,  $p < 0.01$ ), belief in climate change ( $\beta = 0.210$ ,  $p < 0.01$ ), and experience ( $\beta = 0.038$ ,  $p < 0.01$ ) remained significant predictors. Altruistic value orientation was a significant predictor in model 5 ( $\beta = 0.066$ ,  $p = 0.007$ ). Visitors with higher altruistic values had higher risk perceptions. Model 5 significantly explained more variance in visitor risk perceptions ( $F(12,285) = 21.633$ , adjusted  $R^2 = 0.455$ ,  $\Delta$  adjusted  $R^2 = 0.046$ ,  $p < 0.01$ ). Our fifth model explained the most variance in visitor climate change risk perceptions.

Based on the results of these analyses, we partially accept Hypothesis 1 as identifying as female was associated with increased risk perceptions; however, political affiliation was not significant in later models. We partially accept our second hypothesis as higher belief in climate change was significantly associated with increased risk perceptions, but actual knowledge and perceived knowledge were not significant predictors. We accept Hypothesis 3 as more experience with climate change impacts was associated with higher risk perceptions. We partially accept our fourth hypothesis as a higher altruistic values orientation was a significant predictors of risk perceptions; however, having a higher biospheric values orientation did not significantly increase visitor climate change risk perceptions.

## 4. Discussion

The goal of this study was to estimate the role that socio-demographics, cognitive, experiential, and socio-cultural factors have in determining climate change risk perceptions in visitors to ANP. Our

**Table 1**  
Instrument description including example questions for each construct, scale information, and Cronbach's alphas.

Construct	Sub-Construct	Selected Items	Items adapted from original studies	No. Items	Reliability Measure	No. Scale Items	Scale Range
Cognition	Belief in Climate Change	'On average around the earth, I believe the following are happening ...' The temperature of the ocean is rising. The number of flooding events is increasing. Sea level is rising. Climate change is currently happening. Humans contribute to climate change. Carbon dioxide emissions contribute to climate change. Climate change is caused by heat trapped in cities. I know a lot about climate change. The hole in the ozone layer causes climate change. Please check the environmental issues that you have personally experienced during your lifetime: Changes in precipitation Flooding Wildfires	Brownlee, Hallo, Wright, Moore, and Powell (2013)	4	$\alpha = 0.95$	6	Strongly agree-Strongly disagree; I don't know
Cognition	Actual Knowledge		van der Linden (2015)	3	$\alpha = 0.82$	8	Strongly agree-Strongly disagree; I don't know
Cognition	Perceived Knowledge		van der Linden (2015)	3	$\alpha = 0.64$	8	Strongly agree-Strongly disagree; I don't know
Experience	Experience	Please check the environmental issues that you have personally experienced during your lifetime: Changes in precipitation Flooding Wildfires	Akerlof et al., 2013	–	–	2	Yes/No
6							
Socio-Cultural	Biospheric Values	For each value listed below, please rate the extent to which you consider it to be a guiding principle in your life: Preventing pollution Respecting the earth	van der Linden (2015)	3	$\alpha = 0.85$	9	Of extreme importance-Opposed to my values
Socio-Cultural	Altruistic Values	For each value listed below, please rate the extent to which you consider it to be a guiding principle in your life: Promoting peace Having social justice	van der Linden (2015)	3	$\alpha = 0.83$	9	Of extreme importance-Opposed to my values
Socio-Cultural	Egoistic Values	For each value listed below, please rate the extent to which you consider it to be a guiding principle in your life: Having authority Being influential	van der Linden (2015)	3	$\alpha = 0.80$	9	Of extreme importance-Opposed to my values
Risk Perceptions	Risk	Please rate the following climate change factors based on your perception of this as a potential threat to coastal Maine. Extreme weather events Higher temperatures Increased rain	van der Linden (2015)	7	$\alpha = 0.91$	4	High threat-Not a threat; Unsure

**Table 2**

Descriptive statistics for minimum, maximum, mean, standard deviation, and sample size for each sub-construct.

Sub-Construct	Scale Range	Mean	SD	Min	Max	N
Belief	1–6	4.32	0.71	2.20	5	424
Actual Knowledge	1–8	5.89	0.95	2.75	7	445
Perceived Knowledge	1–8	4.54	1.57	1	7	425
Experience	0–13	5.98	2.60	1	12	442
Biospheric Values	1–9	7.57	1.23	3.50	9	425
Altruistic Values	1–9	7.46	1.35	3.33	9	424
Egoistic Values	1–9	5.01	1.57	2	9	423
Risk	1–4	1.97	0.50	1	3	376

results indicate that gender, belief in climate change, experience, and altruistic values are all significant predictors of climate change risk perceptions (Model 5) and accounted for 45.5% of variance in visitor climate change risk perceptions. Consistent with prior studies, female participants had higher climate change risk perceptions than male participants (De Urioste-Stone et al., 2015; Scannell & Gifford, 2011; van der Linden, 2015). Surprisingly, political affiliation was not a significant predictor in the final model. This could be related to participants weakly identifying with a political affiliation, thereby reducing the importance of political orientation on climate change perceptions. Previous studies have found that a liberal political affiliation increases climate change risk perceptions (Lee, Markowitz, Howe, Ko, & Leiserowitz, 2015; Safi et al., 2012), though not always (Kellstedt et al., 2008).

#### 4.1. Higher climate change belief increases risk perceptions

Unsurprisingly, higher levels of anthropogenic climate change belief resulted in higher risk perceptions (Lee et al., 2015). Knowledge of climate change and perceived knowledge were non-significant predictors. Previous work by van der Linden (2015) delineated between cause, impact, and response knowledge, all of which significantly predicted climate change risk perceptions in his sample of UK residents. Informing the public about the consequences of climate change (impact knowledge) was more effective in promoting mitigation behaviors among an environmentally active sample than communicating cause knowledge or response knowledge (Ortega-Egea, García-de-Frutos, & Antolín-López, 2014). Conversely, knowledge of climate change has resulted in lower concern for its effects and lower feelings of

responsibility in taking climate action (Kellstedt et al., 2008). Though not within the context of climate change, Masuda and Garvin (2006) also noted the relationship between cultural world views, norms, and participants' risk perceptions. Their findings indicate that individual place-based experiences and cultural worldviews impacted risk perceptions (Masuda & Garvin, 2006). While norms were not included in our survey, these studies suggest a potentially complex connection between knowledge, norms, culture, and risk perceptions that merits further investigation.

#### 4.2. Experience with climate change impacts increases risk perceptions

While climate change cannot be directly experienced, climate change impacts offer an indirect way to experience this large-scale, global phenomenon. Consistent with previous work, experience with climate change impacts was a significant predictor of climate change risk perceptions (Demski et al., 2017; Spence, Poortinga, Butler, & Pidgeon, 2011; van der Linden, 2015). The role of experience with climate change impacts is reliant on participants being able to connect events to climate change as a cause (Brügger, Dessai, Devine-Wright, Morton, & Pidgeon, 2015; Safi et al., 2012). Experience with climate impacts can increase the saliency of climate change for individuals, and perceived issue saliency can be important in predicting climate change risk perceptions (Yang, Rickard, Harrison, & Seo, 2014).

#### 4.3. Visitors with altruistic values orientation have higher risk perceptions

Previous studies found that participants with high biospheric values

**Table 3**

Intercorrelations between variables.

	Health message	Weather message	Gender	Political affiliation	Age	Belief	Actual knowledge	Perceived knowledge	Experience	Biospheric values	Altruistic values	Egoistic values
1 Health message												
2 Weather message		-0.52**										
3 Gender	0.06	-0.02										
4 Political affiliation	0.03	-0.01	0.07									
5 Age	0.03	0.02	-0.03	-0.10*								
6 Belief	0.09	-0.04	0.03	0.56**	-0.03							
7 Actual knowledge	0.03	-0.03	0.09	0.58**	-0.17**	0.74**						
8 Perceived knowledge	0.12	0.06	-0.13**	-0.38**	0.15**	-0.46**	-0.44**					
9 Experience	0.08	-0.12*	-0.02	0.31	-0.02	0.38**	0.35**	-0.11*				
10 Biospheric values	0.10*	-0.12*	0.10*	0.34*	0.10*	0.45**	0.46**	-0.15**	0.37**			
11 Altruistic values	0.12*	-0.10*	0.15**	0.41	0.04	0.44**	0.46**	-0.22**	0.32**	0.73**		
12 Egoistic values	0.04	-0.06	0.03	0.20	-0.03	0.22**	0.24**	-0.02	0.18**	0.38**	0.44**	
13 Risk	0.11*	-0.03	0.22**	0.40	-0.03	0.51**	0.48**	-0.31**	0.36**	0.46**	0.50**	0.30**

Note: \*p < 0.05, \*\*p < 0.01.

**Table 4**

Visitor profile for participants who took the online follow-up survey.

Visitor Profile	Respondent Composition (%)
<b>Gender</b>	
Female	59
Male	40
Prefer not to answer	1
<b>Age range</b>	
18-30	10.5
31-50	34.1
51-70	49.4
71+over	6
<b>Education</b>	
High school or less	3.8
Some college	9.6
College degree	35.9
Graduate degree	50.7
<b>Political affiliation</b>	
Conservative	24.6
Neutral	23.6
Liberal	51.8
<b>Main purpose of visit</b>	
Business	0.4
Passing through	1.7
Vacation	89.6
Visiting family/friends	2.6
I live here, seasonal residence	3.4
Other	2.3
<b>Travel group</b>	
Self	4.4
Co-workers	0.8
Family	84
Friends	10.6
Other	2.7
<b>First time visit to ANP</b>	
Yes	61.2
No	38.8
<b>Primary leisure activity</b>	
Nature-based tourism	91.2
Cultural tourism	2.5
Shopping	0.4
Other	5.8

tend to have higher climate change risk perceptions (Gifford & Nilsson, 2014; van der Linden, 2015; Yang et al., 2014). In our study, a high biospheric value orientation was not a significant predictor of climate change risk perceptions. This is perhaps because biospheric values were very high among all participants, as you might expect of visitors to a national park. We did find that having a more altruistic values orientation increased climate change risk perceptions. This could perhaps be explained by recent studies unpacking psychological distancing. Psychological distancing previously assumed that making a hazard more salient or psychologically closer to an audience (e.g., geographically local, personally impacted, more immediate time scale, and high likelihood of occurring) would increase the perception of risk associated with it (Zwickle & Wilson, 2014). More recent studies have highlighted that psychologically close threats do not necessarily translate into high perceived risk (Brügger et al., 2015; Schuldt, Rickard, & Yang, 2018; Spence et al., 2012). In relation to altruistic values orientation, some studies suggest that highlighting the risks to other people (more psychologically distant) increases risk perceptions and willingness to act (Spence et al., 2012), though not all studies agree (Schuldt et al., 2018). Based on our results, it may be that altruistic emotions related to ANP caused visitors to care about the area.

#### 4.4. Limitations and future research

Future research could examine the influence of affective response or social norms on visitor climate change risk perceptions. Affect has been an important predictor of climate change risk perceptions in previous studies (Poortinga, Spence, Whitmarsh, Capstick, & Pidgeon, 2011; Shakeela & Becken, 2015) and would likely increase the predictive power of our model. People typically feel obligated to act in accordance with their values, and thus normative behaviors arise from values if norms are activated (DeGroot & Steg, 2007; Stern, 2018).

Visitation has been increasing to ANP in the fall season, and we believe that visitor demographics for fall visitors are different from summer visitors (i.e., older, fewer families, more Maine residents, etc.), which could result in differences in visitor risk perceptions (especially if comparing residents to non-residents). Our sample includes primarily summer visitors; future research could concentrate on increasing the

**Table 5**

Hierarchical regression results for all five climate change risk perception models. Entries are standardized beta coefficients. Model 1 controlled for a messaging experiment (not part of this paper), Model 2 added socio-demographic variables, Model 3 incorporated cognitive variables, Model 4 added experience, and Model 5 incorporated values orientations.

Independent variables	Messaging	Socio-demographics	Cognition	Experience	Socio-cultural
	Model 1 ( $\beta$ )	Model 2 ( $\beta$ )	Model 3 ( $\beta$ )	Model 4 ( $\beta$ )	Model 5 ( $\beta$ )
Weather message	0.119	0.088	0.091	0.078	0.090
Health message	0.040	0.042	0.043	0.063	0.090
Gender	–	0.179**	0.174**	0.195**	0.172**
Political affiliation	–	0.186**	0.059*	0.047	0.027
Age	–	0.001	0.001	0.001	0.000
Belief	–	–	0.269**	0.229**	0.210**
Actual knowledge	–	–	0.060	0.040	–0.001
Perceived knowledge	–	–	–0.012	–0.016	–0.021
Experience	–	–	–	0.044**	0.038**
Biospheric values	–	–	–	–	0.023
Altruistic values	–	–	–	–	0.066**
Egoistic values	–	–	–	–	0.027
adjusted $R^2$	0.005	0.219	0.367	0.409	0.455
$\Delta$ adjusted $R^2$		0.214	0.148	0.042	0.046

\* $p < 0.05$ , \*\* $p < 0.01$ .

sample of fall visitors, especially to explore if differences between residents and non-residents visiting ANP exist. Additionally, we had a response bias in our biospheric values construct where later respondents had higher biospheric values than earlier respondents, indicating that our study was not comprehensively generalizable to all ANP visitors. Given that no other constructs had a response bias, the significant predictors of climate change risk perceptions in our model are likely representative of visitors to ANP.

#### 4.5. Management implications

We applied theories from risk studies and social psychology to add to the body of outdoor recreation and tourism literature on climate change risk perceptions. Consistent with other studies in different contexts, our findings indicate that gender, belief in climate change, experience with climate impacts, and altruistic values increase visitor risk perceptions. Tourism is expected to continue to increase in the coming decades (UNWTO, 2020) and visitation to ANP is also predicted to increase (Fisichelli et al., 2015). It is important to understand visitor climate change risk perceptions to manage visitor use and provide a satisfactory tourism experience. It seems unlikely that visitation will decrease to protected areas in the short-term regardless of visitor climate change risk perceptions (Coombes, Jones, & Sutherland, 2009; Dillimono & Dickinson, 2015; Fisichelli et al., 2015; Hestetune et al., 2018; Seekamp et al., 2019). Visitor management is therefore key as protected areas experience climate impacts (e.g., extreme weather events, increased presence of ticks, and disease outbreaks) that are likely to impact visitor experiences and resource management.

Implications of our study suggest that if park managers and other tourism stakeholders want to convey information about climate change with the goal of influencing perceptions and behaviors, we suggest that they focus on visitor experiences with climate change impacts and appeals to altruistic values. For example, managers could draw attention to changes being observed, such as warmer fall seasons and increased extreme weather events, to illustrate ideas about changing climate in their educational outreach campaigns. Communication appealing to visitors' sense of altruism, such as emphasizing "we're all in this together" messages, might be effective in increasing climate change risk perceptions and possibly encouraging climate friendly behavior, such as riding the bus instead of driving in the park.

Understanding how visitors process climate change risks will help protected area managers understand how to effectively communicate changes affecting the park that might also impact visitor experiences (e.g., safety, access, etc.) (Wang & Pfister, 2008) and resource management. For example, a recent study found that communicating increased hazard from extreme weather events did little to discourage outdoor recreation among visitors to Minnesota's north shore (Kanazawa et al., 2018). This suggests that managers need to find different ways to appeal to visitor risk perceptions other than providing official warnings and that risk perceptions do not necessarily translate into behavioral outcomes (Kanazawa et al., 2018). Protected area managers will have to increasingly communicate climate change risks to visitors at different stages of their trip (Jonas & Mansfeld, 2017), and understanding how to motivate compliance with park policies will be critical in maintaining positive visitor experiences.

Additionally, adaptation initiatives within ANP could alleviate any

negative shifts in visitor perceptions and behaviors, such as perceived loss of scenery, unappealing climatic image, or belief that the destination is no longer safe (Atzori et al., 2018; Bujosa, Torres, & Riera, 2018; McCreary et al., 2018). In a recent study at Acadia National Park, visitors who engaged in a greater number of nature-based tourism activities (nature-based tourism generalists) were more willing to engage with climate change mitigation behaviors (Wilkins et al., 2018). Visitors aware of climate change are likely to demand more infrastructure and climate adaptation policies and might be more willing to pay for those initiatives (McCreary et al., 2018). Understanding visitor risk perceptions and expectations could help tourism stakeholders in coastal destinations, and national parks adapt to continue to meet visitor expectations, ultimately maintaining the long-term competitiveness of the tourism industry and maintaining the integrity of the natural and cultural resources even as climate conditions continue to change.

#### 5. Conclusions

Climate change risk perceptions can predict shifts in visitation, including spatial and temporal patterns to tourism destinations. In this study, we assessed the underlying psychological and social factors that explain climate change risk perceptions of visitors to a protected area destination, Acadia National Park. Using a hierarchical regression analysis, we explained 45.5% of the variance in visitor climate change risk perceptions. Identifying as female, belief in climate change, experience with climate change impacts, and a high altruistic values orientation significantly predicted climate change risk perceptions. This study contributes to the growing body of literature on visitor risk perceptions by applying theories from risk studies and social psychology. Our findings may help inform visitor management by suggesting ways to communicate with visitors to alleviate negative perceptions associated with climate change impacts within national parks and protected areas while also motivating compliance with natural and cultural resource management regulations.

#### CRediT authorship contribution statement

**Lydia Horne:** Project administration, Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **Sandra De Urioste-Stone:** Funding acquisition, Project administration, Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Erin Seekamp:** Conceptualization, Methodology, Writing – review & editing. **Parinaz Rahimzadeh-Bajiran:** Funding acquisition, Conceptualization, Methodology, Writing – review & editing. **Laura Rickard:** Conceptualization, Methodology, Formal analysis, Writing – review & editing.

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#### Appendix A

Several response options were modified for Actual Knowledge, Perceived Knowledge, Experience, and Risk constructs to make them more appropriate for the context of this study. Additionally, the stem of the Risk survey question was modified to focus specifically on the risk to tourism in Acadia National Park.

Construct	Items
Belief	<p>On average around the earth, I believe the following are happening:</p> <ol style="list-style-type: none"> <li>1. Drought is becoming more common</li> <li>2. Air temperature is increasing</li> <li>3. Ice in the Arctic is now thawing</li> <li>4. The amount of snow in mountains is decreasing</li> <li>5. The number of flooding events is increasing</li> <li>6. Sea level is rising</li> </ol>
Actual Knowledge	<p>Please indicate the extent to which you agree or disagree with the following statements:</p> <ol style="list-style-type: none"> <li>1. Humans contribute to climate change</li> <li>2. Climate change is happening</li> <li>3. Tourism contributes to climate change</li> <li>4. Carbon dioxide emissions contribute to climate change</li> </ol>
Perceived Knowledge	<p>Please indicate the extent to which you agree or disagree with the following statements:</p> <ol style="list-style-type: none"> <li>1. We are not experiencing climate change because not all places are getting hotter</li> <li>2. Climate change is caused by heat trapped in cities</li> <li>3. Climate change is just a natural fluctuation in Earth's temperatures</li> <li>4. The hole in the ozone layer causes climate change</li> <li>5. I know a lot about climate change</li> </ol>
Experience	<p>Please check all of the environmental issues you have experienced during your lifetime:</p> <ol style="list-style-type: none"> <li>1. Air pollution</li> <li>2. Changes in precipitation</li> <li>3. Changes in temperatures (heat waves, more severe winters, etc.)</li> <li>4. Climate change</li> <li>5. Flooding</li> <li>6. Hurricanes/tropical storms</li> <li>7. Infectious disease</li> <li>8. Overpopulation (of the earth by humans)</li> <li>9. Pollution of rivers and seas</li> <li>10. Rising sea levels</li> <li>11. Tornadoes</li> <li>12. Wildfires</li> </ol>
Biospheric Values	<p>For each value listed below, please rate the extent to which you consider it to be a guiding principle in your life:</p> <ol style="list-style-type: none"> <li>1. Preventing pollution</li> <li>2. Protecting the environment</li> <li>3. Respecting the earth</li> <li>4. Being unified with nature</li> </ol>
Altruistic Values	<p>For each value listed below, please rate the extent to which you consider it to be a guiding principle in your life:</p> <ol style="list-style-type: none"> <li>1. Having equality</li> <li>2. Having social justice</li> <li>3. Being helpful</li> <li>4. Promoting peace</li> </ol>
Egoistic Values	<p>For each value listed below, please rate the extent to which you consider it to be a guiding principle in your life:</p> <ol style="list-style-type: none"> <li>1. Having social power</li> <li>2. Having authority</li> <li>3. Being influential</li> <li>4. Being wealthy</li> </ol>
Risk	<p>Please rate the following climate change factors based on your perception of this as a potential threat to tourism in Acadia National Park:</p> <ol style="list-style-type: none"> <li>1. Extreme weather events</li> <li>2. Species extinction</li> <li>3. Increased presence of ticks</li> <li>4. Increased presence of mosquitoes</li> <li>5. Increased ice storms</li> <li>6. Higher temperatures</li> <li>7. Lower temperatures</li> <li>8. Increased rain</li> <li>9. Heat waves</li> <li>10. Disease outbreaks</li> </ol>

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