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RESEARCH ARTICLE

Opportunities for meaningful climate change engagement in vulnerable nature settings

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Abstract

1. Nature-based tourism has a unique opportunity, and arguably responsibility, to promote widespread action on climate change. However, research suggests an aversion to providing information that might appear divisive or 'ruin' peoples day, particularly in places that are vulnerable to degradation.
2. We explore how exposure to climate change information in vulnerable nature settings influences indicators of (i) the visitor experience and (ii) climate change engagement. Using a quasi-experimental approach, we provided climate information on tourist boats operating on the Great Barrier Reef, Australia and compared visitor experiences with a control condition where climate information was not provided. Visitor surveys ($n = 656$) assessed perceptions and experiences.
3. Overall, visitors on trips where climate information was provided were more likely to report that the reef experience exceeded their expectations and did not report any reduction in subjective trip satisfaction.
4. However, we detected minimal effects of climate information on indicators of climate engagement (threat awareness, action awareness, or information seeking), suggesting room for improvement in interpretation approach and design. Indeed, visitors reported high levels of acceptability for incorporating more information about climate change, particularly about actions.
5. *Synthesis and applications*: These results suggest that providing climate information does not undermine visitor experiences and while further research is required to determine the most effective approach for influencing climate change engagement, an appetite for more information exists. It is possible that what tourism operators are fearful of, may be an opportunity to improve outcomes aligned with both industry and environmental objectives.

KEYWORDS
behaviour change, climate communication, environmental action, marine conservation, nature-based tourism, public awareness

1 | INTRODUCTION

Nature and tourism are inherently linked. Not only does a large percentage of tourism rely on natural destinations and resources, but tourism can lead to a greater appreciation of nature which can translate into increased funding and motivation for conservation (World Travel and Tourism Council, 2022). Nature-based tourism is one of the fastest-growing tourism sectors globally and supports local, regional, and national economies (Future Market Insights, 2023; Winter et al., 2020). Coastal and marine tourism alone contributes approximately US$4.6 trillion to the global gross domestic product and plays a critical role in the development of small island states and coastal regions (Northrop et al., 2022). The rapid growth of this sector is driven by factors, such as the increasing demand for purpose-driven travel, the rise of last-chance-tourism, and the desire for what can be referred to as 'transformative experiences' in nature (Balmford et al., 2015; D'Souza et al., 2023; Elmahdy et al., 2017; Miller et al., 2020; Piggott-McKellar & McNamara, 2017; Teoh et al., 2021; Zhao & Agyeiwaah, 2023). Consequently, embracing greater stewardship and protection of nature is recognised as not only a responsibility but also as a key commercial priority for the industry moving forward (Haukeland et al., 2023).

Despite its appeal and economic significance, the potential of nature-based tourism to promote widespread stewardship action remains underexplored, especially in the context of a rapidly changing climate. Climate change poses significant challenges to nature-based tourism globally (Elmahdy et al., 2017). For instance, many iconic natural places (e.g., mountains, glaciers, low-lying islands, and coral reefs) are both popular tourist attractions and at heightened risk from climate change (IPCC, 2022; Osipova et al., 2020; Scheffer et al., 2015). However, this creates a window of opportunity to align tourism with global sustainability goals and build public and political support for stronger climate policies (Haukeland et al., 2023). Focusing on marine and dive tourism on the Great Barrier Reef (GBR), Australia, this study explores the role of nature-based tourism in strengthening public engagement with climate change and considers opportunities for nature-based tourism industries to expand their role in protecting our planet's precious natural places.

1.1 | Making climate change relevant through nature interpretation

Engaging the public is an important component of the broader societal change required to mitigate climate change and protect vulnerable ecosystems into the future. For example, reducing household energy use could account for as much as 10%–30% in emissions reductions in the next decade (Dubois et al., 2019; Environment and Climate Change Committee, 2022; IPCC, 2022). People can also share information with others, or engage with local political representatives, and contribute to the social and political pressure required for decision makers to adopt stronger climate policies (Whitmarsh & Lorenzoni, 2010; Wolf & Moser, 2011). However, a significant challenge in engaging people with these actions is a perceived lack of personal relevance (Scannell & Gifford, 2013). This often means that simply providing information on climate change, filling what is known as an *information-deficit*, is not enough to foster engagement (Moser, 2016; Suldovsky, 2017). A useful tactic to improve engagement and overcome this challenge is to ensure that climate change information presented is meaningful and relevant to the audience (Jones et al., 2017; O'Neill & Nicholson-Cole, 2009; Scannell & Gifford, 2013).

Nature-based tourism provides a unique platform to explore how people might respond to climate information that is linked to their direct experiences. For instance, information about the sites visited—known as *interpretation* (Orams, 1996)—is often provided via a range of pathways, including formal presentations, informal conversation with staff, or via books or signs (Coghlan & Kim, 2012). Interpretation can reach broad audiences (Clayton et al., 2013; Geiger et al., 2017) in part due to tourist experiences being perceived as socially and politically safe learning spaces (Geiger et al., 2017). Interpretation may be especially important for nature experiences that are unfamiliar or difficult to access (e.g., marine environments) as it can help people understand what they are seeing or experiencing (Cárdenas et al., 2021; Coghlan & Kim, 2012; Zeppel & Muloin, 2008). Research shows that incorporating interpretation in nature-based tourism can strengthen knowledge of local ecosystems and management, nature appreciation, and desire to reduce environmental impact (Coghlan & Kim, 2012; Wardle et al., 2021; Zeppel & Muloin, 2008). While much interpretation in nature-based tourism emphasises information with a local focus rather than a global focus (Armstrong & Weiler, 2002; Moscardo & Hughes, 2023), there are increasing pressures on tourism operators to offer more interpretation about climate impacts and mitigation actions, highlighting a potential opportunity for the nature-based tourism sector to contribute to the broader sustainability agenda (Ballantyne et al., 2018). Climate interpretation may be particularly well suited to areas with more visible indicators of climate change, such as alpine regions or coral reefs, which provide tangible reference points for discussion (e.g., Roberts et al., 2021). Indeed, to protect vulnerable ecosystems into the future, finding opportunities to engage and empower the public to take action on climate change is paramount (Devine-Wright et al., 2022; van der Linden & Weber, 2021).

1.2 | Are we scared to interpret a climate changed world?

Despite the potential benefits of providing climate interpretation, the nature-based tourism sector is often cautious about discussing climate change (Fernández-Llamazares et al., 2020). For instance, in a review of tourism businesses in Peak District National Park, Font et al. (2017) found that only one of 31 businesses mentioned climate change on their website. Similarly, Roberts et al. (2021) evaluated online climate interpretation across the U.S. National Park System (NPS) and discovered that 57% provided no information about climate change, despite the NPS Climate Response Strategy advocating for robust climate communication. Pereira and Mykletun (2017) also find that generally sustainability and climate issues are not well integrated in tourist guide training programs. This reluctance, sometimes termed 'green-hushing', may arise from fears of negative visitor responses, such as reduced enjoyment or feelings of moral guilt, and concerns about being perceived as hypocritical, as tourism is an extractive industry that largely relies on fossil fuels (Falchi et al., 2022; Font et al., 2017; Goldberg et al., 2018).

Research, however, suggests that providing climate information does not necessarily deter visitors. McCreary et al. (2024) found that visitors with high destination loyalty were unlikely to change their trips based on perceived climate impacts, highlighting the potential of communication strategies that foster connections to place. Additionally, some studies indicate that climate messaging can positively engage visitors. For example, Esson and Moss (2013) discovered that gloomy environmental messages in zoo settings could stimulate critical thinking and self-reflection. Lemieux et al. (2018) found that visitors to the Athabasca Glacier in Canada expressed interest in learning more about climate impacts on glaciers. He and Hinch (2021) followed this up by conducting an experiment where young adults were exposed to climate interpretation during a simulated tour of the Athabasca Glacier and found that incorporating climate interpretation had a positive effect on participants overall satisfaction, highlighting the potential for enhanced climate change engagement in tourism contexts.

Further research is needed to understand the effects of providing climate information in nature-based tourism settings and determine the best approaches for engaging visitors effectively (Wardle et al., 2021). For instance, it has been argued that interpretation that is provocative and touches on controversial issues (termed 'hot interpretation') is important for catalysing transformative change (Hvenegaard et al., 2016; Melena, 2014; Uzzell & Ballantyne, 1998). Within this context, it is possible that what tourism operators are fearful of, may be an innovative opportunity to improve outcomes aligned with environmental objectives and shape the industry's future. However, how climate interpretation influences visitor experiences and capacity for change remains largely untested.

1.3 | Theoretical framework

Transformational learning theory posits that meaningful change in individuals' beliefs, attitudes, and behaviours occurs through a process of critical reflection triggered by an experience or moment that leads them to question their existing beliefs, assumptions, or expectations (Mezirow, 1997). While immersion in nature has the potential to evoke awe and prompt individuals to develop a deep connection to ecological systems (i.e., serving as part of the initial transformative moment), research suggests that it may be insufficient to drive sustained behavioural changes alone (Day et al., 2022). The full transformative learning process must include avenues for exploring solutions and acquiring new knowledge and skills to guide actions (Mezirow, 1997). This aligns with the principles of effective hot interpretation which suggests the importance of provocation followed by providing space for reflection and encourage visitors to personalise and internalise their learnings (Ballantyne et al., 2012). Thus, complementing nature experiences with climate interpretation that contextualises the immersive experiences is an important part of the transformative process.

Another important theoretical framework to explore how experiences contribute to change is the expectancy-disconfirmation model. This model is traditionally used to measure visitor satisfaction, but also provides a framework to examine how information provision (via interpretation) may influence transformative learning outcomes (Krey et al., 2023; Oliver, 1980; Oliver et al., 1994). This model posits that satisfaction is determined by whether an experience meets, exceeds, or falls short of visitor expectations (Oliver, 1980; Oliver et al., 1994). Positive disconfirmation, where an experience exceeds expectations, may foster transformational learning by exposing visitors to unexpected insights and perspectives, which may then enhance visitor satisfaction (Krey et al., 2023). Research suggests that certain experience elements have stronger satisfaction-generating potential making them more likely to influence expectancy disconfirmation (Coghlan, 2012). For example, some research suggests that providing information in situ may help to influence positive disconfirmation by contextualising the actual experience and introducing visitors to new knowledge and perspectives (Coghlan, 2012; Morgan & Dong, 2008; Ziegler et al., 2012). This may be particularly true for experiences that are new or unfamiliar as visitors are likely to have pre-trip expectations based on limited knowledge or idealised representations, such as those often portrayed in the media (Fenton et al., 1998). However, the effect of in situ information on positive disconfirmation, and whether this provides an opportunity for transformation, has yet to be empirically tested.

1.4 | Climate interpretation and tourism on the GBR

The GBR, a global tourism hot spot at extreme risk from climate change, presents a unique opportunity to explore provision of climate information in tourist settings. Without immediate action on climate change, the GBR is predicted to lose up to 99% coral cover by 2030 (Australian Academy of Science, 2021) and has recently experienced its fifth mass coral bleaching event in less than a decade (Great Barrier Reef Marine Park Authority et al., 2024). Recognising the reefs declining health, many tourism operators on the GBR now embrace interpretation and eco-tourism products, and marine park management has increasingly emphasised environmental objectives in their high standard tourism guidelines (Zeppel, 2012). However, tourism operators have traditionally been hesitant to incorporate information about climate change, preferring to focus on local environmental issues, such as crown of thorns starfish outbreaks (Goldberg et al., 2018). Reported concerns relate to the appropriateness of 'lecturing' people about climate change during 'holidays' or when people have paid for an enjoyable experience (Goldberg et al., 2018). In addition, given that climate change is politically polarised in Australia (Hornsey et al., 2022; Unsworth & Fielding, 2014), some operators fear that openly discussing climate change may elicit disapproval from tourists, local government, or industries (Goldberg et al., 2018). While a range of initiatives have developed climate interpretation suited to tourism settings (e.g., Reef Discovery Course, Master Reef Guides) (Great Barrier Reef Marine Park Authority, 2023), anecdotally, the degree of climate interpretation provided on tourism vessels on GBR is heterogeneous. Instead, climate interpretation on the GBR tends to rely on the immersive experience itself to provide the transformational element to visitors and largely avoids provocation, with the tourism tagline 'see the Reef, love the Reef, protect the Reef'. However, there is limited empirical data that examine how tourists perceive and respond to potentially 'provocative' climate information and evaluate its effect on visitor experiences.

1.5 | Research questions

By integrating insights from transformational learning theory and the expectancy-disconfirmation model, this study aims to enhance our understanding of how climate interpretation influences visitors experiences in vulnerable nature settings, such as the GBR, including the potential for this type of information to influence pro-environmental outcomes. We explore the following research questions:

- How does the provision of climate change information shape visitor expectancy disconfirmation, and what implications does this have for achieving transformative outcomes?
- Does the provision of climate change information foster pro-environmental outcomes (such as awareness or behavioural intentions) in visitors?

2 | METHODS

We conducted a quasi-experimental study with tourist vessels, where some trips provided climate information within their regular interpretation, and other trips did not. We conducted brief surveys with visitors to explore how climate interpretation may influence indicators of (i) visitor expectancy disconfirmation and (ii) climate change engagement. Institutional ethical clearance was obtained from the Queensland University of Technology (QUT) Human Research Ethics Committee, approval number LR 2022-5347-8080.

2.1 | Study location

Based in Queensland (Australia), the GBR is the largest coral reef system in the world. It is also renowned for its marine tourism with over 2 million domestic and international visitors each year (GBRMPA, 2023). It is estimated that the GBR contributes ~$6.4 billion to the Australian economy each year (Deloitte Access Economics, 2017). Tourism is concentrated within waters adjacent to the cities of Cairns, Port Douglas, Townsville, and the Whitsundays. Tourism in the GBR is diverse (from sailing tours to week-long expeditions to island resorts), but one key component of the industry is snorkelling and diving trips to the outer reef area (day trips or multi-day liveaboards). For the present study, we worked with tourism operators providing outer reef trips from Cairns and Townsville, covering 14 different sites over eight individual reefs within the GBR (Figure 1). The reef sites mostly comprised of shallow coral gardens, walls, slopes, and sandy lagoons.

2.2 | Boat selection and allocation to study condition

There are over 20 major operators across Cairns and Townsville. Owners and managers were identified through personal connections of the authors and were invited to be involved in this study. In total, 10 different owners/managers were contacted (responsible for operating over 20 different boats) and fiveof them agreed to participate. We did not invite small operators (e.g., trips with less than 15 passengers) or island tours as our study focused on the most typical tourism options for visiting the outer reef, which are larger snorkelling/diving trips.

A quasi-experimental study with two cohorts was conducted: climate condition (10 trips, 274 individuals) and control (18 trips, 382 individuals). A set of dates was agreed on with each operator based on availability (including weekdays and weekends, not always sequential days). The first few trips on each boat were used as a control to better understand the setting and where climate interpretation may be incorporated. We then added climate interpretation on alternate days, but this was sometimes adjusted to suit passenger numbers and to keep an even balance between treatment and control conditions.

2.3 | Content for climate interpretation

For the climate condition, climate-specific interpretation was incorporated throughout the day in multiple formats as recommended by Coghlan and Kim (2012). The core component involved adding climate change information to the marine biology presentation. Other elements included a short 50-s video played on repeat throughout the day, information provided over public address system, and posters distributed around the vessel. Terms related to both threats and solutions were mentioned and noticeably present throughout the day, such as 'climate change', 'coral bleaching', 'warming ocean temperatures', 'greenhouse gas emissions' and 'renewable energy'. Calls to action such as 'support renewable energy' were included where possible. Specific routines and space available varied between boats, which influenced some elements of climate interpretation.

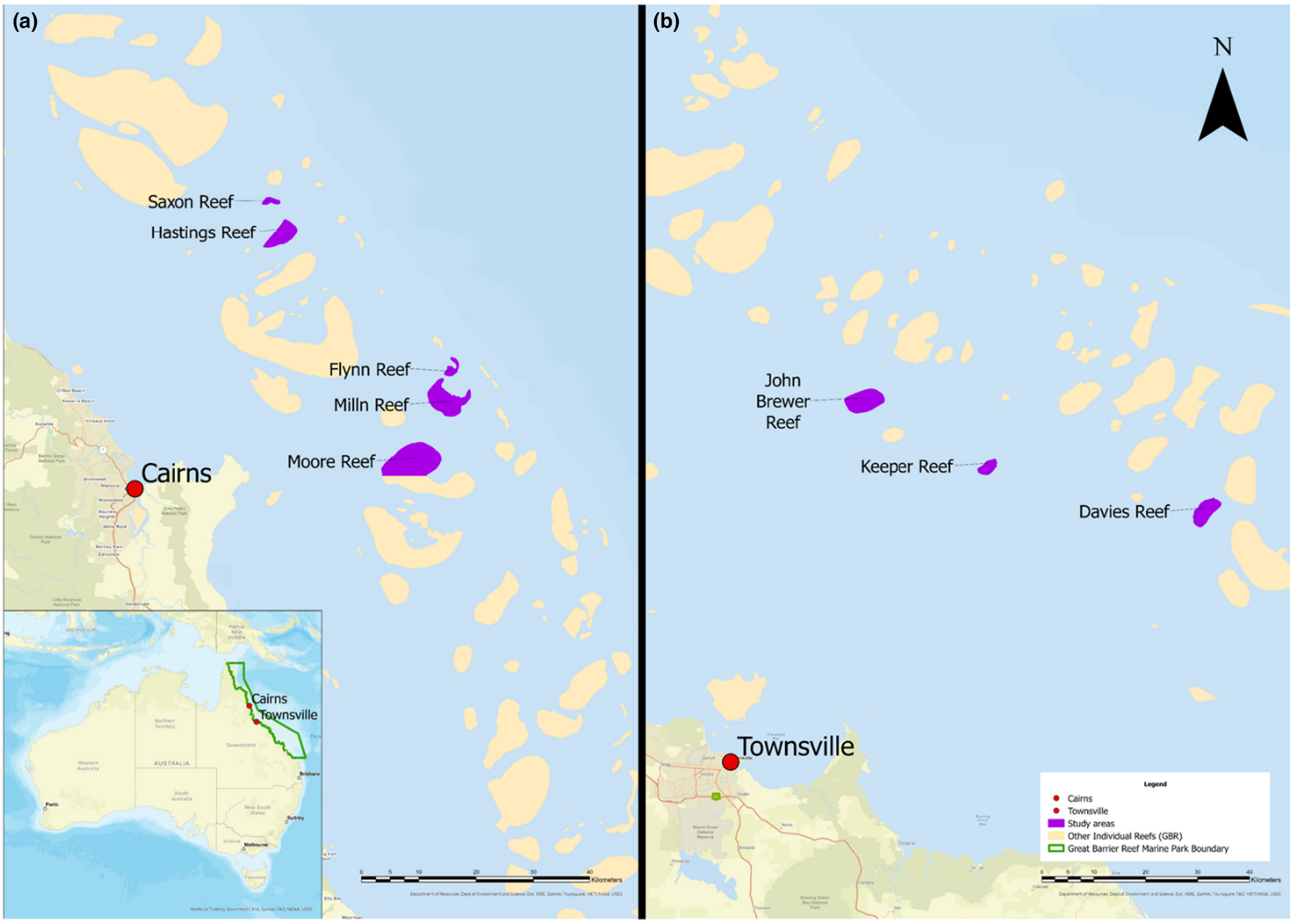

FIGURE 1 Map showing the reef sites visited for this study off (a) Cairns and (b) Townsville. Study locations are indicated in purple. Great Barrier Reef boundary and reef features sourced GBRMPA (2023) (https://geoportal.gbrmpa.gov.au/datasets/). For base maps, see the source information at the right corner on the map. Maps made in ArcGIS Pro 3.1.1 ESRI, Inc.

For example, not all boats had the same space available for posters. We ensured that the climate presentation was provided on all trips allocated to the climate condition, while inclusion of posters and video varied with the specific boat. In the control condition, no specific information about climate change was provided during the trip, and trips provided routine information (e.g., information about corals and marine life).

2.4 | Evaluating the effect of climate interpretation on visitors

Passengers aged at least 18 years were invited to complete a short (5-min) survey during the return leg of the day trip. Participants indicated consent via ticking a box presented at the top of the survey sheet. On smaller vessels, researchers moved throughout the boat inviting all passengers to participate. On larger vessels (i.e., >100 visitors), researchers moved throughout the boat until 40–50 surveys were complete to keep a balanced number of responses between trips. People who were sick or asleep were not approached, and families and couples were asked to complete the survey separately. Participants were offered the choice of completing the survey independently on paper, or in conversation with the researcher. Surveys were pilot tested on vessels and were shortened based on participant feedback (Appendix S1).

2.4.1 | Dependent variables—Visitor expectancy disconfirmation and trip satisfaction

- *Positive expectancy disconfirmation*: Given that operators are concerned with visitors perceiving the reef to be 'dying', and that the reefs physical appearance is important to visitors (Curnock et al., 2019), participants were asked 'In your opinion, how healthy did the reef look today?' (1) Better than I expected, (2) About what I expected, (3) Not as good as I expected. Responses were binary coded for analysis (1 = better than expected/positive disconfirmation 0 = about or not as good as expected).
- *Overall trip satisfaction*: To account for other potential variables not accounted for in the expectancy-disconfirmation model, we also measured overall trip satisfaction on a 10-point scale,

'Overall, how satisfied would you say you were with your experience today?' (1 = not at all, 10 = extremely).

2.4.2 | Dependent variables—Climate engagement

- *Awareness of climate threat*: Participants were asked an open-ended question about what they thought was the most serious threat facing the GBR. Those with responses mentioning climate change, warmer temperatures, greenhouse gas emissions, and fossil fuels were coded as aware of climate threats (binary coded for analysis 1 = aware, 0 = not aware). Those who mentioned 'coral bleaching' but did not relate this to warmer temperatures or other indicators of climate change, they were also coded as 'not aware'.
- *Awareness of climate actions*: Participants were asked if they thought individuals could help protect the reef and if so, to list an action people could take (open-ended). Those who were able to identify an action related to climate change (e.g., support renewable energy, lower carbon footprint) were coded as aware of climate actions (0 = no, 1 = yes, aware).
- *Information-seeking behaviour*: After completing the survey, participants were asked if they would like to receive a card with additional information about climate change and how they could help protect the reef. Participants who accepted the card were recorded as undertaking an information-seeking behaviour (0 = no, 1 = yes).

2.4.3 | Trip characteristics

We also measured a range of external factors which may influence the overall experience or how visitors respond to information for inclusion in analysis as covariates or moderators (Table 1).

2.4.4 | Participant characteristics

Basic demographics of age (ordinal, age group) and gender (0 = not male, 1 = male) were measured. We also coded whether participants accepted climate change to be human-caused or not (0 = no, 1 = yes), whether they were domestic or international travellers (0 = international, 1 = domestic) and whether they had visited the GBR before (0 = no, 1 = yes).

2.4.5 | Acceptability of increasing climate information

In addition to constructs assessed for statistical analysis, we also aimed to explore subjective perceptions about the suitability of increasing climate information provision in this setting. We asked participants 'How acceptable would you find it if this trip provided *more* information about climate change and the reef' (1 = not acceptable, 10 = extremely acceptable). This was followed by an open-ended

TABLE 1 Trip characteristics measured.

Trip characteristic	Description
Wind speed	Wind speeds over 20 knots can make boating uncomfortable and increase propensity of seasickness. To control for this, wind was measured using the daily forecast (e.g., Seabreeze, https://www.seabreeze.com.au/) and by confirming with the boat captain. This was binary coded for analysis (0 = less than 20 knots, 1 = 20 knots or more)
Number of passengers on board (pax)	Perception of high tourist traffic has been known to negatively influence visitor experiences (Cárdenas et al., 2021). Obtained from passenger manifest on each trip
Surface water temperature	Ambient temperature can influence response to climate information (Joireman et al., 2010). To control for this, water temperature was measured in degrees using a dive computer
Marine life experienced	As tourists are generally attracted to seeing large or iconic species (Cárdenas et al., 2021) participants were asked to select which of eight iconic reef species they had seen during the trip (e.g., clownfish, turtle, Māori wrasse). Marine life was binary coded for analysis (0 = saw 4 or less, 1 = saw more than 4)
Exposure to guided activities	Certain marine activities may influence responses to interpretation differently as they offer different opportunities for interaction and learning (Coghlan et al., 2011). Participants selected what activities that had participated in throughout the day. Those who participated in activities requiring a guide (snorkel tours, SCUBA/helmet diving, glass bottom boat tours, fish feeding) were coded as 1, and those who only participated in activities without a guide or stayed on the boat (e.g., snorkelling without a guide) were coded as 0

question asking participants to explain their answer—'If not, why? If yes, what would you like to hear about'.

2.5 | Data analysis

We initially aimed to explore the effect of climate information on outcomes using mixed-effects modelling, using boat as a random effect. However, initial model testing comparing Akaike information criterion scores indicated no influence of random effects, and that excluding random effects enhanced the model. Random effects were removed as per Zuur (2009). For each dependent variable, analysis began with two models:

- Condition + covariates (age, gender, climate belief) + trip characteristics (wind, temp, pax, activities, marine)
- Condition + covariates + trip characteristics + two-way interactions between condition and trip characteristics

Regression assumptions for multicollinearity, autocorrelation, and normality of residuals were met. Continuous variables were standardised for analysis. We note that although our dependent variable for *overall trip satisfaction* could be considered ordinal, much research shows that treating variables derived from Likert-scales as continuous is statistically appropriate (Moses et al., 1984; Norman, 2010; Pasta, 2009; Velleman & Wilkinson, 1993). In fact, when a linear relationship is present and the data can be interpreted meaningfully, as is the case here, treating such variables as continuous can help realise relationships that would otherwise be overlooked (Pasta, 2009).

Open-ended responses about acceptability of climate information were manually coded by the researchers into themes.

3 | RESULTS

3.1 | Descriptive statistics

Between April and July 2022, 28 trips (six tourism vessels) participated in the study, with 656 visitors completing the survey. Just over half (56.6%) of respondents identified as female, the majority (84.1%) were aged below 55 years old, 75.4% were domestic travellers, and over half (54.4%) were first time visitors to the reef. Most common trip types comprised pontoon visits (53.8% of surveys collected, maximum capacity of 220–330 visitors) and day boat visits (no pontoon) (41%, of surveys collected maximum capacity of 30–90 visitors), with only 5.2% of surveys collected on liveaboard trips (refer to Table S1 for randomisation checks).

The climate condition was distributed relatively evenly among vessels (Table S2). We note the slightly higher number of participants in the control condition due to the first few trips on each vessel being used to gain a practical understanding of how to incorporate climate interpretation for each trip. This also gave the researchers time to integrate the experimental content effectively into typical trips. In the end, due to logistical reasons, it was not possible to provide climate interpretation on the two vessels based in Townsville. However, removing these trips from analysis did not influence overall results.

3.2 | Effect of climate information on positive expectancy disconfirmation

One fifth of participants indicated that reef condition was better than they expected (21.2%). Most indicated that they thought the reefs health was 'about what they expected' (61.3%) and 17.5% thought it was 'worse than expected'. Model 1 showed that climate interpretation was associated with positive expectancy disconfirmation (odds ratio [OR] = 2.21, $p < 0.001$) (Table 2). Specifically, participants on trips where climate interpretation was provided were more likely to report that the reefs' health exceeded their expectations. Assessing interactions in Model 2 showed significant interactions between the climate condition and the number of iconic marine species seen, whereby provision of climate interpretation was strongly and positively associated with exceeding expectations for those who saw more species, with a more modest (but still positive), effect for those who saw fewer species (OR = 5.59, $p = 0.003$) (Figure 2).

3.3 | Effects of climate information on trip satisfaction

Overall, trip satisfaction was high (mean = 8.41 ± 1.39), with 80% of participants indicating a score of 8 or higher. Providing climate information did not have any significant main effects on trip satisfaction and effect sizes were small ($B = -0.03$, Cohen's $d = 0.14$) (Table 3, Model 3). Model 4 revealed several interaction effects which suggest the potential for negative effects under certain conditions. Compared with control, the climate condition was associated with marginally lower trip satisfaction on days with low wind ($B = 0.95$, $p < 0.001$), high water temperatures ($B = -0.44$, $p < 0.001$), and a high number of passengers on board ($B = -0.31$, $p = 0.01$) (Figure 3).

3.4 | Effects of climate information on awareness of climate threat

When participants were asked about what they perceive to be the most serious threat to the reef, 52.9% of them identified climate change and/or warming ocean temperatures. While no significant main effects of climate interpretation were observed for threat awareness (Model 5), there were a number of interaction effects (Table 4, Model 6). The climate condition was associated with higher likelihood of mentioning climate change as a major threat on days

TABLE 2 Logistic regression exploring effects of climate information on whether trip exceeded expectations.

	Model 1		Model 2	
	Positive expectancy disconfirmation		Positive expectancy disconfirmation	
	OR	CI	OR	CI
Climate condition	**2.21**	**1.44, 3.37**	1.65	0.56, 4.84
Covariates				
Age (ordinal)	1.03	0.90, 1.18	1.03	0.89, 1.19
Gender (binary)	0.77	0.51, 1.16	0.77	0.51, 1.16
Climate belief (binary)	0.75	0.48, 1.17	0.73	0.46, 1.15
Moderators				
Wind (binary)	**0.51**	**0.31, 0.82**	**0.39**	**0.19, 0.83**
Water temperature (*Z* score)	1.05	0.84, 1.32	1.19	0.79, 1.82
Pax (*Z* score)	0.93	0.73, 1.19	0.67	0.44, 1.02
Guided activity (binary)	1.56	0.94, 2.60	1.83	0.83, 4.03
Marine life (binary)	1.47	0.87, 2.49	0.57	0.24, 1.33
Condition × Wind	-	-	1.69	0.48, 5.92
Condition × Temp	-	-	0.81	0.45, 1.46
Condition × Pax	-	-	1.49	0.80, 2.75
Condition × Guide	-	-	0.82	0.29, 2.33
Condition × Marine	-	-	**5.59**	**1.82, 17.18**
−2LL	593.18		578.14	

Note: OR is the odds ratio generated by logistic regression. An odds ratio of >1 represents a positive association between the independent and dependant variable; conversely, an odds ratio of <1 indicates a negative association. CI = 95% confidence Interval for the odds ratio. Significant values are represented in bold ($p \le 0.05$).

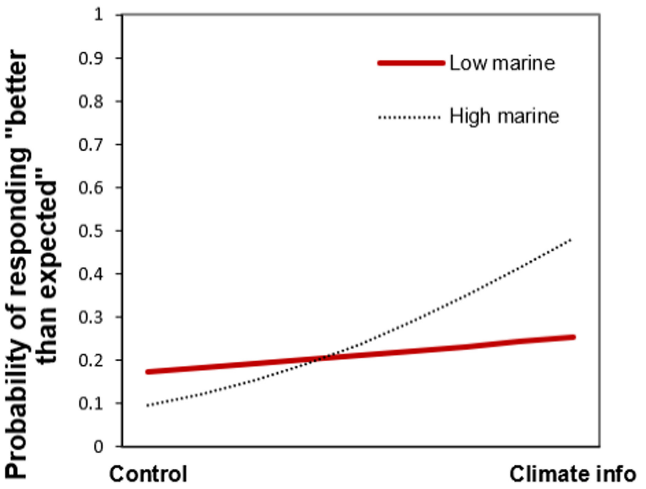

FIGURE 2 Interaction plot showing the interaction effect between number of iconic marine species seen and provision of climate information on reef satisfaction. Provision of climate information had a stronger positive effect on reef satisfaction for those who saw a higher number of iconic marine species.

with high wind (OR = 5.17, p = 0.003), lower water temperature days (OR = 0.59, p = 0.02), and low number of passengers (OR = 0.56, p = 0.03), with minimal effect for days with low wind, high water temperatures, and high number of passengers. For those who participated in a guided activity, the climate condition was associated with *lower* likelihood of mentioning climate change as the most serious threat (OR = 0.36, p = 0.009) (Figure 4).

3.5 | Awareness of climate action

Over half (57.3%) of participants indicated that they believed individuals could help protect the reef. However, only 12.2% of the whole sample (80/656) identified a behaviour related to climate change (e.g., reduce personal energy use, pressure government). Other responses focused on actions related to reducing waste and pollution (e.g., use less plastic, do not pollute). No significant main or interaction effects were detected for the climate condition on being able to identify an action related to climate change (Table 5).

3.6 | Information-seeking behaviour

When offered the chance, 50.6% of the participants took a copy of the pledge/card indicating information-seeking behaviour. No main effects were found for the climate condition on information-seeking (Table 6). Interaction effects were found, where the climate condition had a positive effect on information seeking for those who *did not* take part in any guided activities, and a negative effect for those who did (OR = 0.33, p = 0.007) (Figure 5).

3.7 | Acceptability of more climate interpretation

Visitors reported a high level of acceptability for receiving additional climate information, with 72.4% scoring 8 or higher (mean = 8.35 ± 2.22). Qualitative analysis of open-ended responses (n = 275) reveals three most common types of information sought by visitors (Table 7).

A further 41 participants reinforced that they would like more information, but did not specify the type (e.g., 'absolutely would love to hear more on this'), and 12 suggested information about existing actions being taken to reduce impacts. Less than 5% (17 participants) wrote responses with negative sentiment towards receiving more information, for example, 'I'm coming to relax, not be lectured on science' (Table S3).

TABLE 3 Linear regression for trip satisfaction.

	Model 3		Model 4	
	Trip satisfaction		Trip satisfaction	
	B (±SE)	CI	*B* (±SE)	CI
Climate condition	−0.03 (0.08)	−0.19, 0.13	**−0.68 (0.19)**	**−1.05, 0.32**
Covariates				
Age (ordinal)	0.02 (0.03)	−0.04, 0.07	0.01 (0.03)	−0.04, 0.06
Gender (binary)	−0.10 (0.08)	−0.25, 0.05	−0.10 (0.07)	−0.25, 0.05
Climate belief (binary)	0.12 (0.09)	−0.05, 0.29	0.11 (0.09)	−0.06, 0.27
Moderators				
Wind (binary)	**−0.41 (0.08)**	**−0.58, −0.25**	**−0.51 (0.11)**	**−0.73, −0.28**
Water temperature (Zscore)	**0.08 (0.04)**	**0.00, 0.15**	**0.16 (0.06)**	**0.05, 0.27**
Pax (*Z* score)	0.04 (0.04)	−0.05, 0.12	0.01 (0.06)	−0.11, 0.14
Guided activity (binary)	0.01 (0.09)	−0.16, 0.18	−0.04 (0.11)	−0.27, 0.18
Marine life (binary)	**0.35 (0.10)**	**0.15, 0.56**	0.14 (0.13)	−0.11, 0.40
Condition × Wind	-	-	**0.95 (0.23)**	**0.50, 1.41**
Condition × Temp	-	-	**−0.44 (0.10)**	**−0.64, −0.24**
Condition × Pax	-	-	**−0.31 (0.11)**	**−0.52, −0.24**
Condition × Guide	-	-	0.17 (0.17)	−0.17, 0.51
Condition × Marine	-	-	0.40 (0.21)	−0.01, 0.81
AIC	1797.78		1776.57	

Note: *B* values are unstandardised coefficients where one unit change in the independent variable generates a change of *B* in the dependant variable. CI = 95% confidence interval. Significant values are represented in bold ($p \leq 0.05$).

Abbreviation: AIC, Akaike information criterion.

4 | DISCUSSION

The study demonstrates that while climate interpretation has the potential to enhance visitor experiences and threat awareness, it falls short in translating this awareness into actionable outcomes, prompting a critical discussion on the role of the nature-based tourism sector in influencing widespread change. Using tourism on the GBR as a case study, we explored the extent to which providing climate interpretation in vulnerable nature settings could influence the visitor experience and indicators of climate change engagement. Firstly, we found little evidence to suggest that providing climate interpretation will negatively influence visitors' experiences. In fact, we found that those exposed to climate interpretation were more likely to say the reef's condition was 'better than expected' than those in the control condition—indicating an important first step in the transformative learning journey. However, we found that while providing climate interpretation had positive effects on threat awareness under certain conditions, it had little to no effect on action awareness or information-seeking behaviour. Our findings suggest that climate interpretation, while a potentially useful entry point, must go beyond simple provision of information if the goal is to encourage tangible, action-focused outcomes. Open-ended responses on the acceptability of additional information suggest that there is an appetite for more information among visitors, particularly regarding climate actions and solutions. This suggests an opportunity for the tourism industry to step-up and embrace comprehensive strategies that integrate immersive experiences with a range of informative content and consider the visitors entire transformative journey to promote behavioural change.

4.1 | Climate interpretation contributes to positive experiences

We find that providing information about climate change to visitors may help to combat negative perceptions of reef health and contribute to a *positive* nature experience. We found that those who were exposed to climate interpretation were more likely to report that the condition of the reef exceeded expectations compared with control. This adds to the growing evidence that debunks assumptions that climate change information will 'ruin people's day' and aligns with research which suggests that provision of in situ information can influence positive disconfirmation through a range of mechanisms (Coghlan, 2012; He & Hinch, 2021; Morgan & Dong, 2008; Roese & Vohs, 2012; Ziegler et al., 2012). For example, in our study, many visitors were surprised to learn that some coral species are resilient and can 'bounce back' from bleaching events, and that some brown coloured corals are healthy. Such expansion of knowledge may

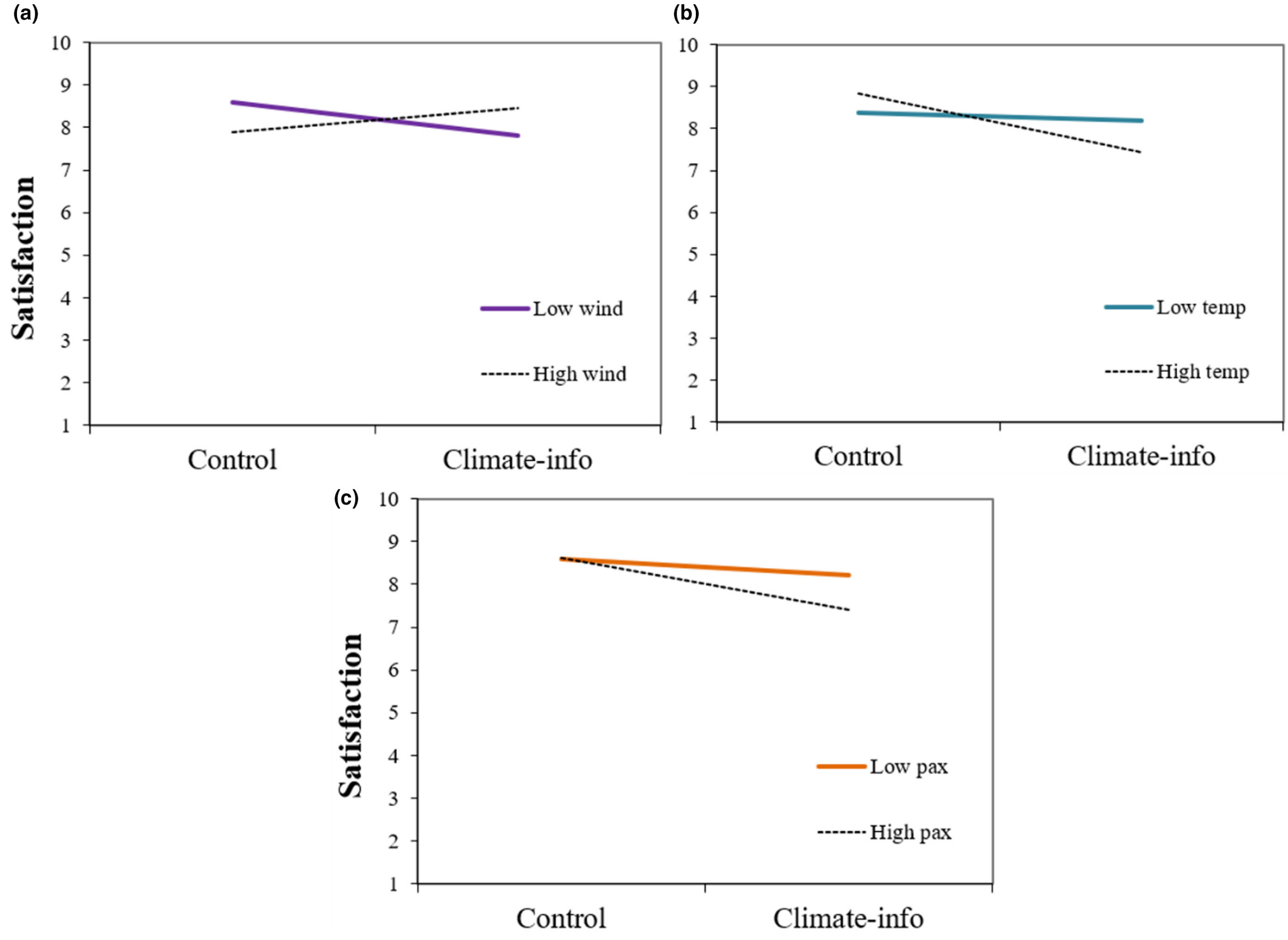

FIGURE 3 Interaction plots showing the interaction effect between certain trip characteristics and provision of climate information on trip satisfaction. A slight negative trend can be seen for certain conditions. (a) Wind. (b) Water temperature. (c) Number of passengers on board.

have helped negate negative pre-trip influences, contextualise the experience, and create positive disconfirmation (Krey et al., 2023; Miller et al., 2020). In their study on climate interpretation during polar bear viewing, Miller et al. (2020) also find that climate interpretation can help to correct visitor misconceptions. For example, the authors found that sightings of polar bear congregations were correlated with reduced intentions to become ambassadors for polar bear conservation, and emphasised the importance of interpretation to clarify that such congregations were due to seasonal ice distances (Miller et al., 2020). Moreover, in our study, while climate information was associated with exceeding expectations about reef health, information had no detectable main effects on general trip satisfaction. Interaction effects suggest that there may be certain conditions where providing climate interpretation is less optimal. For example, days with low wind and higher water temperatures (often indicating good weather and high visibility) or high passenger numbers were associated with less positive responses to climate interpretation. However, it is important to note that despite slightly lower trip satisfaction in these groups, overall trip satisfaction remains in the upper range of the scale.

4.2 | Improving climate interpretation for action outcomes

Interestingly, we found that climate interpretation, while it had a positive influence on threat awareness, had minimal effects on other indicators of climate engagement. Climate interpretation was associated with greater threat awareness under certain conditions (i.e., days with higher wind, lower water temperatures). Though windy days still permit in-water activities, visitors may spend more time inside the boat, and thus have greater opportunity to be exposed to climate interpretation (compared with calm days where more time may be spent in the water). Regarding the role of temperature, research shows that climate change is more top of mind when ambient temperatures are warmer (Joireman et al., 2010). It is possible that the climate interpretation had less effect on days where the water was warmer, as climate change may have already been salient; thus the effect of interpretation was more pronounced on cooler days. We also found that climate interpretation was associated with higher threat awareness on trips with fewer passengers. This may be due to several reasons.

TABLE 4 Logistic regression for awareness of climate change threat.

	Model 5		Model 6	
	Threat awareness		Threat awareness	
	OR	CI	OR	CI
Climate condition	1.25	0.88, 1.76	1.24	0.54, 2.87
Covariates				
Age (ordinal)	1.10	0.98, 1.23	1.11	0.99, 1.24
Gender (binary)	0.81	0.59, 1.12	0.80	0.58, 1.11
Climate belief (binary)	**2.47**	**1.69, 3.59**	**2.56**	**1.74, 3.76**
Moderators				
Wind (binary)	1.17	0.82, 1.68	1.02	0.62, 1.67
Water temperature (Z score)	0.98	0.83, 1.16	1.04	0.81, 1.33
Pax (*Z* score)	**0.80**	**0.66, 0.96**	0.78	0.59, 1.03
Guided activity (binary)	1.33	0.92, 1.93	**2.13**	**1.29, 3.55**
Marine life (binary)	**2.06**	**1.30, 3.26**	**2.15**	**1.19, 3.88**
Condition × Wind	-	-	**5.17**	**1.75, 15.26**
Condition × Temp	-	-	**0.59**	**0.38, 0.92**
Condition × Pax	-	-	**0.56**	**0.34, 0.94**
Condition × Guide	-	-	**0.36**	**0.17, 0.78**
Condition × Marine	-	-	0.79	0.30, 2.05
−2LL	860.12		840.94	

Note: OR is the odds ratio generated by logistic regression. An odds ratio of >1 represents a positive association between the independent and dependant variable; conversely, an odds ratio of <1 indicates a negative association. CI = 95% confidence interval for odds ratio. Significant values are represented in bold ($p \leq 0.05$).

For example, fewer passengers may allow greater interactions between visitors and staff. On trips with high visitor numbers (in some cases, more than 300), visitors may also be more likely to detect tourism impacts as serious threats to the reef (i.e., they may see more rubbish on the boat, people standing on the reef, etc.). Visual representations of in situ environmental threats may override the effects of information provided about climate change, which is relatively less visible.

However, climate interpretation did not enhance ability to identify climate-related behaviours and had minimal effect on information-seeking. This contrasts with other research on climate interpretation in nature-based tourism settings. For example, Khadka et al. (2020) conducted a pre-post experiment of a climate education toolkit in Prairie Fork Conservation Area and found that the information had a positive effect on participants behavioural intentions related to climate change. Other studies, such as the study by He and Hinch (2021), suggest the potential of climate interpretation to influence pro-environmental outcomes via an increase in visitor learning outcomes (but do not measure environmental outcomes directly). Indeed, of the handful of studies that exist about climate interpretation, none to our knowledge have explicitly tested the effect of climate interpretation on climate change engagement outcomes (e.g., He & Hinch, 2021; Lemieux et al., 2018; Roberts et al., 2021). Thus, our findings suggest that climate interpretation may need to be more carefully designed and consider additional factors if it is to effectively motivate changes in behaviour.

It is well documented that when it comes to climate change, information must move beyond raising awareness and actively target the drivers of behaviour (Goldberg et al., 2020; Schultz, 2014). For example, targeting social norms by highlighting what others are doing or using techniques such as behavioural priming can increase impacts on behaviour (Cialdini & Jacobson, 2021; Waters et al., 2023). We found these behavioural elements were difficult to incorporate in situ, which may explain our null effects. This stresses the importance of recognising that providing information about threats to nature is not sufficient to lead to action. If behaviour change is a goal, interpretation should be intentionally designed to reach behavioural goals. Furthermore, the climate interpretation used in this study primarily aimed to inform rather than provoke action, which may explain its limited efficacy in driving behavioural outcomes. An 'epiphany' or transformative moment is likely required for optimising environmental outcomes (Mezirow, 1997; Miller et al., 2020). Research suggests that adopting 'hot interpretation' principles that provoke thought—narrative and personal storytelling, balancing negative and positive emotions, focusing on education and reflection over persuasion, learning from the past—could enhance the effectiveness of interpretation efforts (Uzzell & Ballantyne, 1998). Melena (2014) also recommends leaning into complexity and include components that address difficult questions and provide actionable solutions. Overall, these findings suggest that climate interpretation may require more than simple information to elicit sufficient 'provocation' for transformative experiences. It would be useful for future research to identify what types of interpretation can deliver these broader outcomes.

4.3 | We need to focus on solutions and building action competence

Though climate interpretation may not have led to desired engagement outcomes, an important finding from this study is that providing additional climate interpretation was highly acceptable for visitors. The most requested type of information by visitors was about individual actions and solutions. Responses exposed an apparent contradiction where participants desired more information about tangible 'everyday' actions that they can take to mitigate climate impacts, but also describe feeling disillusioned with general environmental behaviours (e.g., clean up litter). This is evidenced through responses which emphasised the need for actions that will 'actually' help. Such responses suggest the need for campaigns to move beyond normative environmental behaviours promote more impactful

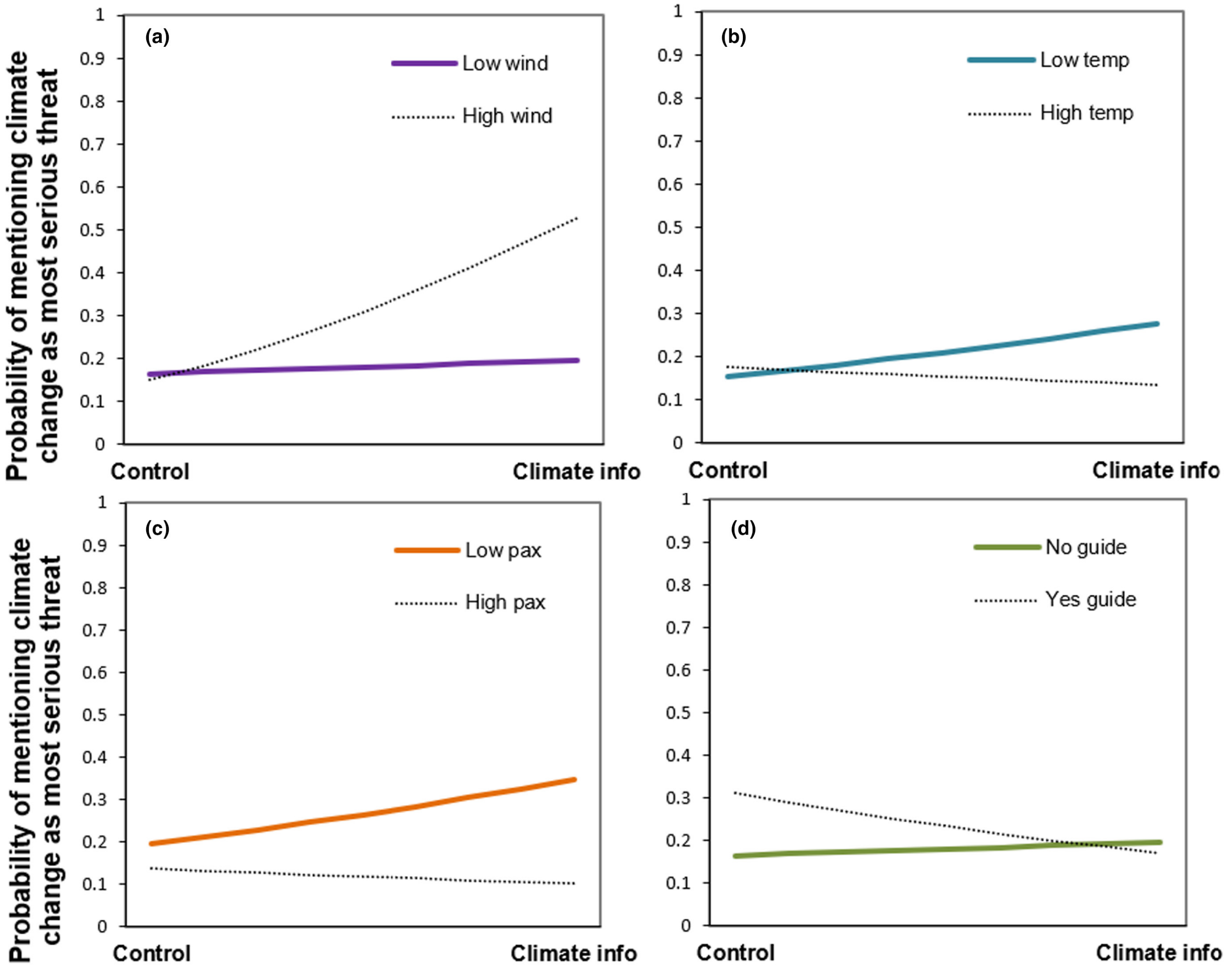

FIGURE 4 Interaction plots showing the interaction effect between certain trip characteristics and provision of climate information on threat awareness. (a) Wind. (b) Water temperature. (c) Number of passengers on board. (d) Participation in guided activities.

actions that individuals can connect with the bigger issue (Dean & Wilson, 2022; Jacobs et al., 2015). This aligns with frameworks for integrating conservation messaging into wildlife tourism, which recommend providing actionable information, and linking experiences with consumption choices (Fernández-Llamazares et al., 2020). Indeed, some scholars argue that transforming climate communications from 'issue' to 'action' is necessary to build agency, lead to deeper engagement, and potentially catalyse action (De Meyer et al., 2021; Vaughter, 2016).

In general, public knowledge about climate mitigation actions is limited (e.g., Dean et al., 2020), and though our climate condition included general calls to action such as 'support renewable energy', we detected negligible effects on action awareness and information-seeking behaviour. It is not clear whether different calls to action (versus changes in presentation frequency or format) would have influenced findings. While some research prioritises community climate actions (e.g., Hofman et al., 2020), there is little research that examines how communities interpret or respond to different calls to action. One study suggests that communicating a mix of 'easy' (e.g., recycling) and 'difficult' (e.g., attend an environmental rally) actions is likely to be most effective (Andrews et al., 2022), while others suggest that focusing on collective actions and public-sphere behaviours may be more beneficial (Hofman et al., 2020; Waters et al., 2022). It is also important to consider who should be responsible for developing and delivering these calls to action as there may be practical restraints. For example, tourism operators may lack the resources needed to develop appropriate materials, particularly if requiring post-trip follow-up (Nousiainen et al., 2022).

Altogether, these findings highlight the need to treat visitors not as disinterested observers (Uzzell & Ballantyne, 1998), but as active and engaged agents of change. Indeed, research suggests that visitor motivations are changing and drivers such as last-chance-tourism may present a range of short to medium term opportunities to promote stewardship (Lemieux et al., 2018). That is, there is potential for these experiences to encourage pro-environmental behaviours and cultivate ambassadors for nature, but they require careful curation and intentionality, particularly regarding action (Miller et al., 2020).

TABLE 5 Logistic regression for awareness of climate change action.

	Model 7		Model 8	
	Action awareness		Action awareness	
	OR	CI	OR	CI
Climate condition	1.35	0.80, 2.28	1.07	0.22, 5.30
Covariates				
Age	1.17	0.99, 1.39	1.18	0.99, 1.40
Gender (binary)	0.85	0.51, 1.40	0.85	0.51, 1.41
Climate belief (binary)	**6.28**	**2.43, 16.24**	**6.27**	**2.40, 16.41**
Moderators				
Wind (binary)	1.62	0.94, 2.80	1.89	0.76, 4.73
Water temperature (Z score)	0.85	0.66, 1.09	1.05	0.67, 1.65
Pax (ordinal)	**0.60**	**0.44, 0.83**	**0.41**	**0.23, 0.74**
Guided activity (binary)	**1.95**	**1.00, 3.83**	1.94	0.81, 4.64
Marine life (binary)	**3.35**	**1.86, 6.05**	**2.47**	**1.13, 5.38**
Condition × Wind	-	-	1.25	0.24, 6.62
Condition × Temp	-	-	0.64	0.30, 1.36
Condition × Pax	-	-	1.55	0.66, 3.60
Condition × Guide	-	-	1.15	0.29, 4.56
Condition × Marine	-	-	1.73	0.51, 5.85
−2LL	428.45		423.32	

Note: OR is the odds ratio generated by logistic regression. An odds ratio of >1 represents a positive association between the independent and dependant variable; conversely, an odds ratio of <1 indicates a negative association. CI = 95% Confidence Interval for odds ratio. Significant values are represented in bold ($p \le 0.05$).

TABLE 6 Logistic regression for information seeking.

	Model 9		Model 10	
	Information seeking		Information seeking	
	OR	CI	OR	CI
Climate condition	1.16	0.81, 1.67	1.83	0.78, 4.31
Covariates				
Age	**0.75**	**0.66, 0.84**	**0.74**	**0.66, 0.84**
Gender (binary)	0.79	0.57, 1.10	0.78	0.56, 1.10
Climate belief (binary)	**1.68**	**1.14, 2.48**	**1.72**	**1.16, 2.56**
Moderators				
Wind (binary)	1.11	0.76, 1.61	1.07	0.64, 1.78
Water temperature (Z score)	**1.79**	**1.50, 2.14**	**1.93**	**1.48, 2.52**
Pax (ordinal)	**1.24**	**1.02, 1.51**	1.18	0.88, 1.59
Guided activity (binary)	1.13	0.77, 1.67	**1.90**	**1.11, 3.25**
Marine life (binary)	0.66	0.42, 1.06	0.67	0.37, 1.20
Condition × Wind	-	-	2.29	0.79, 6.59
Condition × Temp	-	-	0.73	0.46, 1.16
Condition × Pax	-	-	0.78	0.47, 1.30
Condition × Guide	-	-	**0.33**	**0.15, 0.74**
Condition × Marine	-	-	0.84	0.31, 2.26
−2LL	817.94		806.37	

Note: OR is the odds ratio generated by logistic regression. An odds ratio of >1 represents a positive association between the independent and dependant variable; conversely, an odds ratio of <1 indicates a negative association. CI = 95% confidence interval for odds ratio. Significant values are represented in bold ($p \le 0.05$).

4.4 | Opportunities for strengthening climate engagement in nature-tourism settings

Nature-based tourism in vulnerable settings indeed poses an ethical challenge (Groulx et al., 2019; Weber et al., 2019). Not only does it tend to rely on high carbon producing travel but also visitors do not connect their travel behaviours, among other climate actions (e.g., Dean et al., 2020) to the health of the places they are visiting (D'Souza et al., 2023; Groulx et al., 2019). While environmental education efforts have improved over the past decade (D'Souza et al., 2023), they have not effectively translated into significant changes in tourist behaviour, raising ethical concerns about the industry's responsibility (D'Souza et al., 2023). Efforts are desperately needed to integrate climate considerations into destination management and cultivate a stronger ethic of care and stewardship towards culturally, socially, and ecologically valuable sites (Groulx et al., 2019; Walker & Moscardo, 2016), particularly as we lag behind 1.5-degree targets (IPCC, 2023).

This study shows that climate interpretation can enhance visitor experiences and increase threat awareness; however, more is needed for the experience to be truly transformative. This presents a significant opportunity for nature-based tourism operators to think beyond simple interpretation and provision of information and consider the entire transformative journey of visitors. So, while operators should embrace climate interpretation, the future of nature-based tourism should focus on how activities, services, and information provided can shape visitors' experiences to encourage greater climate change engagement, particularly in destinations that are significantly affected (Lemieux et al., 2018).

Our findings echo recommendations to use place-based climate education materials (e.g., Khadka et al., 2020; Pecl et al., 2023), incorporating multiple sources of interpretive information (known as interpretive layering), including off-site interpretation (e.g., websites) (e.g., Coghlan & Kim, 2012), and providing post-experience materials to support long-term engagement (e.g., Ballantyne et al., 2018;

Hughes et al., 2011). For example, tourism operators may benefit from tailoring climate change information to the specific site visited on the day (e.g., impacts on common species seen), and clearly linking the experience to relevant solutions and calls to action. The level of interpretive layering required may depend on certain trip characteristics. For example, larger trips that cater for diverse audiences by providing infrastructure (such as reef pontoons or interpretation centres) may require more strategic layering throughout each element of the experience and should not rely on a single presentation. We also emphasise the importance of developing post-experience resources in either physical (e.g., a booklet) or digital (e.g., email) form. This may help to influence motivation to act when visitors return home. Overall, research suggests that the experience should encourage a multiple voices approach that allows visitors to gain insights independently rather than feeling persuaded and emphasise personal storytelling (Ballantyne et al., 2012; Hvenegaard et al., 2016).

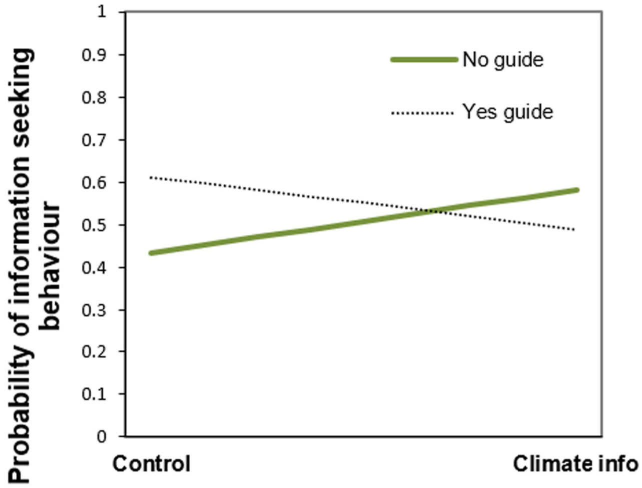

FIGURE 5 Interaction plot showing the interaction effect between participation in guided activities and provision of climate information on information-seeking behaviour. Provision of climate information had a positive effect on information seeking for those who did not participate in activities requiring a guide and a negative effect for those who did.

However, it is one thing to recommend ways to integrate climate interpretation into tourism experiences, and another to implement it in practice. This requires practical considerations of the setting and cultural context. For example, climate change conversations are not always easy and tourism staff may not feel comfortable engaging in these discussions, as we learned anecdotally while conducting this study. We suggest that overcoming such challenges comes down to creating a climate-positive workplace and culture across the industry. In practice, this may look like reassuring staff that most visitors are open to receiving this type of information, providing access to additional training on climate communication to all staff (i.e., not just guides), and finding ways to reward staff that embrace the climate change communication role (Geiger et al., 2017; Pope & Selna, 2015). To show further support from industry, implementing tools such as 'Destination Pledges' which require a commitment from both visitors and

TABLE 7 Three most common types of information sought by visitors.

Type of information	Number of mentions	Description
Individual actions that can help	104 mentions (37.82% of responses)	Responses placed emphasis on *practical*, *every day*, and *tangible* actions that individuals can do to help protect the reef. Responses also indicate an appetite for information which includes potentially more impactful actions that go beyond simple lifestyle behaviours
Specific climate change impacts	86 mentions (31.27% of responses)	Visitors were interested in learning about specific climate impacts rather than generic information. For example, the impacts of warming ocean temperatures on the reef site visited and effects on local species (e.g., 'how climate change is affecting this particular reef'). Responses also highlighted interest in the flow-on effects to other marine ecosystems
Changing reef conditions	25 mentions (9.10% of responses)	Several responses specifically requested comparison photos or descriptions that illustrate the reefs changing condition. This included both 'what has changed in the last 20 years' (past) and 'alternative futures of the reef' (future)

businesses to adopt desirable behaviours relevant to tourism locations (in this case, a commitment to specific climate actions) may help to broaden positive social norms and show visible industry leadership (Albrecht & Raymond, 2023).

4.5 | Limitations and future directions

While this is a single case study that explores tourism on the GBR, the findings provide insight into nature-based tourism and climate interpretation more broadly. For instance, we show that even on one of the most iconic destinations, that is visibly impacted by climate change, the effect of climate change interpretation is limited, and more is needed to for tourism experiences to positively influence environmental change. However, we recognise that our study involved mostly domestic visitors. Future research should replicate the study with broader audiences and compare to other iconic destinations. In addition, we note that this is a quasi-experimental study, where provision of climate information was not identical between trips but adapted to suit situational needs. Next, to understand whether a causal relationship exists between climate change interpretation, satisfaction, and engagement, future research should adopt a Before-After-Control-Treatment design. Ideally, a longitudinal research design would be implemented that tracks behaviours and intervention effects over time. Finally, we found that those who participated in an activity with a guide were less likely to identify climate change as a major threat to the reef and engage in information-seeking behaviour. We suspect this may be due to visitors with guides receiving a large amount of varied information about the reef which we were unable to control for. This prompts an interesting area of future research which explores the effect of information overload or competing environmental messages on visitors.

AUTHOR CONTRIBUTIONS

Yolanda L. Waters: Conceptualisation; data collection; formal analysis; writing – original draft. **Riccardo Losciale:** Data collection; preliminary analysis; writing – review and editing. **Angela J. Dean:** Conceptualisation; supervision; writing – review and editing. **Kerrie A. Wilson:** Supervision; writing – review and editing. All authors contributed critically to the drafts and gave final approval for publication.

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CONFLICT OF INTEREST STATEMENT

Angela Dean is an Associate Editor for People and Nature but was not involved in the peer review and decision-making process. There are no other potential conflicts of interest.

DATA AVAILABILITY STATEMENT

According to ethical requirements data is available only upon request to the authors.

ETHICS STATEMENT

Institutional ethical clearance was obtained from the Queensland University of Technology (QUT) Human Research Ethics Committee, approval number LR 2022-5347-8080.

STATEMENT OF INCLUSION

Our study involved collaborating with local stakeholders (e.g., tourism operators) to ensure that data collection was contextually appropriate and resulted in practical outcomes. Tourism operators provided input throughout the early design and data collection process, and results were shared in multiple formats to increase accessibility of information.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Table S1. Randomisation checks between experimental groups.

Table S2. Distribution of experimental conditions among vessels.

Table S3. Qualitative responses to “If yes, what would you like to hear about”?

Appendix S1. Full survey item.

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