https://doi.org/10.1038/s44168-026-00334-w

Understanding fluctuating climate change risk perceptions through the lens of trust: a study of Great Barrier Reef region residents

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Public perceptions of climate change risks are fundamental to public support for climate action. From a decade of surveying residents in the Great Barrier Reef region (2013–2023; $n = 9920$), we found that climate risk perceptions have fluctuated markedly, with shifts mainly occurring at the extremes of the belief–denialism spectrum. Along with a trend of decreasing belief and increasing denialism, trust in scientists strengthened in its predictive potential over time.

Actions to mitigate climate change have been slow to gain momentum across the globe despite scientific consensus and urgent warnings from the scientific community that anthropogenic climate change is real and increasing in severity and impact[1,2]. The success of climate action hinges not only on scientific innovation, government policy and business investment, but also on widespread public support and acceptance of climate solutions and the science that underpins them[3]. However, the work of climate scientists has long been challenged in the political sphere, impacting public acceptance of, and trust in climate science[4,5]. Additionally, amid contested narratives and persistent misinformation about climate change and climate science in the media, public opinion about climate change has fluctuated over time, with increasing polarisation of views along political lines emerging in recent years[6,7].

In recent years the Great Barrier Reef (the Reef) has become a global climate icon due to recurrent mass coral bleaching events[8,9] and it continues to be the focus of contested media narratives about the effects of climate change[10,11]. These events and narratives may play a critical role in shaping public understanding and concern regarding the Reef's vulnerability to the threat of climate change – that is, their climate change risk perceptions. In this paper we report findings from decade-long (2013–2023) monitoring of climate change risk perceptions among residents of the Great Barrier Reef region in Australia ($n = 9920$). We also explored the relationship between these risk perceptions and the level of trust in scientific institutions as a source of information about the Reef, noting that other studies have shown how trust in scientists significantly shapes public perceptions and actions on climate change[12,13]. While a relationship between trust in science and climate change beliefs has been identified in other contexts, to date there has been no exploration of how this relationship may change over time.

Our results, based on aggregated cross-sectional survey data (with population weights applied to the sample data so it matched the age by gender distribution of the Queensland regional population in each year), showed climate change risk perceptions among residents in the GBR region fluctuated over the 10-year period (Fig. 1a and Table S3). From 2013 to 2017 there was a statistically significant increase in climate change risk perceptions (odds ratio = 1.63, indicating a 63% greater chance of higher climate change risk perceptions in 2017 vs. 2013). Perceptions of risk severity then declined between 2017 and 2021 (odds ratio = 0.65), returning to 2013 levels. The decline continued in 2023 (odds ratio = 0.71) to the point that it dropped below the level of 2013. These year-to-year changes reflect shifts in the aggregate distribution of responses, primarily driven by changes in *immediate-action belief*, *need for more evidence*, and *disbelief*. In contrast, changes in *no-immediate action belief* and *no view* were relatively minor across survey years.

Levels of stated trust in information sourced from scientists and their research institutions (hereafter *trust in scientists*) also varied significantly across years (see Fig. 1b and Table S6). While there was no meaningful change in trust levels between 2013 and 2017 ($t = -0.17$, *ns*) or between 2017 and 2021 ($t = -1.81$, *ns*), a significant decrease was observed between 2021 and 2023 ($t = -5.83$, $p < 0.001$).

An ordered logit regression (controlling for gender and generational effects) revealed a positive relationship between *trust in scientists* and climate change risk perceptions (see Table S2, Model 3). Overall, for every 1-unit

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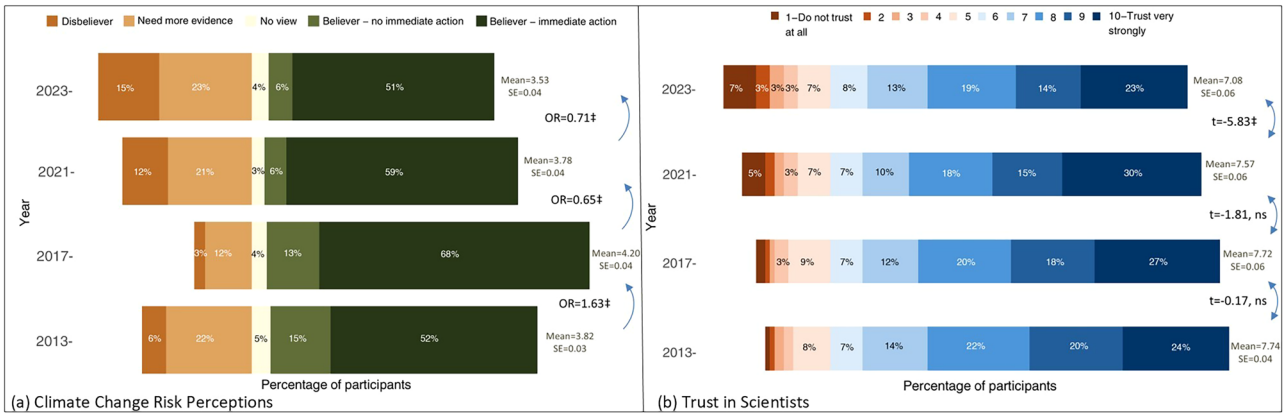

Fig. 1 | Raw percentage distributions for climate change risk perceptions and trust in scientists. Panel **a** presents the results for climate change risk perceptions and Panel **b** presents the results for trust in scientists. For Panel **a**, the valid $n = 3074$ in 2013 ($n = 107$ missing); valid $n = 1863$ in 2017 ($n = 71$ missing); valid $n = 2488$ in 2021; valid $n = 2317$ in 2023. *p < 0.05. †p < 0.01. ‡p < 0.001. Climate change risk perceptions were measured by asking participants: 'Which of the following statements best describes your beliefs about climate change and the Great Barrier Reef?'. The means were adjusted for by applying a population weight for age and gender combined (i.e., population proportion divided by the sample proportion). The odds ratio (OR) between successive years was obtained from ordinal logit regression models (including the population weight), repeated with a different baseline comparison year (see Table S3). SE = Standard Error. For Panel **b**, the valid $n = 3016$ in 2013 ($n = 165$ missing); valid $n = 1851$ in 2017 ($n = 83$ missing); valid $n = 2411$ in 2021 ($n = 77$ missing); valid $n = 2246$ in 2023 ($n = 71$ missing). *p < 0.05. †p < 0.01. ‡p < 0.001. Trust in scientists was measured by asking participants: 'Considering the information you receive about the Great Barrier Reef, how much do you trust the information that comes from the following groups?' with 'scientists from research institutions (e.g., CSIRO, Universities)' as one of the options. The means were adjusted for by applying a population weight for age and gender combined (i.e., population proportion divided by the sample proportion). The t-scores (t) between successive years were obtained from contrasts requested post hoc to the population-weighted linear regression model (see Table S6). SE = Standard Error.

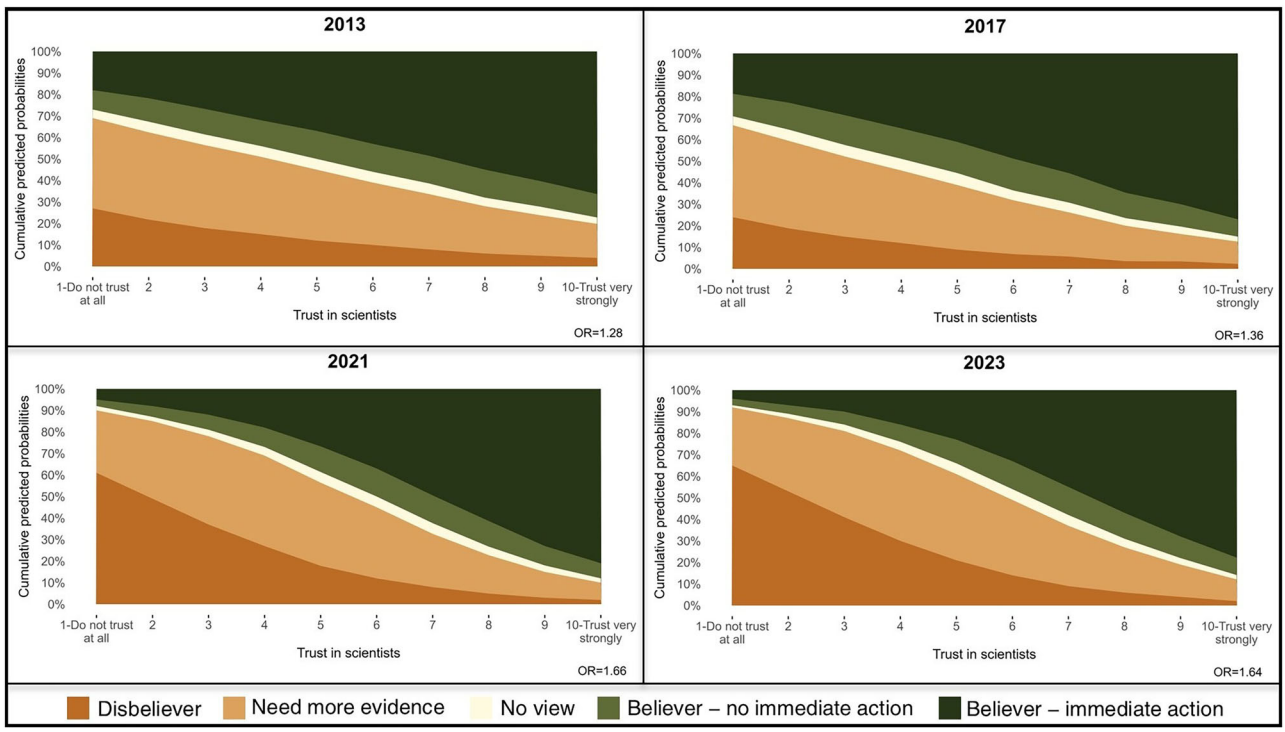

Fig. 2 | Predicted probabilities for climate change risk perceptions categories, by level of trust in scientists, across the years. Valid $n = 3074$ in 2013 ($n = 107$ missing); valid $n = 1863$ in 2017 ($n = 71$ missing); valid $n = 2488$ in 2021; valid $n = 2317$ in 2023. Predicted probabilities are obtained post hoc from population-weighted ordinal logit models (including year, gender, generation, and trust in scientists, and the interaction between year and trust) and reflect the probability of a participant selecting that particular climate change risk perception category. 95% confidence intervals are reported in Table S8a–k. The Odds Ratio (OR) in each year is obtained from the same population-weighted ordinal logit model with the relevant year set as the baseline comparison (see Table S7).

increase in *trust in scientists*, the odds of moving into a higher climate change risk perception category increased by 49%. The relationship between *trust in scientists* and climate change risk perceptions increasingly strengthened across the years, with a significant change occurring between 2017 and 2021 (OR = 1.22, $z = 5.58$, $p < 0.001$) (see Fig. 2 and Table S7). A 1-unit increase in trust was associated with 28% greater odds of stronger climate change risk perceptions in 2013, 36% greater odds in 2017, 66% greater odds in 2021 and 64% greater odds in 2023.

To examine the relationship between *trust in scientists* and climate change risk perceptions over time, in Fig. 2 we show the predicted

probabilities for the categories of risk perception, by trust, in each year (see Table S8a–k for summary statistics). The risk perception profile changed most markedly among people with lower *trust in scientists* and between the years of 2017 and 2021. For example, people with no *trust in scientists* had a higher probability of expressing *disbelief in climate change* in 2021 (62%) than they did in 2017 (23%), and this disbelief remained consistently high thereafter (i.e., 65% in 2023). The increase in the probability of disbelief between 2017 and 2021 corresponded with falls in the predicted probability of *immediate action-belief* (from 21 to 5%), *no immediate action-belief* (from 10 to 3%), *need more evidence* (from 41 to 29%) and *no view* (from 5 to 2%). Among respondents with medium (i.e., mid-point of 5.5) levels of *trust in scientists*, changes in the risk perception profile were also most significant between 2017 and 2021. Here, respondents had a higher probability of expressing *disbelief* and *need more evidence* in 2021 (15% and 36%, respectively) than in 2017 (7% and 24%, respectively), while the probability of *immediate action-belief* decreased between these years (from 51% in 2017 to 32% in 2021). For respondents with high levels of *trust in scientists*, the largest changes occurred between the earlier years of 2013 and 2017. Here, the predicted probability for *immediate action-belief* increased (from 67% in 2013 to 80% in 2017) and thereafter remained relatively high (i.e., 81% in 2021, and 78% in 2023). Between 2013 and 2017, the predicted probability of *need for more evidence* (from 16 to 9%) and *no immediate action-belief* (from 11 to 7%) decreased and thereafter remained relatively stable. In the remaining categories of *disbelief* and *no view*, small yet significant changes (i.e., 1.9 and 1.3 percentage points, respectively) were observed between 2013 and 2017, and thereafter remained relatively stable.

Prior research shows that public perceptions of climate change can change as people interpret events (proximate and distal) through personal values and beliefs[7,8,13]. Our case study shows fluctuations in climate risk perceptions as they relate to an iconic climate symbol (the Great Barrier Reef), with significant shifts towards and then away from recognition of such risks in just a few short years. Trust in scientists also fluctuated over this time, becoming more closely related to climate change risk perceptions in recent years.

Our findings in the GBR region can be meaningfully compared with a 2023 national survey that also assessed public perceptions of climate change risks to the GBR[14]. Using an identical climate change risk perception question, the *Climate Action 2023* survey found that 68% of Australians believe climate change poses a threat to the GBR (requiring immediate action). An additional 6% viewed it is a threat but did not see the need for urgent action, 5% had no opinion, 14% felt they needed more evidence to form an opinion, 4% did not consider climate change a threat and 3% did not believe in climate change at all[14]. The contrast between these national results and our regional findings is substantial. Notably, there is a 17-percentage point gap in the proportion of people who view climate change as an urgent threat to the GBR. This comparison suggests that residents in the GBR region are significantly less likely than the broader Australian population to perceive climate change as a serious and immediate risk to the GBR. This disparity may be associated with political views in this and other regional areas, contrasting with those in major population centres[15].

It remains an open question as to why residents in the GBR region have become more sceptical of the impacts of climate change over time – especially since there have been widely publicised, repeated mass coral bleaching events in the GBR since 2016. We hypothesise that the observed fluctuations in climate risk perceptions in our case study are less attributable to the proximate climate risk events and more so to the media and social media representations of such events and accompanying misinformation that undermines the science. For instance, following the back-to-back mass coral bleaching events in 2016 and 2017, news media reports presented alarming and sensationalised viewpoints of GBR health and impacts[10], which may have contributed to heightened public concern, as reflected in our 2017 results. However, from 2018 onwards, misinformation campaigns – particularly over social media – began to exploit scientific uncertainty, nuance and complexity to propagate climate change scepticism and denialism[16]. This shift in narrative may have contributed to a decline in perceived urgency. Broader anti-science sentiment in the global socio-political context, such as that observed during the COVID-19 pandemic, may also have contributed to a decline in public trust in science since 2020[17]. Additionally, it is plausible that over the last decade, GBR residents have become desensitised to repeated mass coral bleaching events (i.e., in 2016, 2017, 2020, and 2022[18]). News of these recurrent events may be leading to a psychological normalisation of environmental decline, where such changes are increasingly viewed as part of a new, albeit degraded, status quo. This idea aligns with research showing that people tend to rapidly adapt to worsening environmental conditions, which can act as a barrier to sustained climate concern and action[19].

Overall, our results reveal a widening disparity in views about climate change among those living in the region. On the one hand, there is a growing segment of GBR residents with low trust in scientists who are more likely to reject climate change as a threat to the GBR. While at the other end of the spectrum, there is a downturn in the proportion of residents with high trust in scientists who believe climate change is an urgent threat requiring immediate action.

By presenting a case study of the Great Barrier Reef, a globally significant ecosystem and World Heritage Area that has become an icon of climate change, we draw attention to an unfolding crisis that is at risk of worsening, if public support and political will for climate mitigation and adaptation continues to falter in the GBR region. While international oversight of GBR threats and management responses is influential (e.g., through the UNESCO World Heritage Committee[20]), residents in regional areas of Australia (like in many democratic countries) can exert a strong influence on national environmental policy and climate action through the federal electoral system[21]. Considering the economic and cultural importance of the GBR to the proximate community who depend on its health and maintenance[22], one should expect strong public protective sentiment. However, our results suggest that recognition of climate change as a threat to the GBR has fallen considerably in this community. This does not mean, however, that support for Reef protection is in decline. Many people may still perceive the GBR as vulnerable to other stressors – such as pollution and overfishing—which can continue to motivate protective behaviour, even if these are not explicitly climate-related. At a fundamental level then, it would be important to assess whether people believe the GBR is under threat at all, regardless of the source. We also suggest that when climate-related threats are framed in more tangible terms—such as ocean heatwaves or cyclones—people may be more likely to acknowledge their impacts, potentially offering a more effective pathway for engaging public support for broader climate action.

Our findings demonstrate that public climate change risk perceptions can change over the course of a few years and are entwined with trust placed in science. Recognising that trust in science and scientists, now more than ever before, has the potential to significantly shape public belief in climate change and its proximate risks, concerted efforts are required to restore and maintain public trust in ecological and climate science.

Methods

Participants and procedure

Our results are derived from a time-series of cross-sectional surveys of residents in the GBR region. Residents were surveyed in 2013, 2017, 2021, and 2023, as part of a long-term monitoring programme of social and economic indicators of the Reef. In 2013 and 2017, the surveys were conducted face-to-face in public locations throughout the GBR catchment region (e.g., beaches, boat ramps, parks, shopping centres and markets). In 2021, the method of participant recruitment and data collection shifted to online and telephone surveying to eliminate health and safety risks during the COVID-19 pandemic, and to improve cost-effectiveness. In 2023, only online surveying was used. A total of 9920 residents were surveyed across four waves of independent data collection—2013 (n = 3181), 2017 (n = 1934), 2021 (n = 2488) and 2023 (n = 2317) (see Table S1 for the demographic characteristics of participants in each year). Ethical approval (#069/21) for this research was granted by the CSIRO Social Science Human

Research Ethics Committee and was conducted in accordance with the Australian National Statement on Ethical Conduct in Human Research (2007). All respondents gave informed consent to participate in the voluntary survey.

Measures

While changes were made to some questions in the survey across the years, the questions used in this study were comparable across the four time-points. In all surveys, respondents were presented with the following plain English definition of the GBR: 'The 'Great Barrier Reef' or the 'GBR' includes all land and water from the beaches on the coast, the bays and creeks, the islands, the shoals and seafloor, the open waters, and of course the coral reefs'. To measure and compare resident's belief in climate change and risk perceptions for the GBR, participants were asked to select a statement that best reflected their viewpoint about climate change and how it affects the GBR. These statements were coded into the following 5 belief categories and ordered such that higher scores reflect stronger belief in climate change: (1) Disbeliever ('I believe that climate change is not a threat at all' (2013, 2017)/ 'Climate change is not a threat to the GBR' (2021, 2023)/'I do not believe in climate change' (2021, 2023) (2) Need more evidence ('I need more evidence to be convinced of the problem' (2013, 2017)/'I need more evidence to form an opinion about climate change and how it may threaten the GBR' (2021, 2023), (3) No view (' I do not have a view on climate change' (2013, 2017)/'I do not have a view on climate change and how it relates to the GBR' (2021, 2023), (4) Believer – no immediate action ('climate change is a serious threat but the impacts are too distant for immediate action' (2013, 2017)/'climate change is a threat but does not require immediate action' (2021, 2023), and (5) Believer – immediate action ('climate change is an immediate threat requiring action' (2013, 2017)/'climate change is a threat to the GBR, requiring immediate action' (2021, 2023). To measure trust in research scientists/institutions, respondents were asked to think about the information they receive about the GBR, and to rate how much they trusted information about the GBR that comes from 'scientists from research institutions (e.g., CSIRO, Universities)', with a ten-point response scale (1 = 'do not trust at all', to 10 = 'trust very strongly').

Analytic approach

Statistical analysis was performed using STATA 17.0[23] and figures were created using R Statistical Software version 4.3.1[24]. Ordinal logistic regression analyses (i.e., proportional-odds ordered logit model) were used to determine the likelihood that different climate change beliefs (as an ordered, categorical response variable) could be explained by variation in year and trust. A population weight was applied to ensure that the sample's age by gender distribution matched the regional Queensland population distribution in the relevant year[25]. Demographics were also included as control variables, given that prior research has indicated females and younger generations tend to hold stronger climate change beliefs. Several regression models were run, in a sequential manner, to evaluate the effects of (1) year, (2) demographic controls (i.e., gender and generation), (3) trust, and (4) the interaction between trust and year (see Table S2). The regression models also were repeated with alternative base comparison categories to evaluate differences between successive years. Predicted probabilities and marginal effects were obtained post hoc to the main analyses, to reveal the pattern of results for year (see Table S3), gender (see Table S4), generation (see Table S5), and trust across the years (see Table S8a–k).

Data availability

The data that support the findings of this study (SELTMP 2013; 2017; 2021; 2023) are publicly available from the CSIRO online data access portal at https://doi.org/10.25919/5c74c7a7965dc; https://doi.org/10.25919/we28-jk48; and https://doi.org/10.25919/ebzb-s968.

Received: 15 May 2025; Accepted: 5 January 2026;
Published online: 21 January 2026

References

1. Lynas, M., Houlton, B. Z. & Perry, S. Greater than 99% consensus on human caused climate change in the peer-reviewed scientific literature. *Environ. Res. Lett.* **16**, 114005 (2021).
2. Ripple, W. J. et al. World scientists' warning of a climate emergency 2021. *BioScience* **71**, 894–898 (2021).
3. Schaffer, L. M., Oehl, B. & Bernauer, T. Are policymakers responsive to public demand in climate politics?. *J. Public Policy* **42**, 136–164 (2022).
4. Björnberg, K. E., Karlsson, M., Gilek, M. & Hansson, S. O. Climate and environmental science denial: a review of the scientific literature published in 1990–2015. *J. Clean. Prod.* **167**, 229–241 (2017).
5. Marquardt, J. & Lederer, M. Politicizing climate change in times of populism: an introduction. *Environ. Poli.* **31**, 735–754 (2022).
6. Ophir, Y., Walter, D., Jamieson, P. E. & Jamieson, K. H. The politicization of climate science: media consumption, perceptions of science and scientists, and support for policy. *J Health Commun* **29**, 18–27 (2024).
7. Whitmarsh, L. & Capstick, S. Perceptions of climate change. in *Psychology and Climate Change*. *Human Perceptions, Impacts, and Responses* (ed. Clayton, S. & Manning, C.) 13–33 (Academic Press, 2018).
8. Curnock, M. et al. Shifts in tourists' sentiments and climate risk perceptions following mass coral bleaching of the Great Barrier Reef. *Nat. Clim. Chang.* **9**, 535–541 (2019).
9. Hughes, T.P. et al. Global warming and recurrent mass bleaching of corals. *Nature* **543**, 373–385 (2017).
10. Eagle, L., Hay, R. & Low, D. R. Competing and conflicting messages via online news media: potential impacts of claims that the Great Barrier Reef is dying. *Ocean Coast. Manag.* **158**, 154–163 (2018).
11. Foxell-Norton, K. & Konkes, C. The Great Barrier Reef: news media, policy and the politics of protection. *Int. Commun. Gaz.* **81**, 211–234 (2019).
12. Cologna, V. & Siegrist, M. The role of trust for climate change mitigation and adaptation behaviour: a meta-analysis. *J. Environ. Psychol.* **69**, 101428 (2020).
13. Hornsey, M. J., Harris, E. A., Bain, P. G. & Fielding, K. S. Meta-analyses of the determinants and outcomes of belief in climate change. *Nat. Clim. Chang.* **6**, 622–626 (2016).
14. Paas, K., Bradley, G. & Deshpande, S. Climate Action Survey, 2023. Technical Report. https://doi.org/10.25904/1912/5518 (2024).
15. Colvin, R. M. & Jotzo, F. Australian voters' attitudes to climate action and their social-political determinants. *PLoS ONE* **16**, e0248268 (2021).
16. Lubicz-Zaorski, C., Newlands, M. & Petray, T. Fuelling the climate and science 'denial machine' on social media: a case study of the Great Barrier Reef's 2021 'in danger' recommendation on Twitter, YouTube and Facebook. *Public Underst. Sci.* **33**, 270–289 (2014).
17. Prasad, A. Anti-science, misinformation and conspiracies: COVID-19, post-truth, and science and technology studies (STS). *Sci. Technol. Soc.* **27**, 88–112 (2022).
18. Australian Institute of Marine Science. Coral Bleaching Events. https://www.aims.gov.au/research-topics/environmental-issues/coral-bleaching/coral-bleaching-events (2025).
19. Liu, G., Snell, J. C., Griffiths, T. L. & Dubey, R. Binary climate data visuals amplify perceived impact of climate change. *Nat. Hum. Behav.* **9**, 1355–1364 (2025).
20. Morrison, T. H. Evolving polycentric governance of the Great Barrier Reef. *Proc. Natl. Acad. Sci. USA* **114**, e3013–e3021 (2017).
21. Moore, B. et al. Politicians and climate change: a systematic review of the literature. *Wiley Interdiscip. Rev. Clim. Change* **5**, e908 (2024).
22. Marshall, N. A. et al. The dependency of people on the Great Barrier Reef, Australia. *Coast. Manag.* **45**, 505–518 (2017).
23. StataCorp. Stata Statistical Software: Release 17. College Station, TX: StataCorp LLC. https://www.stata.com (2021).

24. R Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria. https://www.R-project.org/ (2023).
25. Australian Bureau of Statistics. Customised report on estimated resident population for each single year of age, by sex, by statistical area levels 1 and 2 (SA1 and SA2) and local government area in Queensland and Tweed, 2011 to 2024p (ASGS Edition 3, 2021). https://www.qgso.qld.gov.au/statistics/theme/population/population-estimates/regions (2025).

Acknowledgements

This research was funded by the partnership between the Australian Government's Reef Trust and the Great Barrier Reef Foundation, with support provided by the Great Barrier Reef Marine Park Authority, the Queensland Government's Office of the Great Barrier Reef and World Heritage, and the Commonwealth Department of Climate Change, Environment, Energy and Water. The scientific results and conclusions, as well as any views or opinions expressed herein, are those of the authors and do not necessarily reflect the views of the Australian Government or the Queensland Government and their respective Ministers for the Environment.

Author contributions

E. H., A. M. and M.C. designed and administered the survey; E.H. and M.C. conceived the research questions; E.H. analysed the data; E.H., M.C., and M.D. wrote substantive sections of the manuscript; E.C. prepared all figures. All authors reviewed the manuscript.

Funding

Open access funding provided by CSIRO Library Services.

Competing interests

The authors declare no competing interests.

Additional information

Supplementary information The online version contains supplementary material available at https://doi.org/10.1038/s44168-026-00334-w.

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