Reef Restoration and Adaptation Program

Australian attitudes toward the protection and restoration of the Great Barrier Reef: Summary Findings

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Acknowledgements

This work was undertaken for the Reef Restoration and Adaptation Program, a collaboration of leading experts, to create a suite of innovative measures to help preserve and restore the Great Barrier Reef. Funded by the Australian Government, partners include: the Australian Institute of Marine Science, CSIRO, the Great Barrier Reef Foundation, Southern Cross University, The University of Queensland, Queensland University of Technology and James Cook University.

The survey instrument used in Phase 1 this research was co-designed by Professor Brent Ritchie (UQ) and Dr Justine Lacey (CSIRO) with input from Bruce Taylor (CSIRO), Line Bay (AIMS), David Mead (AIMS) and Stewart Lockie (JCU) to test public attitudes to novel reef interventions in 2018 as part of the Concept Feasibility Phase of RRAP.

The Phase 1 survey instrument now provides the basis for longitudinal assessment of public attitudes to novel reef interventions presented here. The authors acknowledge additional input and ideas used to update the instrument from Dr Justine Lacey (CSIRO), particularly the experimental design component in the 2022 survey. Professor Stewart Lockie, Dr Victoria Graham and Dr Gillian Paxton (James Cook University) helped to design/refine some sections based on their deep dive interviews. Thank you to Ms Jane Adcroft (Science Communicator and RRAP Communication Lead) and Dr Cedric Robillot (Executive Director of the RRAP) for their help in refining the intervention descriptions. We also received a list of the GBR catchment postcodes from Dr Petina Pert CSIRO) and Dr Matt Curnock (CSIRO) which informed our survey sampling strategy.

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The Great Barrier Reef

Visible from outer space, the Great Barrier Reef is the world's largest living structure and one of the seven natural wonders of the world, with more than 600 coral species, and 1600 types of fish. The Reef is of deep cultural value, and an important part of Australia's national identity. It underpins industries such as tourism and fishing, contributing more than $6 billion a year to the economy and supporting an estimated 64,000 jobs.

Why does the Reef need help?

Despite being one of the best-managed coral reef ecosystems in the world; there is broad scientific consensus the long-term survival of the Great Barrier Reef is under threat from climate change. In addition to strong global action to reduce carbon emissions, and continued management of local pressures, bold action is needed. Important decisions need to be made about priorities and acceptable risk. Resulting actions must be understood and co-designed by Traditional Owners, Reef stakeholders and the broader community.

What is the Reef Restoration and Adaptation Program?

The Reef Restoration and Adaptation Program (RRAP) is a collaboration of Australia's leading experts to create a suite of innovative and targeted measures to help preserve and restore the Great Barrier Reef. These interventions must have strong potential for positive impact, be socially- and culturally-acceptable, ecologically-sound, ethical and financially-responsible. They would be implemented if, when and where it is decided action is needed – and only after rigorous assessment and testing.

RRAP is the largest, most comprehensive program of its type in the world; a collaboration of leading experts in reef ecology, water and land management, engineering, innovation and social sciences, drawing on expertise from around the world. It aims to strike a balance between minimising risk and maximising opportunity to save Reef species and values.

RRAP is working with Traditional Owners and groups with a stake in the reef – as well as the general public - to discuss why these actions are needed, and to better understand how these groups see the risks and benefits of proposed interventions. This will help inform planning and prioritisation, to ensure the proposed actions meet community expectations. Coral bleaching is a global issue. The resulting reef restoration technology could be shared for use in other coral reefs around the world, helping to build Australia's international reputation for innovation.

RRAP is being progressed by a partnership including: the Australian Institute of Marine Science, CSIRO, Great Barrier Reef Foundation, James Cook University, The University of Queensland, Queensland University of Technology, Southern Cross University as well as researchers and expert from other organisations around the world.

EXECUTIVE SUMMARY

Study Aim and Approach

This report presents the main results of the 2022 survey aimed to provide an understanding of Australian attitudes toward the development and deployment of novel restoration and adaptation options in the Great Barrier Reef (GBR), along with factors (confidence in regulations, trust in governance, procedural fairness, beliefs in interventions, overall perceived benefits v risks and other indicators) that influence attitudes toward restoration and adaptation and ways to engage and communicate with the Australian public around novel management interventions.

Comparisons are made between a national population sample and a Great Barrier Reef sample located within 50km of the GBR coast. A total sample of 4,410 split between the National (N= 3,082) and GBR residents (N = 1,328) was collected through a survey and used in the final analysis. Respondents were representative of the Australian population based on gender, age, and location (Australia State and Territory) and had a mix of urban and rural respondents.

Key Results

- The Australian public understand the benefits the GBR provides, believe should be done to save the GBR, and did not think enough was being done to effectively manage the GBR.

- Respondents indicated some uncertainty in relation to trusting government to manage the GBR, but still had high levels of confidence that regulation and research can make a major difference to the health of GBR.

- Providing opportunities for the public to participate in decision-making, considering consent before restoration and adaptation activities are undertaken, listening and demonstrating respect for community opinions

- A willingness by government and regulators to change their practices in response to community concerns are likely to increase trust in governance of any proposed intervention.

- 79% of the sample supported general restoration and adaptation actions to sustain the GBR, while between 74% and 78% supported restoration through large scale restoration and adaptation technologies.

- 67% agreed that it was valuable to have specific interventions deployed in the GBR region, although some were cautious or uncertain. This could possibly be explained by gaps in knowledge or understanding; hence, more information about interventions may be required.

- A total of 77% of the sample would approve novel technological interventions to help the GBR, while 76% would embrace such interventions.

- Coral seeding, manual removal and rubble stabilisation were perceived as higher value interventions than genetic engineering, biological agents and cloud brightening. Natural breeding and fogging were perceived to have fewer benefits or risks than others.

- 84% of respondents agreed that research is needed to help repair damage to the GBR. Testing interventions through small scale outdoor trials and indoor lab research were supported by 77% and 78% of respondents respectively.

- 85% believe the public should have access to an easy-to-read summary or documentation of scientific results on the interventions, while 84% wanted an outline of the risks of technologies.

- The results showed 64% of the public were likely to visit a website providing information and updates on research about a respective intervention. An easy-to-read summary report was the most preferred option to access information or to provide feedback about the interventions.

- Respondents indicated they were unlikely to actively participate through being a member of a community reference group nor likely to make a written submission to government regulators, although some might want to express their views via social media about the interventions.

- Support for social acceptance of interventions were influenced by six key factors with the top three being consistent across both samples (in order of influence):

    1) *Beliefs toward intervention* (beliefs about society intervening to repair, restore and build resilience of the Reef).
    2) *Confidence in regulation* (beliefs that government, regulatory, and scientific research institutions to make a major difference to the health of the GBR).
    3) *Trust in organisations* to be responsible to manage and protect the Reef.

- Understanding of proposed interventions and emotional responses about reef interventions were two important factors which can drive intentions to acquire future information and engagement in relation to proposed reef interventions.

- Hopeful-cautious and proud-sad emotional responses toward proposed reef interventions were the most importance emotions influencing a potential acquisition of future information and engagement related to the proposed interventions.

In conclusion, while members of the public appeared to value the benefits of deploying novel interventions on the GBR, promoting awareness of potential risks and benefits associated with intervention through any media platforms would be helpful to increase public knowledge associated with risks and benefits.

Inclusive and mutual relationships (partnerships) should be promoted and developed among government, regulators, other GBR stakeholders and the public through reciprocal communication strategies such as on how possible negative impacts are mitigated or managed through different types of research support (i.e., small scale outdoor trials, indoor lab research, large scale deployment and funding). This could create positive feelings and ultimately enhanced confidence (trust), acceptance and downstream engagement of the public concerning the deployment of novel interventions.

INTRODUCTION

This project is part of Stakeholder and Traditional Owner Engagement Research and Development – The Social License and Impact Monitoring (SLM) project for the Reef Restoration and Adaptation Program (RRAP). RRAP is a multidisciplinary collaboration between lead universities and research agencies that brings together reef experts to research and develop an integrated suite of novel, scaled-up restoration solutions to help our Great Barrier Reef (GBR) resist and adapt to the impacts of climate change. No intervention will be progressed as ready to deploy on the Reef unless it is deemed scientifically proven, ecologically effective, technically feasible, economically viable and **socially acceptable**. We recognise these novel interventions will only be successful if accepted by the broader Australian public and if local reef communities and industry are involved in their implementation under the guidance of reef managers.

This project aims to provide a longitudinal understanding of Australian attitudes toward the development and deployment of novel reef restoration and adaptation options in the Great Barrier Reef, along with the factors that influence attitudes toward restoration and adaptation. Its objectives are to:

- Identify values, perceived threats and attitudes related to the GBR and its management.
- Identify factors that influence attitudes toward different reef restoration and adaptation options.
- Examine intentions to seek information and engage with the deployment of reef restoration and adaptation.
- Compare attitudes across Australia and regions close to the GBR.

The first phase of this was conducted in September 2018 (Taylor et al., 2019). This report is based on the second phase of data collection conducted in February 2022. Outcomes of this research are intended to support ongoing investment in the Reef Restoration and Adaptation Program (RRAP) funded by the partnership between the Australian Government's Reef Trust and the Great Barrier Reef Foundation.

METHODOLOGY

The purpose of conducting large-scale surveys with members of reef communities and the wider Australian public is to assess community attitudes toward the development and implementation of novel management interventions intended to build reef resilience in the face of anthropogenic climate change. It is accepted that successful deployment of proposed interventions at scale will depend on their acceptability among the Australian public.

The survey instrument used in this research has drawn on and adapted a range of 'social license' measures developed and tested by researchers based at the CSIRO over the last decade (Parsons et al., 2014; Moffat et al., 2016; Lacey et al., 2017). Specifically measures of procedural fairness, trust, confidence in governance, public efficacy, the role of benefits and impacts, and acceptance have been adapted for use within the context of reef restoration and management (see measures reported in Moffat & Zhang, 2014; Moffat et al., 2014; Zhang & Moffat, 2015; Zhang et al., 2015; Moffat et al., 2018). Behavioural intentions (participatory and

information seeking) in relation to future engagement with interventions were also assessed. The measures were adapted from McCrea, Walton and Measham (2018) and Mankad, Hobman and Carter (2021).

The current survey was divided into two sub-groups comprising: (1) an Australia-wide study of residents from all States and Territories, and (2) a specific sample of residents located within 50 kilometers of the Great Barrier Reef coast (GBR-50km). An online questionnaire was developed using Qualtrics and the link to the survey distributed by a market research company to an online panel.

After an initial pilot study (11-13 February 2022), the final survey was launched on 14 February 2022 and closed on 28 February 2022. The data collection for this study adopted a stratified sampling method. The representativeness of this study was guaranteed by using the Australian census data to establish a quota for the Australia-wide sample (ABS, 2016), while for the GBR sample soft quotas for Queensland were used as a guide. The respondents of the Australia wide sample were representative based on gender, age, and location (Australian State or Territory) and had a mix of urban and rural respondents. A current response of 4,718 and 1,765 were recorded from national and the GBR-50km samples. A total of 3,082 (65%) and 1,328 (75%) useable responses from the national and the GBR-50km sample respectively were used for the final analysis.

The total sample for the study was divided into eight main subsamples with equal proportion of national and GBR50km respondents ($N_{National}$= 379-392 and $N_{GBR\text{-}50km}$ = 161-170 for each subsample) for each intervention type:

1. Increased shading using fogging
2. Increased cooling using cloud brightening
3. Dead coral rubble stabilisation
4. Enhanced heat resistant - coral seeding
5. Enhanced heat resistance through natural breeding techniques
6. Enhanced heat resistance through genetic engineering
7. Pest control using biological agents
8. Pest control using manual removal

The 2022 survey structure is similar to the 2018 survey (Taylor et al., 2019) with some revisions on rewording the questions and adding conditions (scenarios) for each intervention (technology/approach) in the survey (See Australian attitudes toward the protection and restoration of the Great Barrier Reef: Technical report).

Descriptive statistics, independent and both parametric and non-parametric discriminant tests and statistical path modelling using SPSS and Smart PLS software were applied as data analytical techniques. PLS-SEM (Partial Least Square – Structural Equation Modelling) was used to examine the direct paths between the factors and overall social acceptance of reef restoration and adaptation as well as social acceptance of interventions, research supports and intentions for future engagement or options to access information about interventions.

SURVEY RESULTS

This section is divided into five main sections. Firstly, respondents' profiles with respects to their demographics and background information are presented which is then followed by descriptions of perceived toward reef management, restoration and adaptation as well as specific management interventions. Perceived current knowledge, future information and engagement about interventions are then described. The section concludes with presenting structural path models that highlight the relationships between underlying factors that drive overall social acceptance of reef restoration and adaptation as well as social acceptance, research supports and future engagement with interventions.

Background information

The total respondents for the study survey consisted of 70% national (N = 3,082) and 30% GBR-50km (N = 1,328) respondents. Within each group, slightly more female than male respondents completed the survey. About 55% national and 51% of GBR-50km respondents were 49 years old or younger. Around half of national respondents resided in Greater Sydney (21%), Greater Melbourne (19%) and Greater Brisbane (11%). Around 4% of respondents identified as Aboriginal and/or Torres Strait Islander. Furthermore, the majority of respondents (46%) completed a higher education qualification with about 50% national and 38% of GBR-50km respondents completing undergraduate and/or postgraduate degrees. In terms of employment status, around two-thirds of both national (63%) and GBR-50km (57%) respondents held full-time and part-time jobs. Based on the eight intervention types, the total sample was distributed equally with around 379 national and 161 GBR-50km respondents completing the survey for each restoration type.

A total of 73% of respondents noted they had visited the Great Barrier Reef (GBR) at least once, with 82% of the GBR-50km sample having visited the GBR previously. Approximately one half of total respondents (52%) rated their knowledge between 5 and 7 out of a rating of 10. News media (newspapers and online) or television (16%), direct observation and experience (11%) and general Internet sources (11%) were the most used information sources while scientific research reports and literature were the most trusted source on the GBR.

Perceptions toward reef management, restoration, and adaptation

The highest reported values (benefits) ascribed to the GBR were in ranked order were environmental, national/intrinsic, economic and socio-cultural. All values were rated higher by the GBR-50km sample. Similarly, perceived threats to the GBR were rated slightly higher by the GBR-50km sample who recognised their dependence on the GBR and the impact of pests (such as the COTS). Interestingly the national sample perceived somewhat higher threats of industry on the GBR than the GBR-50km sample.

Table 1: Opinions of GBR Management and Research

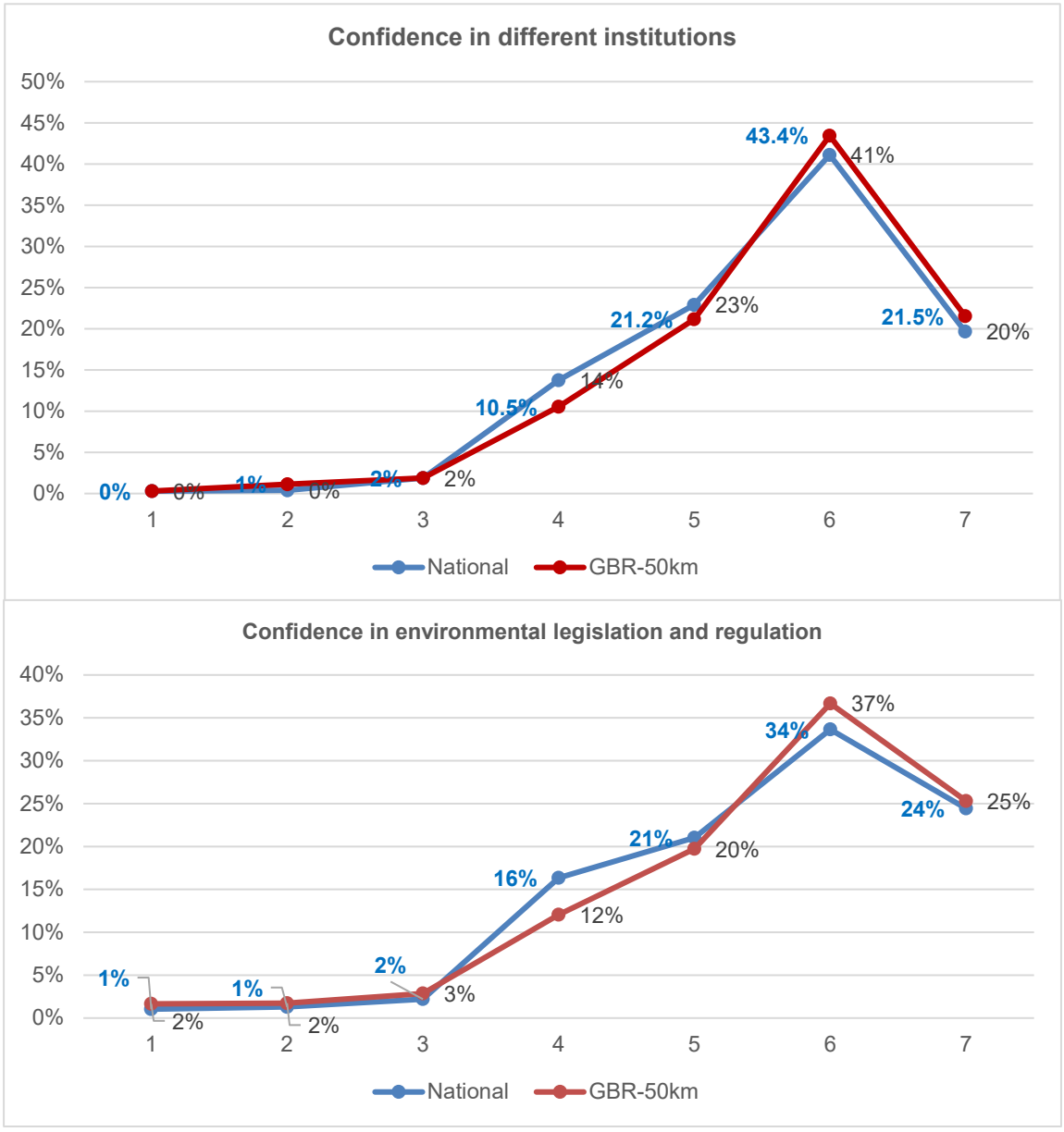
Item	National	GBR-50km
Reef management - Personal confidence	4.12	4.15
I feel confident that the GBR is well managed	4.30	4.29
I feel optimistic about the future of the GBR***	4.41	**4.57**
I think enough is being done to effectively manage the GBR	3.65	3.60
Reef management - Confidence in scientific research**	5.59	**5.76**

Scientific research can provide solutions to help repair the damage to the GBR****	5.63	**5.79**
Scientific research can provide solutions to help prevent damage to the GBR****	5.67	**5.86**
More research funding is required to examine solutions to help the GBR***	5.48	**5.62**

Notes: Bolded mean scores are significantly different from other sample (***p ≤0.01, ****p ≤0.000) with green highlighting high scores. Rated on scale from 1 (strongly disagree) to 7 (strongly agree). Midpoint = 4 (neither agree/disagree).

About 39% of total respondents were confident in the current and future management of the GBR although one in three respondents indicated neutral responses (32%) or disagreement (28%) reflecting some uncertainty about management of the GBR. Most respondents (85%) believed that *scientific research could be helpful in providing solutions to sustain the GBR.* Interestingly, the respondents did not think enough was being done to effectively manage the GBR (the mean scores for both samples were below 4 – midpoint).

Figure 1: Level of agreement on confidence in regulation

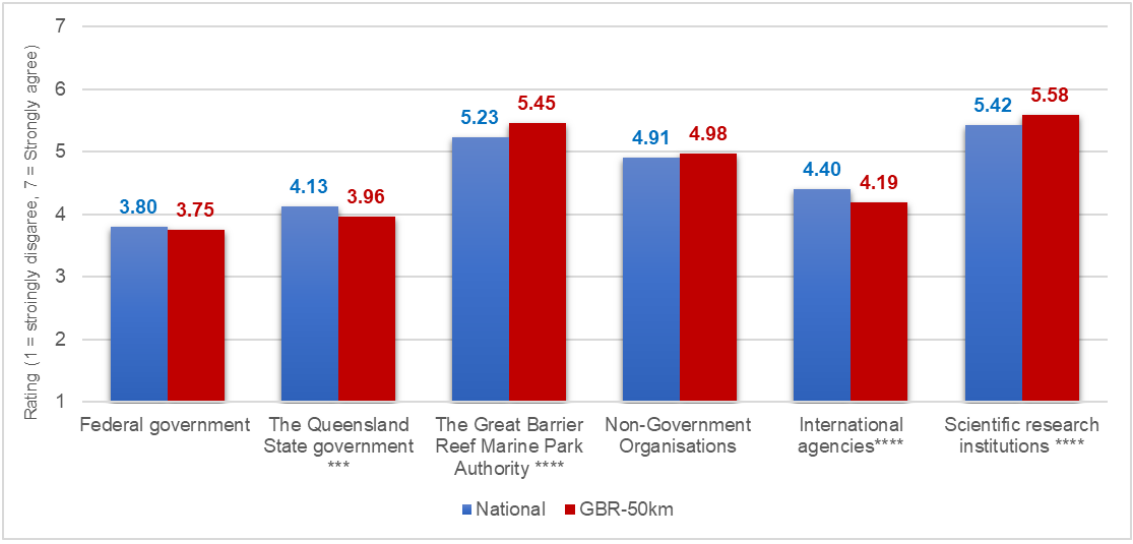


Note: X axis- Level of agreement with rated scale from 1 (Strongly Disagree) to 7 (Strongly Agree), midpoint = 4. Y axis: response percentages from each total number of group data (National and GBR-50km).

Most of the total sample (83%) had confidence in regulation (public confidence in governance) in making a difference to the health of the GBR (Figure 1, Score 5-7). About 73% of total respondents were confident the public can influence government policies and defend public or community interests although one in every five respondents (20%) was uncertain.

Respondents were neutral and uncertain about trusting organisations to manage the GBR. Scientific research institutions and the Great Barrier Reef Marine Park Authority (GBRMPA) were more trusted than governments (Figure 2).

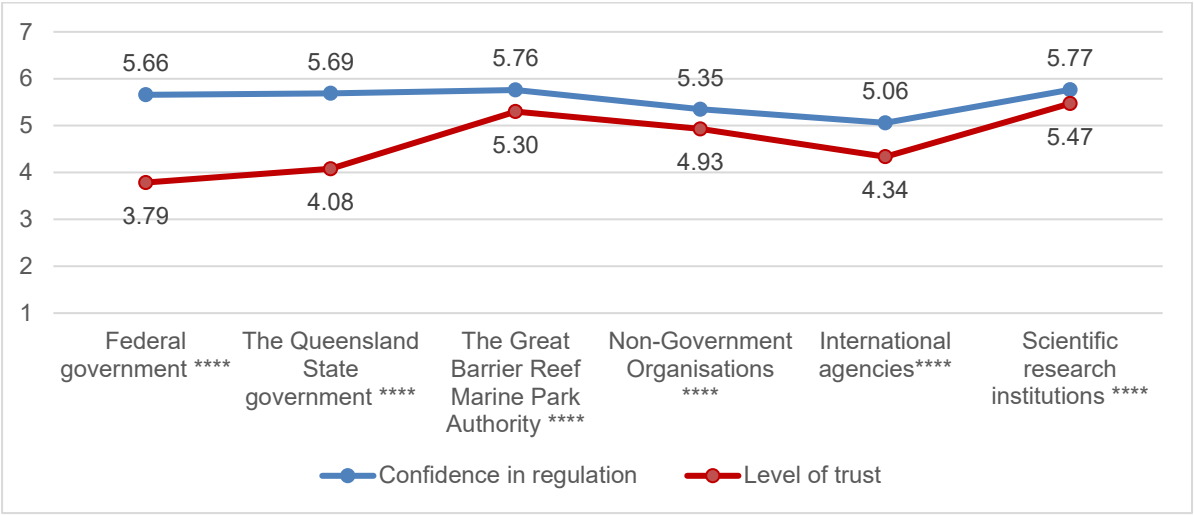
Figure 2: Trust across organisations and samples



Statistically different at *** p ≤ 0.01 and ****p ≤ 0.000

Figure 3 shows overall respondents rated confidence in regulation slightly higher than trust for different institutions. It demonstrates high confidence in scientists followed by the GBRMPA and Queensland Government to make changes to improve the health of the GBR.

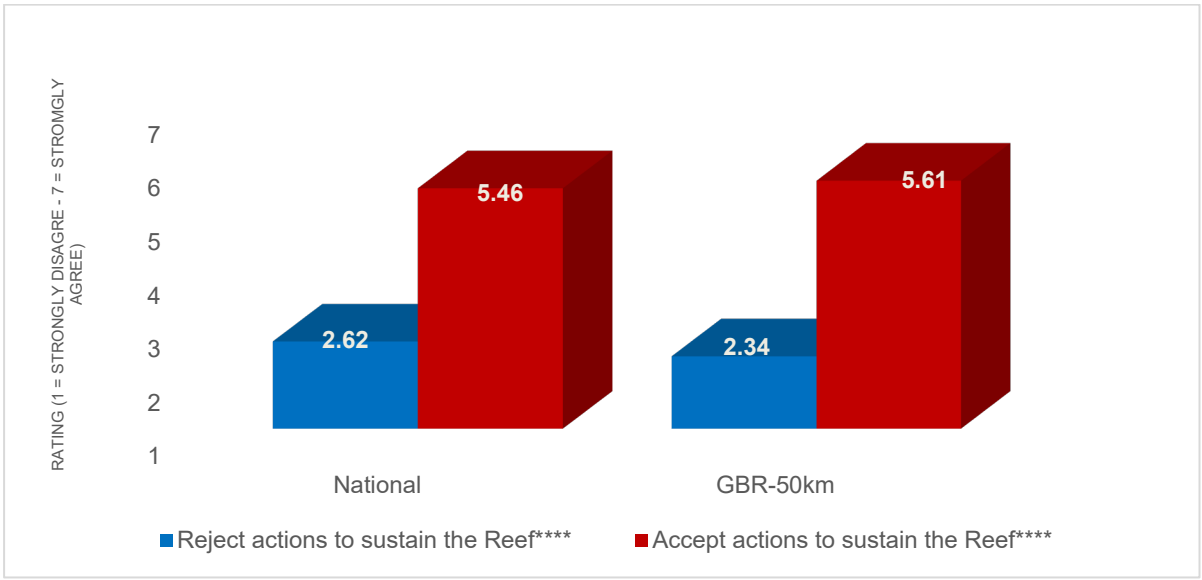
Figure 3: Mean scores - Confidence in regulation and Trust for different institutions



**** Statistically different at p ≤ 0.000

Supporting the resilience of the GBR through large-scale restoration and adaptation technologies was supported by between 74% and 78% of total respondents. Particularly, 72% of total respondents agreed that something should be done and the GBR should not be left alone.

Figure 4: Social acceptance (tolerate, accept, approve, embrace) for general reef intervention



Respondents were also asked if they would support general restoration of the GBR. Overall, 79% of the total sample would accept any restoration actions to sustain the GBR ($M_{GBR\text{-}50km}$ = 5.61 compared to $M_{National}$ = 5.46) as shown in Figure 5 while 77% and 76% of total sample would approve and embrace novel technological interventions to help the GBR respectively.

Perceptions of specific management interventions

To better understand the nature of the support that exists for reef restoration and adaptation, the survey was designed to explore public attitudes toward more specific intervention approaches and technologies. Scenarios were used to examine if any differences in attitudes and support existed across approaches/technologies. A total of eight interventions (Fogging, cloud brightening, rubble stabilisation, coral seeding, natural breeding, genetic engineering, biological agents and manual removal) were assessed.

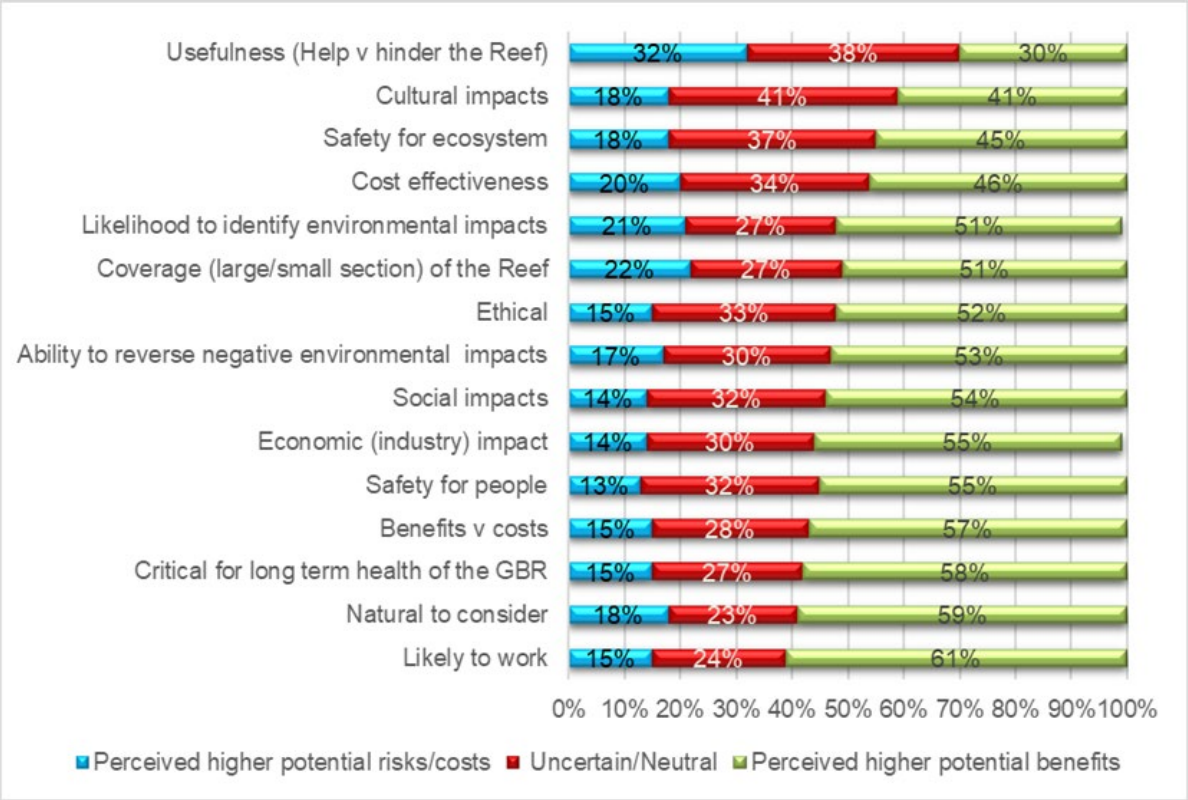
We tested for potential bias in our written framing of each intervention because the survey presented detailed descriptions of a range of interventions to a largely non-scientific audience (The descriptions of each intervention tested in the national survey can be found in Australian attitudes toward the protection and restoration of the Great Barrier Reef: Technical report).

Overall, the majority felt that descriptions were neutrally framed (70%), while 24% felt they were biased in favour of the intervention outlined and 6% felt they were biased against the intervention described.

Respondents were provided with a list of 15 perceived risks/benefits (‘*Perceived benefits v risks’*). Respondents were asked which of these statements best reflect their reason for their emotional responses. Perceptions of benefits and risks associated with interventions were then rated by respondents. Generally, the eight interventions were perceived to hold more

benefits than potential risks or costs (30%-55% of total respondents). The individual responses show some uncertainty based on neutral ratings of between 23% and 41% for each potential intervention. Between 30% and 40% of respondents felt that the intervention/approach would *'hinder more than it will help the Reef'* (32%) or were uncertain about the advantages of interventions (38%) ('Usefulness'). Furthermore, some respondents felt uncertain (34%) about the cost benefits of deploying the interventions or felt that the '*benefits of the intervention will be too small to justify the cost*' (20%) ('Cost effectiveness'). Respondents were also unsure whether the interventions were safe for the ecosystem (37%) and what or how the deployment of interventions had impacts culturally (41%).

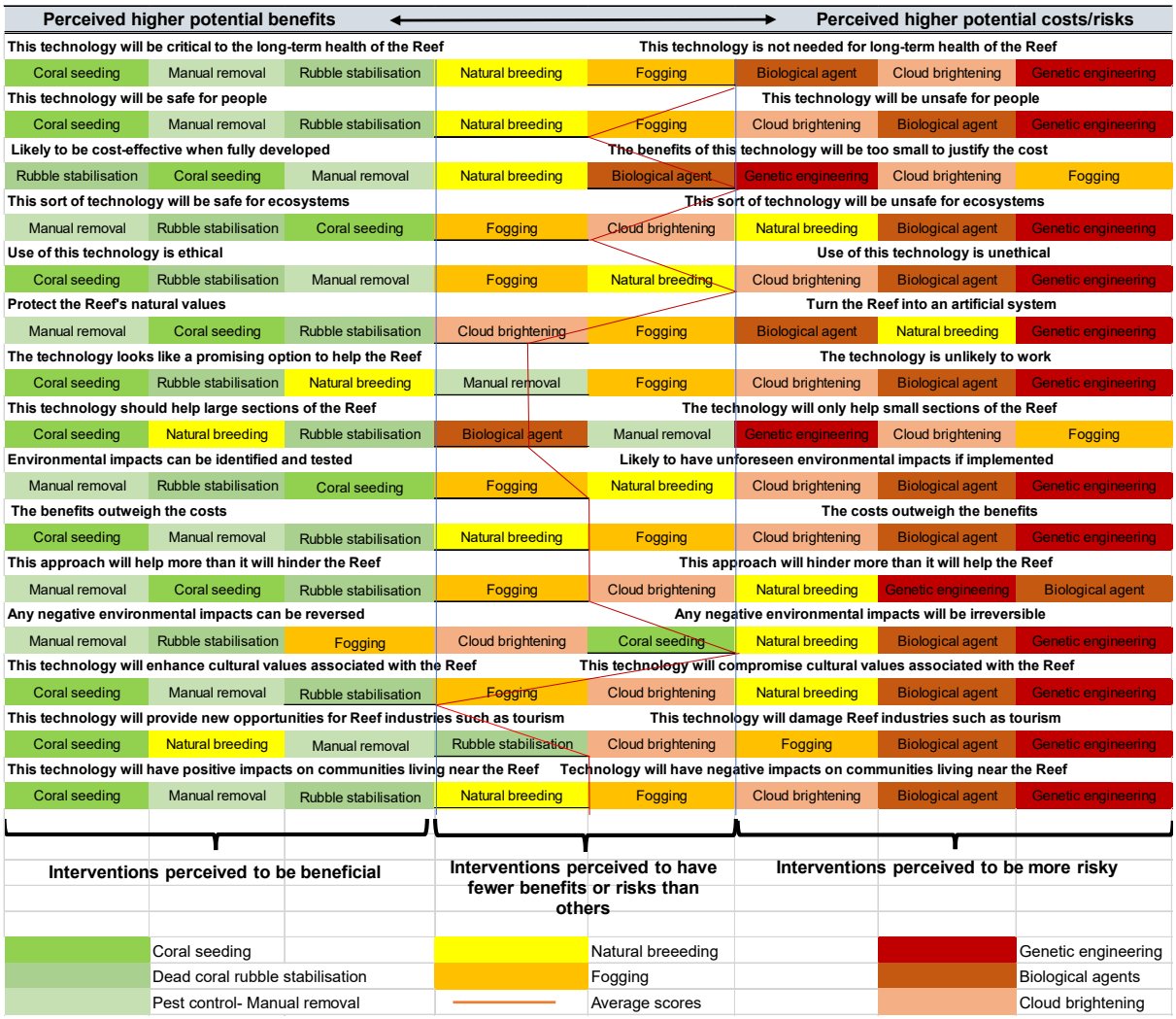
Figure 5: General perceived differences in benefits/risks of interventions by percentages



Based on the potential risks/benefits and intervention-type segmentation, the main eight interventions were perceived to have higher potential benefits although some interventions were perceived to be more beneficial or risky than others.

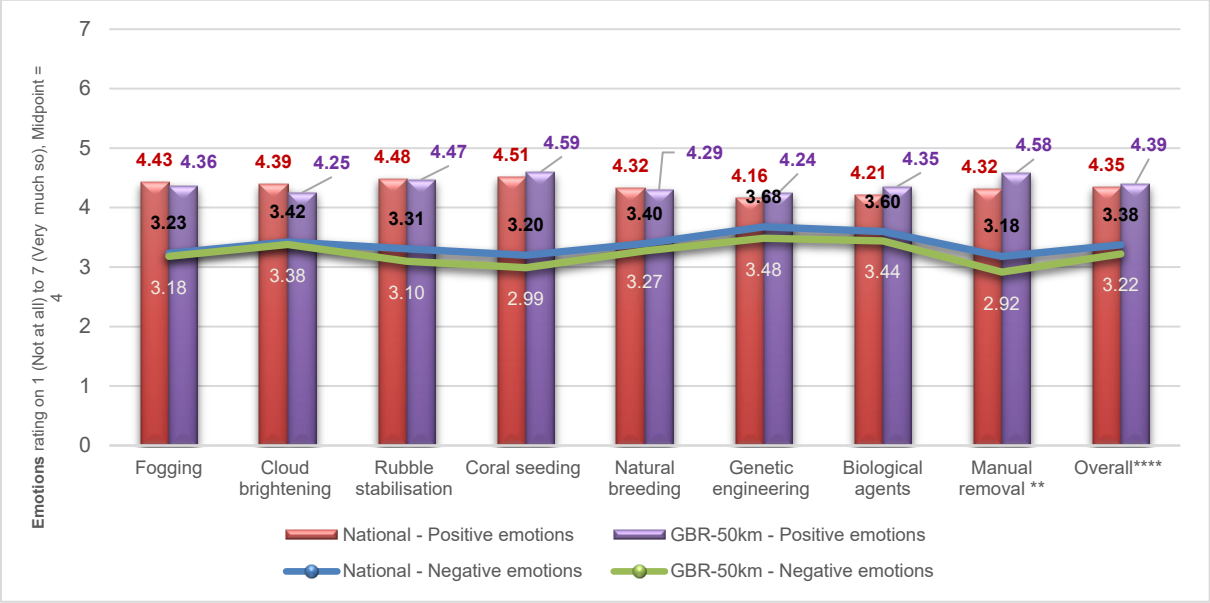
Overall, considering the balance of benefits and the costs ('*Overall benefits v risks'*), more than two-third of respondents (67%) agreed that it was valuable to have the interventions deployed in the GBR region. They also agreed that the GBR region would receive a fair share of benefits from these interventions ('*Distributive fairness'*). Considering the balance of benefits and costs as well as equitably shared benefits, coral seeding, manual removal and rubble stabilisation were perceived as higher value interventions than genetic engineering, biological agents and cloud brightening. Natural breeding and fogging were perceived to have fewer benefits or risks than others (Figure 6).

Figure 6: Summary of perceived differences in possible benefits / risks across interventions



Respondents were also asked to rate their initial emotions elicited by the intervention described in the description. A proportion of neutral (31%-36%) responses represented some uncertainty in their feelings towards interventions although results show that positive emotions (hopeful, happy, confident, relieved, and proud) were stronger than negative emotions (cautious, powerless, worried, scared and sadness).

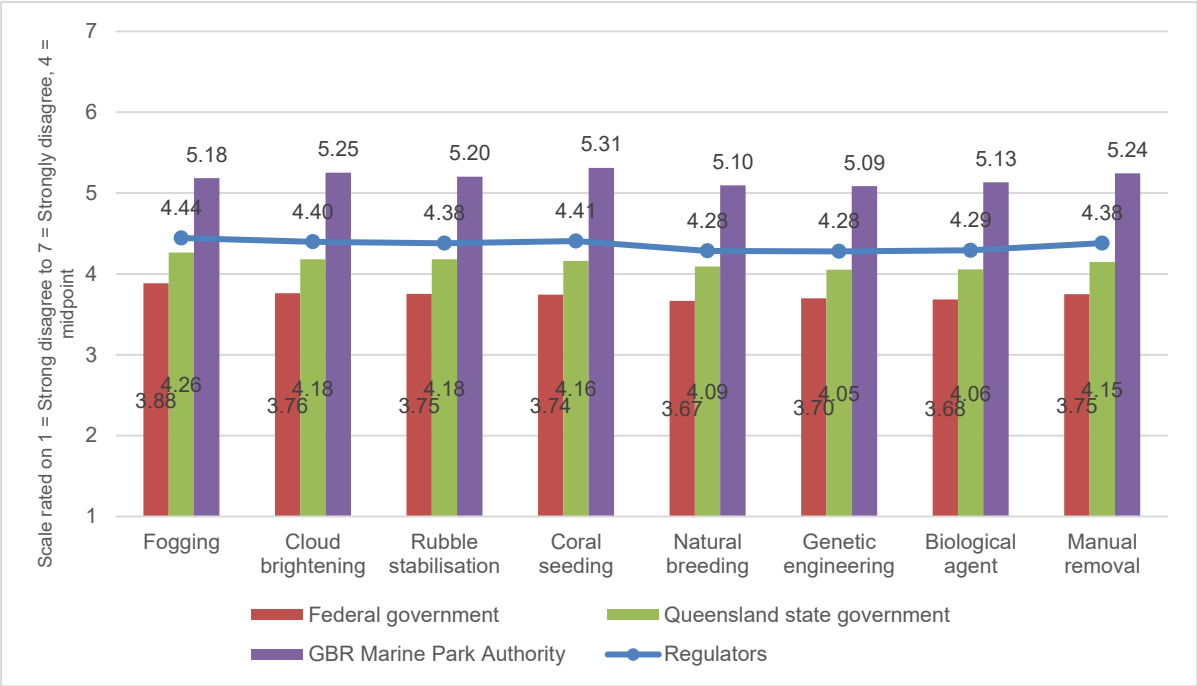
Figure 7: Overall emotional responses to interventions



Statistically different between the national and GBR-50km samples at **p ≤ 0.05 and ****p ≤ 0.000

Respondents were asked about their trust in governance in relation to the respective interventions. Although most respondents (83%) indicated their confidence in regulation in making a major difference to the health of GBR, only two-third of respondents (61%) indicated their agreement with some respondents unsure (27%) or expressing distrust (11%) of governance concerning the interventions.

Figure 8: Mean scores - Procedural fairness (Federal government, QLD state government, GBRMPA)



About two-third of respondents (60%) indicated the need to consult the community by different stakeholder before intervention activities took place or how these activities were managed, although 27% were uncertain. A similar proportion of neutral (27%) responses represented some uncertainty in trusting the Federal Government, Queensland Government and GBRMPA to listen and respect community opinions or response to their concerns considering the interventions.

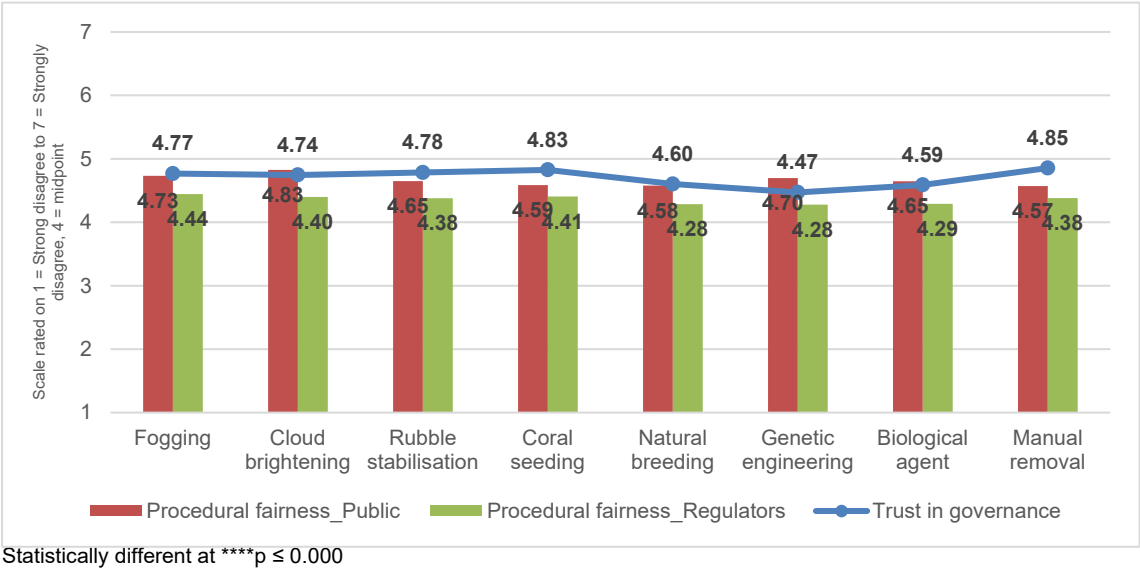
Table 2: Mean scores: Trust in governance and procedural fairness (by intervention types)

Intervention	N	Trust in governance	Procedural Fairness				
			Public	Regulators	FG	QLD	GBRMPA
Manual removal	560	**4.85^{H****}**	4.57^{L}	4.38	3.75	4.15	5.24
Coral seeding	542	4.83	4.59^{L}	4.41	3.74	4.16	5.31
Rubble stabilisation	553	4.78	4.65	4.38	3.75	4.18	5.20
Fogging	555	4.77	4.73	4.44	3.88	4.26	5.18
Cloud brightening	545	4.74	**4.83^{H**}**	4.40	3.76	4.18	5.25
Natural breeding	553	4.60^{L}	4.58	4.28	3.67	4.09	5.10
Biological agent	550	4.59^{L}	4.65	4.29	3.68	4.06	5.13
Genetic engineering	552	4.47^{L}	4.70	4.28	3.70	4.05	5.09
Total	4,410	4.70	4.66	4.36	3.74	4.14	5.19

Note: Significant differences among mean scores of interventions at **p≤ 0.05 - ****p≤ 0.00, Overall scores show differences within the column with highest and lowest indicated in superscript (ANOVA, Post-hoc Tukey test). 1 = Strongly disagree – 7 = Strongly agree, Mid-point = 4 (Neither disagree/agree). FG = Federal government, QLD = Queensland state government, GBRMPA = Great Barrier Reef Marine Park Authority.

Overall, respondents also indicated higher agreement on trust in governance and procedural fairness in obtaining public consent, and opportunity to participate in making decisions than the agreement that the regulatory bodies will listen to and respect the community opinion as well as change their practices in response to the public or community concerns considering the deployment of interventions.

Figure 9: Mean scores: Trust in governance and procedural fairness (by intervention types)



Statistically different at ****p ≤ 0.000

Respondents were asked to what extent they accepted the reef restoration and adaptation interventions presented to them. Between 12% and 13% of respondents from each of the national and GBR samples responded to one intervention. Figure 10 summarises the level of overall acceptance for the eight reef interventions by the national and GBR-50km samples. On this scale, respondents were asked to rate their level of acceptance (tolerate, accept, approve, embrace) of a specific proposed intervention from 1 (not at all) 7 (very much so) with the midpoint of 4 indicating that they are 'somewhat accepting'.

The results across all eight interventions indicate a moderate to strong tendency toward acceptance in both national and GBR-50km populations. However, importantly many respondents (22%-35%) also indicated they are uncertain.

One in three respondents were unsure whether biological agents (National = 34%, GBR-50km = 33%), genetic engineering (National = 35%, GBR-50km= 30%), and cloud brightening (National = 30%, GBR-50km= 30%) were acceptable interventions that could help sustain the GBR. The national sample indicated a slightly higher proportion of uncertainty than the GBR-50km sample for accepting natural breeding technique (National = 31%, GBR-50km= 26%), rubble stabilisation (National = 30%, GBR-50km= 22%), and manual pest control (National = 28%, GBR-50km= 22%). Both samples indicated a similar proportion of uncertainty in accepting fogging (27%) and coral seeding (22%).

Across the eight technologies/approaches tested in the survey, genetically modified heat resistant corals (National= 17%, GBR-50km= 22%) and pest control using biological agents (National = 17%, GBR-50km = 15%) attracted higher level of opposition than technologies such as natural breeding techniques (National and GBR-50km = 16%), coral seeding (National and GBR-50km = 11%) and pest control using manual removal (National and GBR - 50km = 9 %). Furthermore, about 18% or less of respondents appeared to 'reject' fogging (National = 10%, GBR-50km= 18%) and cloud brightening interventions (National = 14%, GBR-50km= 15%).

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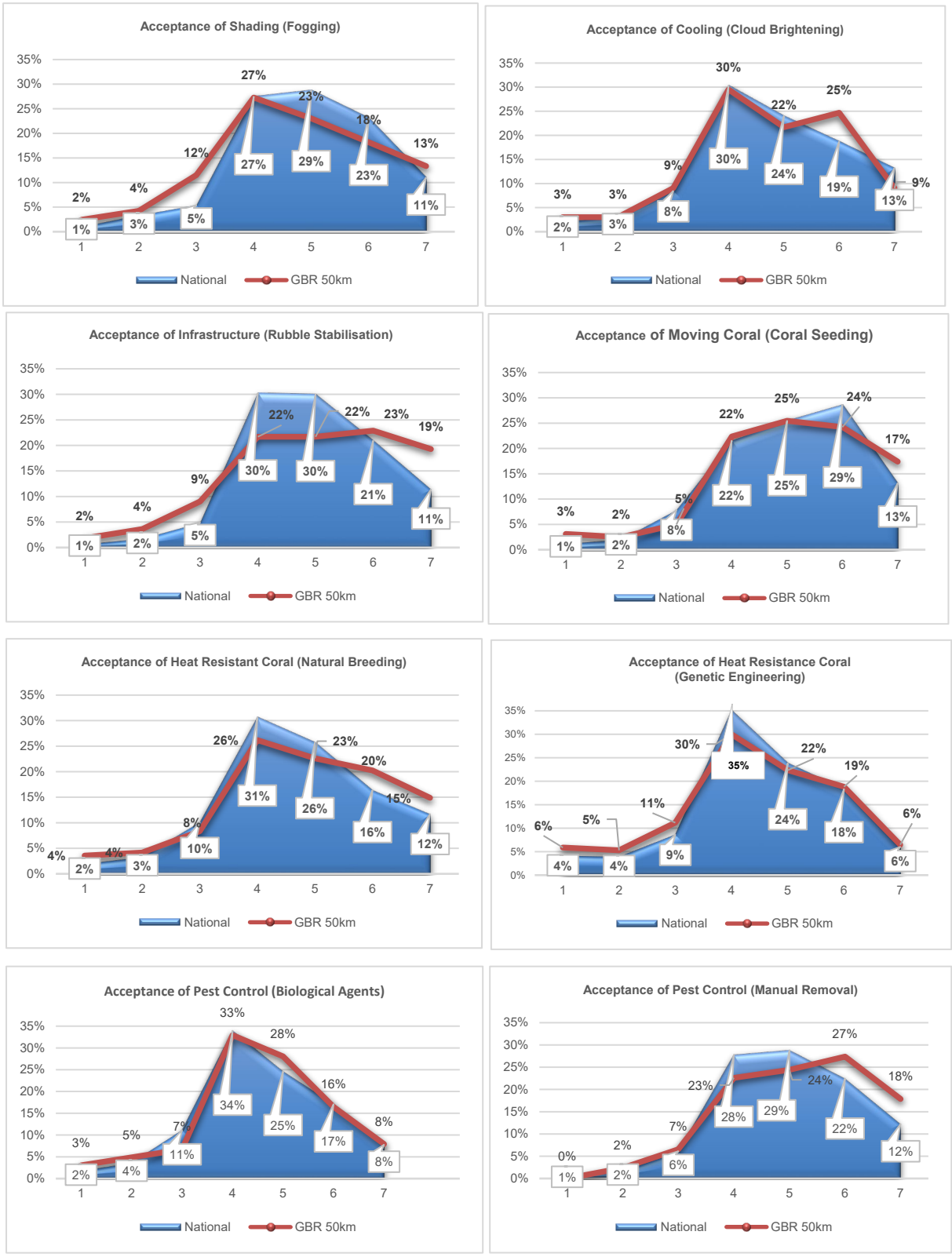
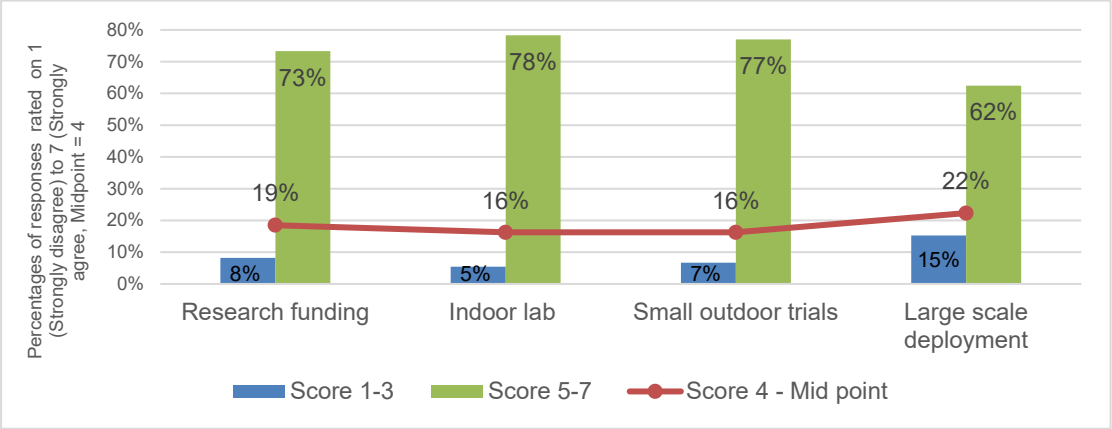
Figure 10: Acceptance of specific reef restoration interventions by geographics samples (local and national)



Note: X axis- Level of agreement with rated scale from 1 (Strongly Disagree) to 7 (Strongly Agree), midpoint = 4. Y axis: response percentages from each total number of group data (National and GBR 50km

Respondents were asked about support for research into the interventions. Approximately 78% agreed that more research funding is required to examine solutions to help the GBR. Specifically, 84% and 85% of total respondents agreed that research is needed to help repair damage to the GBR, and science could provide solutions to help prevent damage respectively. Small scale outdoor trials (77%) and indoor lab research (78%) for the development of future interventions to help the GBR were supported by most respondents, followed by the support for funding of research (73%). Indoor lab research was more strongly supported than large-scale deployment of interventions. Coral seeding was highly approved for all four types of research supports while genetic engineering, biological agents and cloud brightening were less supported.

Figure 11: Percentages of responses on specific types of research support

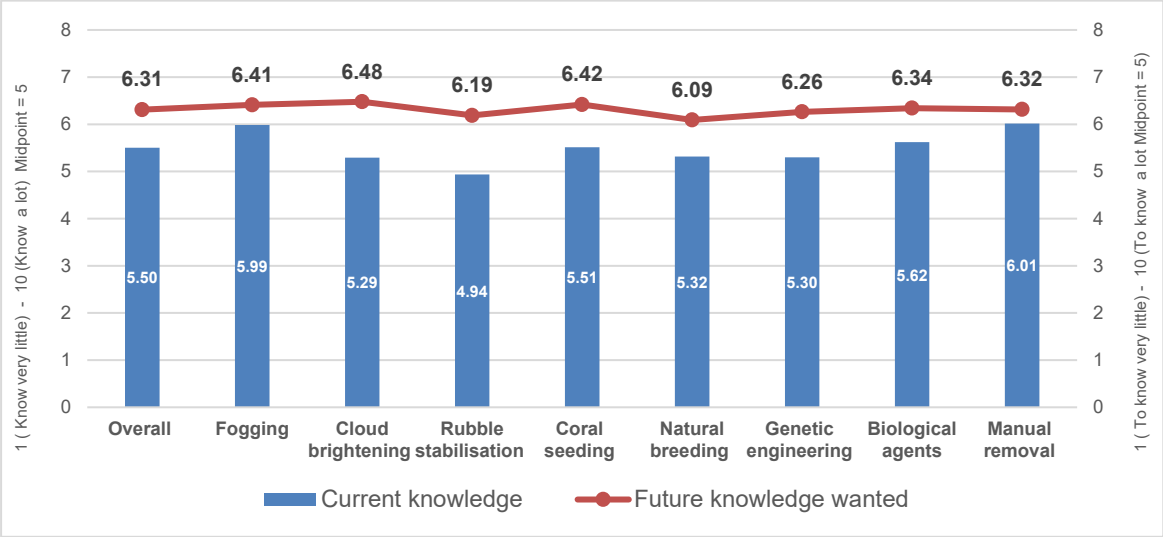


As many of the technological interventions have had limited research and development to date it was deemed worthwhile to understand type of support. Such an understanding can also be beneficial when tracking changes in attitudes over time. Caution should be provided in interpreting the findings due to respondents' uncertainty concerning the risks/benefits of specific interventions.

Current knowledge - Future information and engagement about interventions

Around 26% of total respondents had heard of the interventions before and rated their knowledge 5.5 out of a possible score of 10. Although a subjective knowledge rating, 51% of respondents who claimed some knowledge was higher (score 6-10), than expected and above the mid-point (score 5) while 30% had limited knowledge (score 1-4) about the interventions. About 64% of total respondents wanted to know more about interventions or approach used to sustain the GBR (Score 6-10) while some were uncertain (19%) and only wanted to know little or very little (score1-4). Overall, the knowledge respondents wanted was rated 7 from a possible score of 10, suggesting a small amount additional information could be sufficient.

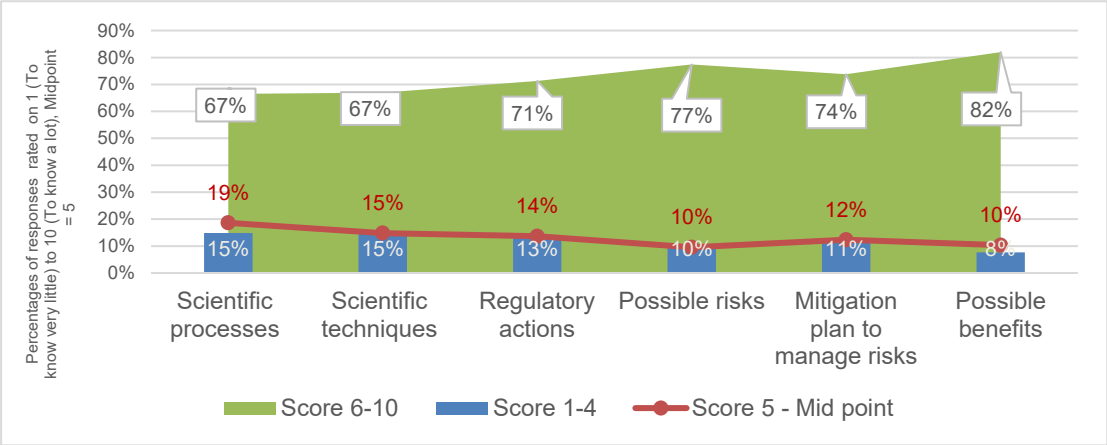
Figure 12: Current and future knowledge about interventions



Statistically different at ****p ≤ 0.000

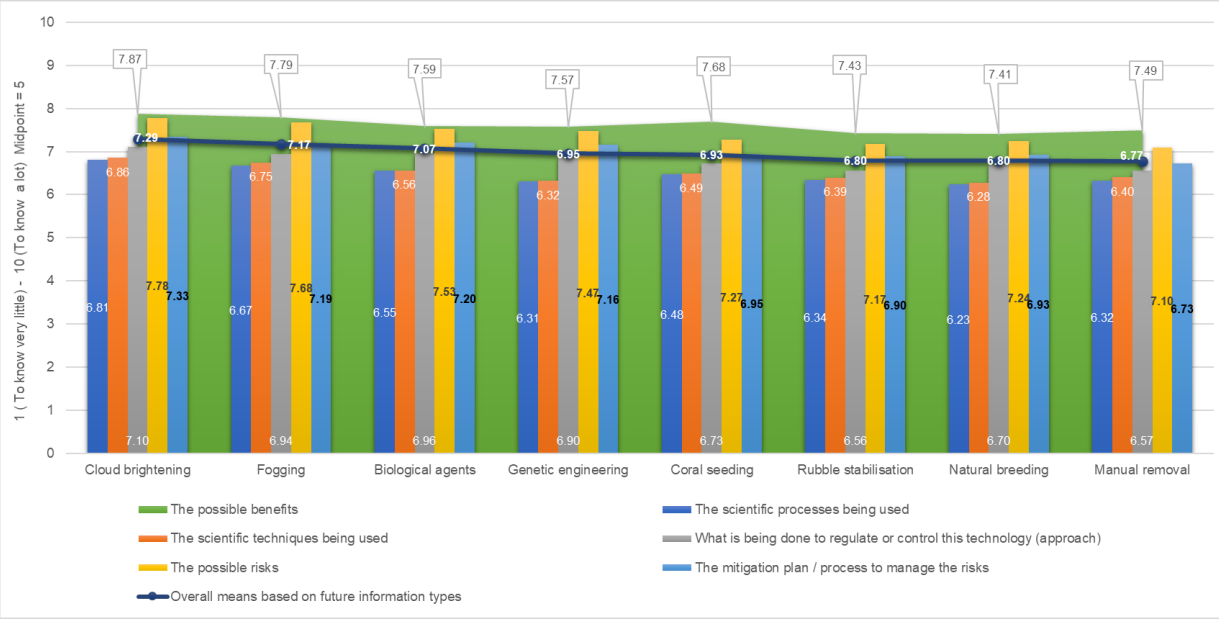
Most respondents would like to know more about the possible benefits (82%, M = 7.60) followed by the possible risks (77%, = 7.40), mitigation plan or processes to manage risks (74%, M=7.05), what is being done to regulate the technology (71%, M= 6.81) and scientific processes (67%, M = 6.46) and techniques (67%, M =6.51) (Figure 13).

Figure 13: Preferences of types of future knowledge wanted



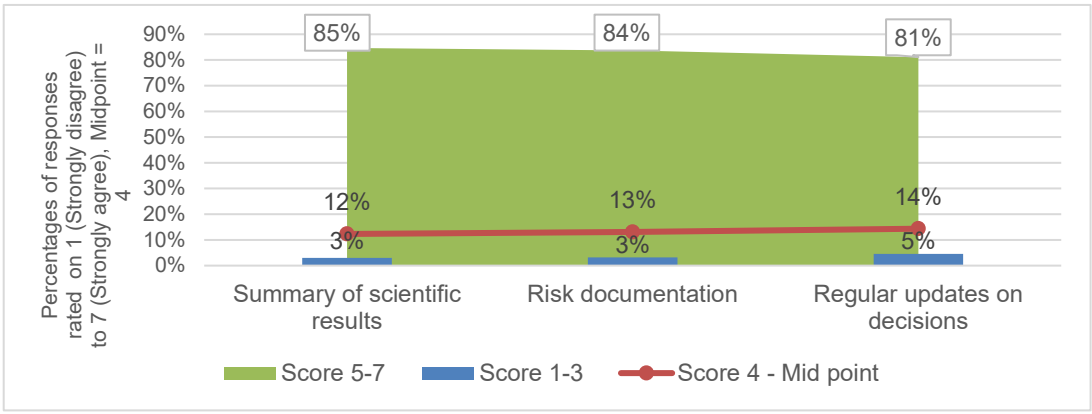
The results also indicated there were no significant differences found between the samples in relation to obtaining future knowledge about the scientific processes and techniques used in the interventions or their possible benefits. However, the GBR-50km sample were slightly more inclined to want to know more in relation to activities that have been implemented to control or regulate biological agents. The GBR-50km sample also wanted to know more about the possible risks of cloud brightening, genetic engineering and rubble stabilisation. The mitigation plan/process to manage the risks for rubble stabilisation and natural breeding techniques were also rated somewhat higher for the GBR-50km sample than for the national sample.

Figure 14: Mean score - Types of future information needed (by intervention-type segmentation)



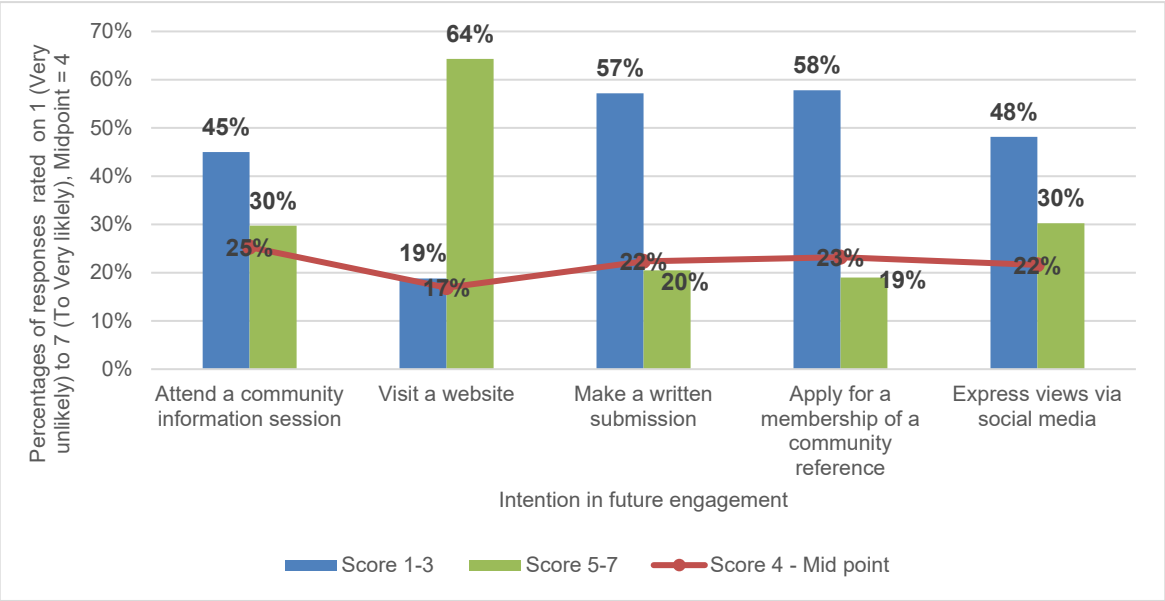
Across all kinds of information, cloud brightening, and fogging were the interventions respondents wanted to know most about, followed by biological agents, genetic engineering, coral seeding, rubble stabilisation, natural breeding and manual removal. In relation to information about benefits, the top three interventions were cloud brightening, fogging and coral seeding (Figure 14).

Figure 15: Level of agreement on options to obtain information about interventions



Most respondents (81%-85%) agreed to strongly agreed that the *public should have access to an easy-to-read summary or documentation of scientific results* and *risks of the technology*, as well as *regular updates regarding decisions made about the interventions*. Respondents also ranked *a research result summary report as their most preferred option to access information or to provide feedback about the intervention*, followed by a public seminar or information session, formal contribution through written submission to the relevant authority, conventional media (e.g., newspaper) and social media.

Figure 16: Intention in future engagement



Respondents were asked about their likelihood to participate or intent to acquire further information or provide feedback if there was an opportunity. Most respondents were unlikely to very unlikely to participate by applying for a membership of a community reference group (58%), making a written submission to government regulators (57%), and expressing their views via social media about the technology (48%). While one in four to five respondents (17%-25%) were unsure about their future participation to either obtain information or provide feedback about the interventions, *two-thirds of total respondents (64%) were likely to very likely to visit a website providing information and updates on research for each respective intervention*.

Factors influencing social acceptance

Overall social acceptance of reef restoration and adaptation

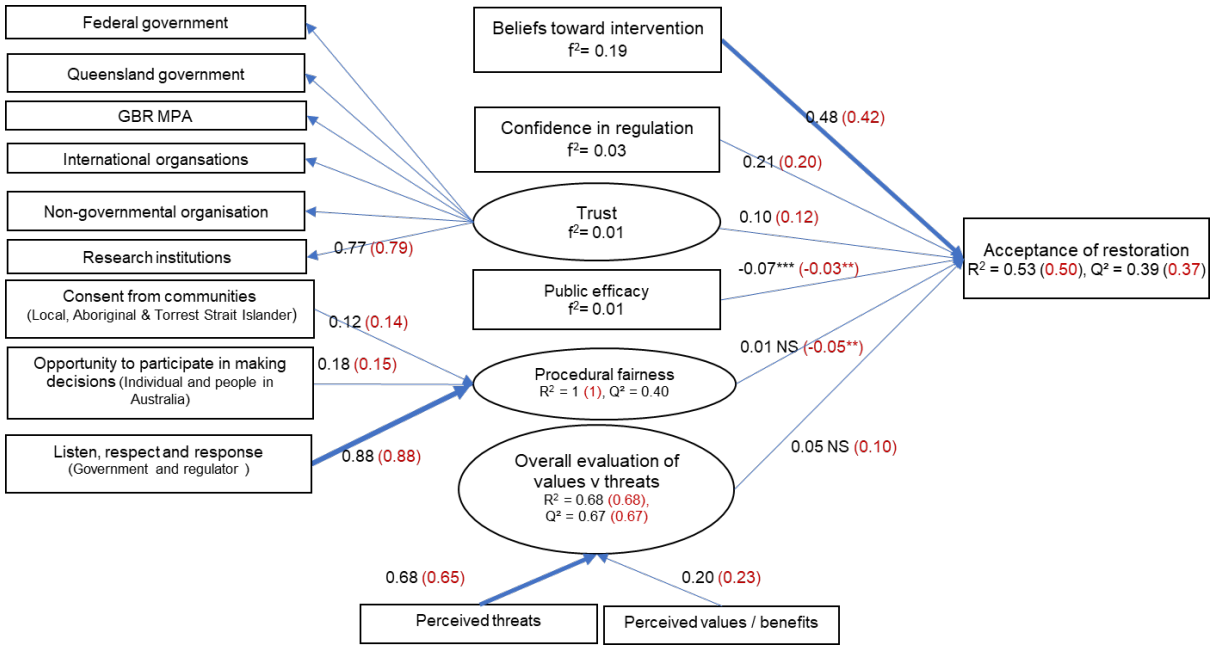
A direct path model was used to assess the relationship between a range of factors and overall acceptance of reef adaptation and adaptation interventions. Overall acceptance was rated across four items on a scale from 1 (not at all) to 7 (very much so). Two separate models were examined for the GBR and national samples (Figure 17).

The results show most similarities across both survey populations. In order of importance, the main direct drivers of social acceptance of reef restoration were:

1) *Beliefs toward intervention* (beliefs about society intervening to repair, restore and build resilience of the Reef).
2) *Confidence in regulation* (beliefs that government, regulatory, and scientific research institutions to make a major difference to the health of the GBR).
3) *Trust in organisations* to be responsible to manage and protect the Reef.

4) *Overall evaluation of values v threats* (only national sample). This was an overall question on whether more needs to be done to save the GBR based on the overall weighting up of values and threats of the GBR.
5) *Procedural fairness* (only national sample) represents opportunities for people to participate in decision making and whether consent would be needed before restoration activities occurred. It also assesses whether community opinion was listened to and respected and whether government and regulator would change their practices in response to community concerns.
6) *Public efficacy* is related to public capability (Australian public and communities living along the GBR) to uphold their interest in influencing governments' management to ensure the GBR is protected.

Figure 17: Direct path model - Overall acceptance of restoration by geographic samples (Local and national)



Number of path arrows represent beta weights (ß) and the relative strength of each relationship - GBR-50 km (National). The paths were significant at ****p≤0.00 unless specified **p≤0.05, *** p≤0.01, NS = non-significant. Positive ß values indicate positive relationship vice versa. The effect size value (f^2) of each predictor construct in the model ranged between 0.01 and 0.19 which was included in the category small and medium. The Q^2 values for restorations were greater than 0, indicating they had good predictive relevance and validity in the model.

Social acceptance, research supports and future engagement with the interventions

The acceptance of eight restoration intervention approaches and technologies were also assessed through the survey. This allowed us to move beyond generalised attitudes toward restoration and start to develop a baseline understanding of how public respond to more specific intervention approaches and technologies. Each respondent was presented with only one scenario followed by a series of statement designed to assess their responses to the scenario.

A range of factors (positive and negative emotions, understanding intervention, trust in governance, procedural fairness, distributional fairness, perceived benefits v risks, and overall evaluation of benefits v risks) were assessed directly towards:

- Acceptance of intervention (i.e., tolerate, accept, approve, embrace)
- Specific types of research support for intervention (i.e., research funding, indoor lab, small outdoor trials and large-scale deployment)
- Intention in future engagement (i.e., attend a community information session, visit a website, make as written submission, apply for a membership of a community reference, express views via social media)
- Options to access information about intervention (i.e., summary of scientific result, risk documentation and regular updates on decisions about intervention).

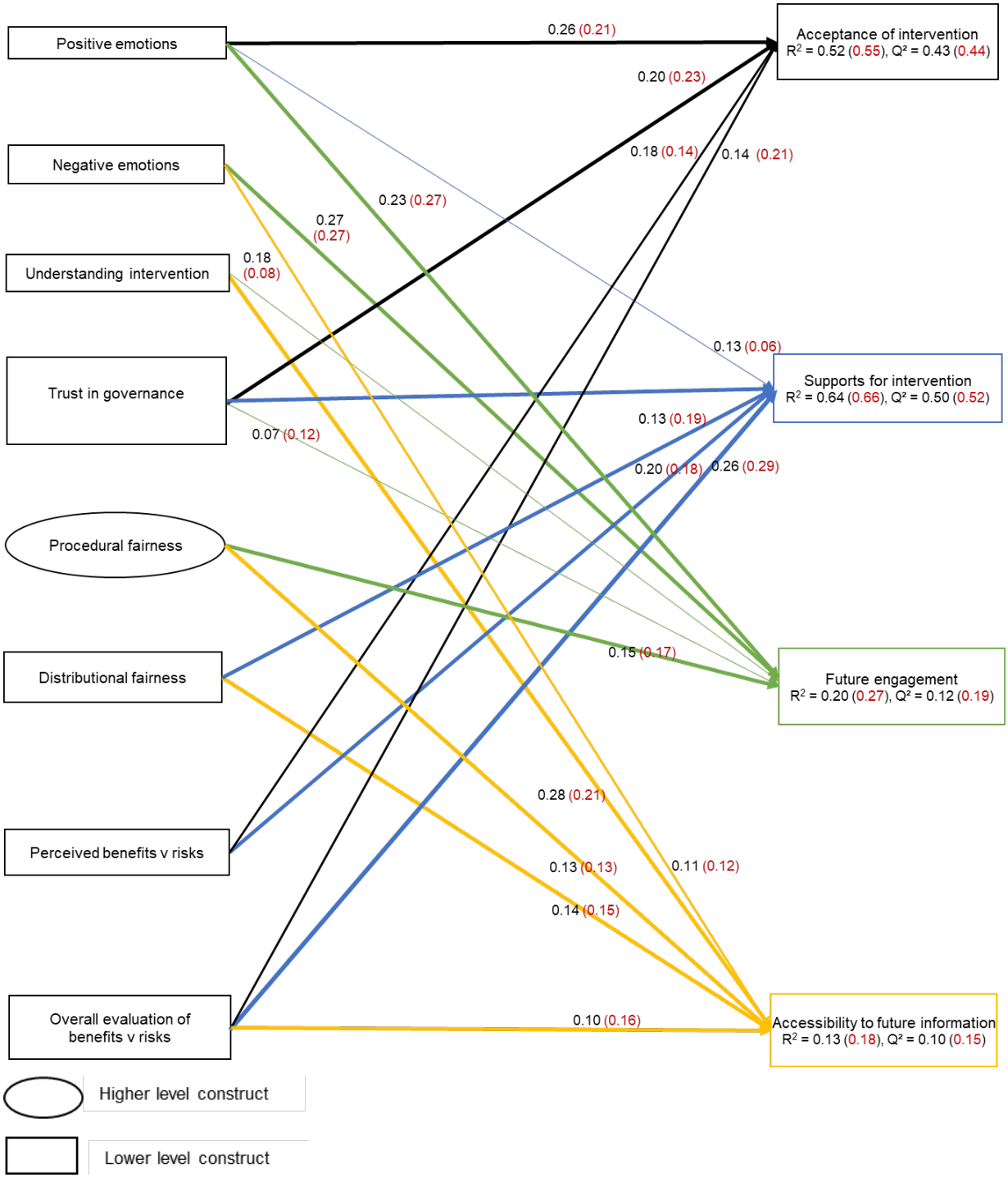
Similar results were found for both national and GBR-50km samples. In order of importance, *positive emotions, trust in governance, perceived benefits v risks* and *overall evaluation of benefits v risks* were found to be the main factors to influence social acceptance of each intervention. Similarly*, perceived benefits v risks, overall evaluation of benefits v risks, trust in governance, distributional fairness,* and *positive emotion* (i.e., GBR-50 km sample) *were* the main factors to influence types of research support for each intervention.

Emotions (positive and negative), procedural fairness, understanding intervention (i.e., GBR-50km sample) and *trust in governance* (i.e., national sample) were found to be the main factors to influence future engagement in each intervention. Specifically, understanding intervention was found to be a general main factor to influence options to access future information about each intervention although distributive and procedural fairness, negative emotions and overall evaluations of benefits v risks also had some influences.

These factors explained about more than a half of the total effects (R^2) on attitude towards types of research supports (64% - 66%) and acceptance of intervention (52% - 55%). While less than one third of total effects explained future engagement (20% - 27%), and options to access future information about intervention (13% -18%). Similar results were found when applying the same path structural model on the eight main interventions.

In conclusion**,** emotions, understanding intervention, trust in governance, procedural fairness, distributive fairness, perceived (overall) benefits and risks of each intervention had direct influences on public's acceptance of intervention, types of research support, future engagement and options to access future information of intervention.

Figure 18: Path model - Factors influencing social acceptance, research supports and future engagement of interventions by geographic samples (local and national)



Notes: Number of path arrows represent beta weights (ß) and the relative strength of each relationship - GBR-50 km (National). Only significant and meaningful paths were included in the model (p≤0.00). Positive ß values indicate positive relationship vice versa. The Q^2 values for acceptance of intervention, types of research support, future engagement and options to access future information were greater than 0, indicating they had good predictive relevance and validity in the model.

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