Design of an Aesthetics Long-Term Monitoring Program for the Great Barrier Reef

Tropical Water Quality Hub
National Environmental Science Programme
NESP TWQ Hub Project 5.6

Abstract

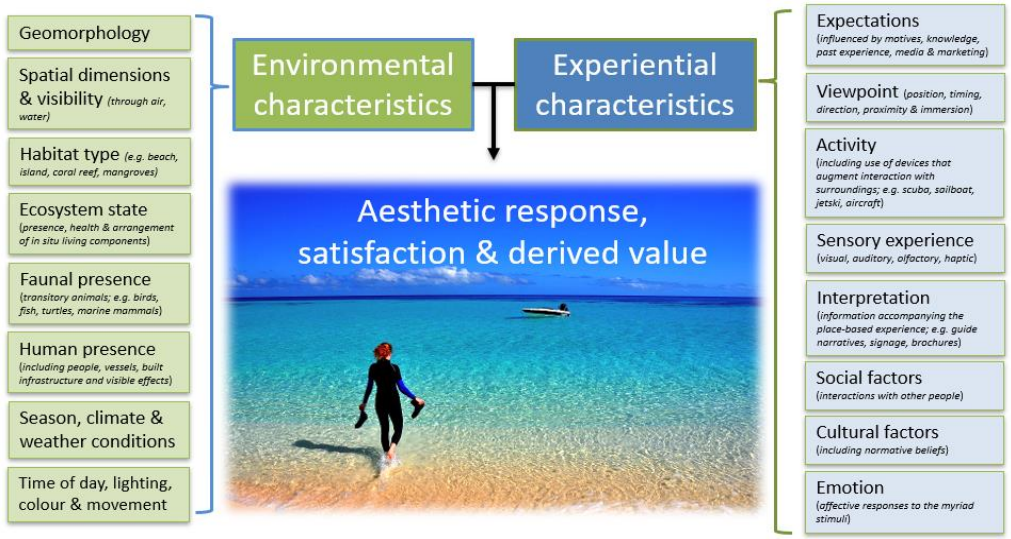
Aesthetic beauty is a major driver of tourism and recreational visitation to natural areas, and it forms a part of the selection criteria for many natural World Heritage properties, including Australia's Great Barrier Reef (GBR). To date, reporting on the state and trend of 'aesthetic heritage values' for the GBR has been inferred, based on the site's natural heritage values, and there is no dedicated monitoring of aesthetic values. Among the challenges in assessing and monitoring aesthetic values is the identification of reliable metrics and scalable methods. Here we describe our research and key findings that have contributed to the design of an Aesthetics Long-Term Monitoring Program (ALTMP) for the GBR.

Four phases of work recently completed include (i) the identification of coral reef attributes that contribute to aesthetic value, (ii) statistical evaluation of non-expert aesthetic ratings as a monitoring method, (iii) end-user and stakeholder engagement to establish the program objectives and management applications, and (iv) design of monitoring protocols and survey instruments. ALTMP also provides a means of integrating A.I./M.L. analyses of digital photographs alongside human assessments.

Monitoring of aesthetic values can potentially serve as a proxy for reef health monitoring in places where scientific ecological monitoring is not feasible or too expensive. Additional opportunities and benefits offered by ALTMP include greater engagement between Reef managers, scientists, citizen scientists, and the wider community in initiatives to restore and maintain aesthetic and other values of important habitats and places throughout the GBR World Heritage Area.

What is aesthetic value?

It is: "…the response (the aesthetic response) derived from the experience of an environment or parts of an environment. Human senses - sight, touch, smell, sound, movement – are important in how humans experience an environment. And culture, knowledge, expectations and past experience mediate sensory perceptions. Aesthetic response can therefore be said to be linked to: (i) the characteristics of an environment, and (ii) culturally or personally derived preferences. Aesthetic value or aesthetic significance is therefore defined …as including sensory, experiential and emotional response to place." (Context Pty Ltd 2013, p.33)



Aesthetic value is derived from people's aesthetic responses to an environmental setting, which is influenced by both environmental and experiential characteristics at the time of an observation or experience.

How is it measured?

1. **Environmental characteristics** – via biophysical monitoring programs and identification of in-situ attributes that contribute to aesthetic responses.
2. **Experiential characteristics** – surveys of observers, capturing minimum demographic, personal and experience details.
3. **Aesthetic response** – a 10-point "beauty" rating scale (+ other constructs where applicable); 1 = "very ugly, unpleasant", 10="exceptionally beautiful"

i. ***In-situ*** – by anyone! Expert and non-expert alike: *e.g. tourists, citizen scientists, tour operators, scientists, Reef managers…*
ii. ***Post hoc*** - geo-tagged image assessment by people and/or computers (A.I./M.L. algorithms – see NESP TWQ Project 5.5 "*Measuring aesthetic and experience values using Big Data approaches*" for more info).

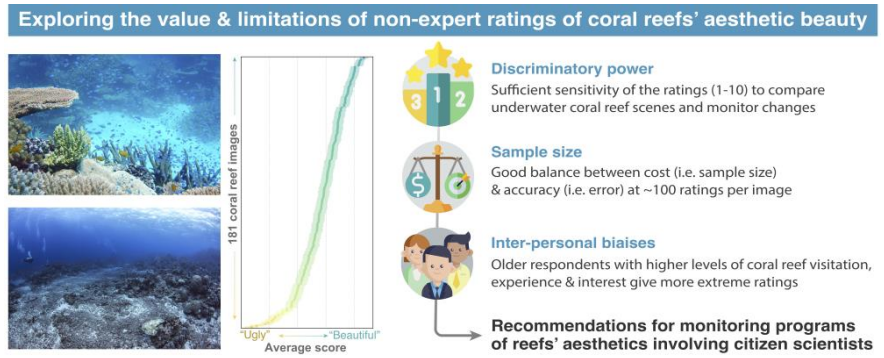
If it's subjective, how can we trust and interpret the data?

Aesthetic responses are individually variable, thus there can be no 'true value' that represents an absolute aesthetic value of a setting. Instead, it is useful to consider the *precision* of aesthetic response monitoring data. The mean standard error (±SE) represents the closeness of agreement (i.e. precision) around a relative value that can be used for monitoring and assessment.

Questions we addressed:

1. Is the discrimination power of non-expert aesthetic beauty ratings sufficient for detecting changes in relative aesthetic value between coral reef settings?
2. What are the sampling requirements for this method to provide reliable information for management decision making purposes?
3. To what extent are the ratings subject to observer biases, and how can such biases be accounted for or treated?

Key Findings (reported in Pert et al. 2020: https://doi.org/10.1016/j.scitotenv.2020.139156):



Our findings provide guidance on the use of non-expert aesthetic response ratings for monitoring, and caveats associated with different sample sizes and observer biases are now better understood.

How can this be used in long-term monitoring?

We engaged with >50 end-users and stakeholders to co-design objectives, operational requirements and protocols for monitoring under different scenarios across different habitats. Key outcomes included:

- Objectives & design that aligns with integrated monitoring for the Reef 2050 Long Term Sustainability Plan
- Standard protocols enabling uptake of aesthetics monitoring by existing scientific & citizen science monitoring programs, for cost-effective implementation & broad spatial representation.
- Generic and site-specific tools for specific end-user needs (e.g. social acceptability monitoring of coral restoration sites, underwater art installations)

Want to know more?

- Our final report will be published soon. Contact matt.curnock@csiro.au for more info.

CSIRO
Matt Curnock, Petina Pert, Lauric Thiault, Nadine Marshall
Adam Smith, Nathan Cook, Gemma Molinaro
Reef Ecologic For a better planet

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Abstract

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Photos © Matt Curnock

Diverse settings and attributes contribute to the GBR's Statement of Outstanding Universal Value for World Heritage criterion (vii): "*to contain superlative natural phenomena or areas of **exceptional natural beauty and aesthetic importance***." (UNESCO 2012)

NESP TWQ Project 5.6: https://nesptropical.edu.au/index.php/round-5-projects/project-5-6/

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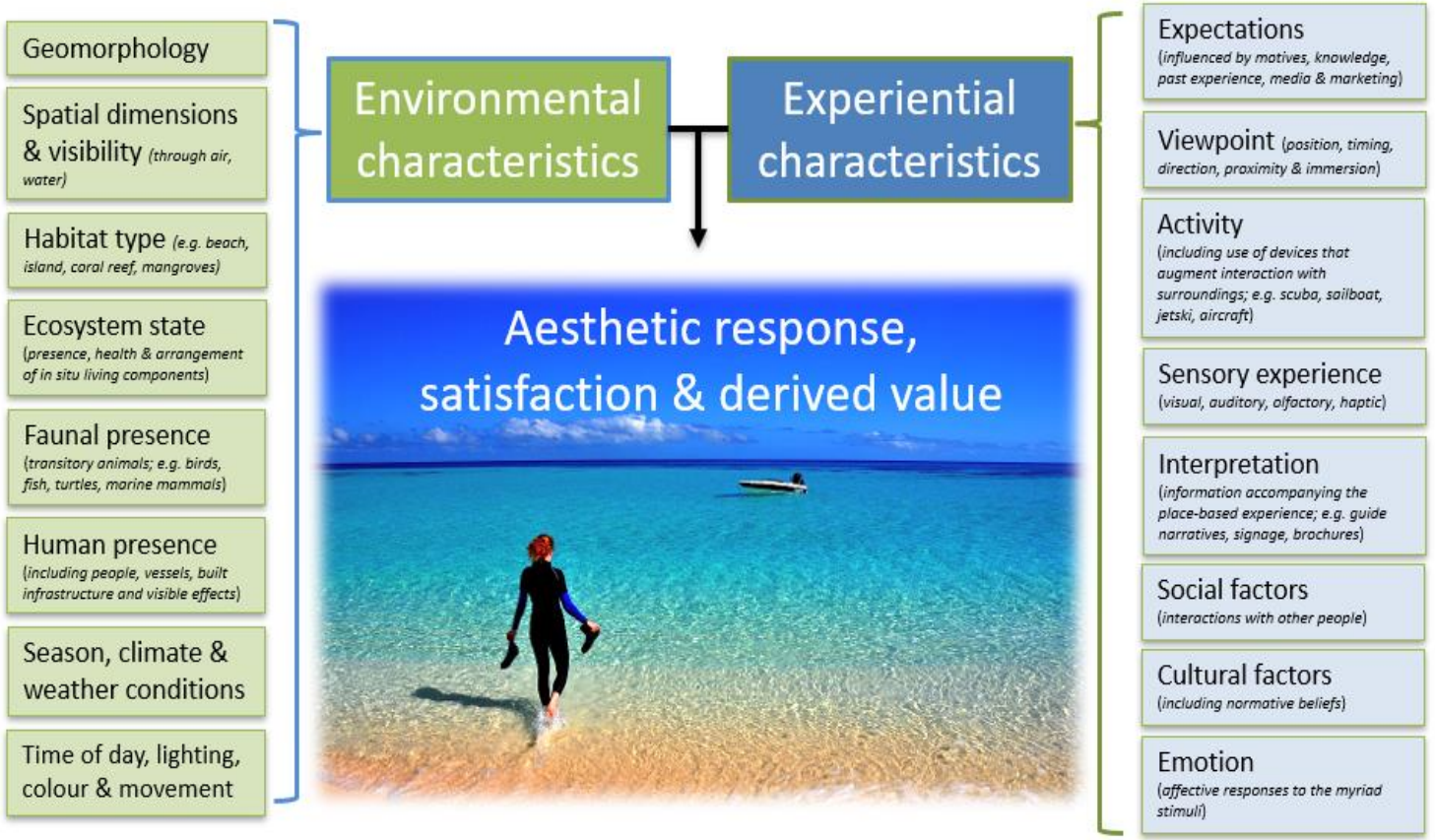
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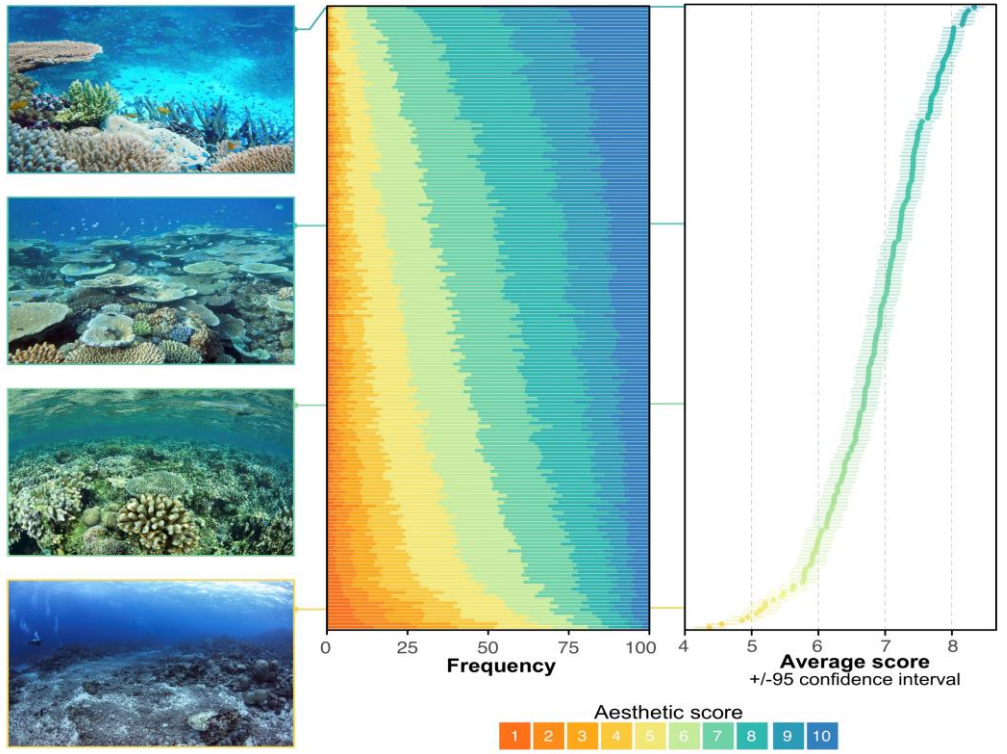
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Key Findings

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Fig 1: Participant ratings of reef aesthetics from 181 images on a ten-point scale, from online survey of 1417 Australians, who rated the aesthetic beauty of 181 coral reef images. Each image was rated by >380 respondents.



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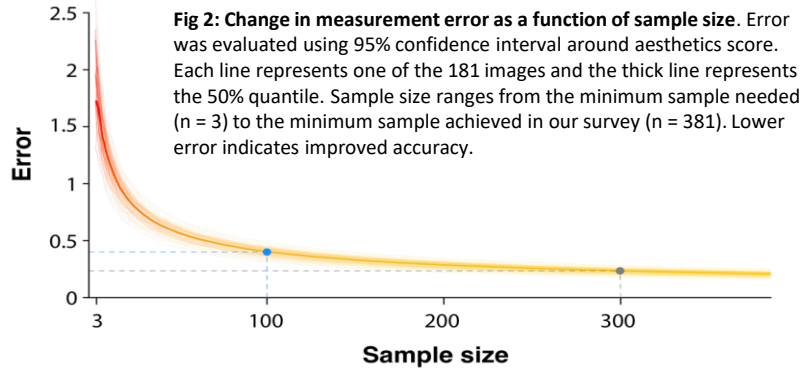


Fig 2: Change in measurement error as a function of sample size. Error was evaluated using 95% confidence interval around aesthetics score. Each line represents one of the 181 images and the thick line represents the 50% quantile. Sample size ranges from the minimum sample needed (n = 3) to the minimum sample achieved in our survey (n = 381). Lower error indicates improved accuracy.

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