Journal of Sustainable Tourism
Volume 27 Issue 10, 2019
0966-9582 (Print)

Routledge
Taylor & Francis Group

Journal of Sustainable Tourism

ISSN: 0966-9582 (Print) 1747-7646 (Online) Journal homepage: https://www.tandfonline.com/loi/rsus20

Tourists' aesthetic assessment of environmental changes, linking conservation planning to sustainable tourism development

Dung Le, Noel Scott, Susanne Becken & Rod M. Connolly

To cite this article: Dung Le, Noel Scott, Susanne Becken & Rod M. Connolly (2019) Tourists' aesthetic assessment of environmental changes, linking conservation planning to sustainable tourism development, Journal of Sustainable Tourism, 27:10, 1477-1494, DOI: 10.1080/09669582.2019.1632869

To link to this article: https://doi.org/10.1080/09669582.2019.1632869

Published online: 02 Jul 2019.

JOURNAL OF SUSTAINABLE TOURISM
2019, VOL. 27, NO. 10, 1477–1494
https://doi.org/10.1080/09669582.2019.1632869

Routledge
Taylor & Francis Group

Tourists' aesthetic assessment of environmental changes, linking conservation planning to sustainable tourism development

Dung Le[a], Noel Scott[a], Susanne Becken[a] and Rod M. Connolly[b]

[a]Griffith Institute for Tourism, Griffith University, Australia; [b]Australian Rivers Institute – Coast and Estuaries, School of Environment and Science, Griffith University, Australia

ABSTRACT

Tourists often travel to experience the natural beauty of a destination such as the Great Barrier Reef (GBR) in Australia. This nature-based destination attracts millions of tourists every year because of its outstanding underwater aesthetics. Recently, parts of the GBR have been degraded by warming sea temperatures and other local anthropogenic influences, threatening the Reef aesthetics and tourism in the region. In order to deal with this topical issue, the current research investigates tourists' aesthetic assessment of environmental changes in the GBR ecosystem. Research outcomes indicate that tourists' perceived beauty of the Reef is sensitive to environmental changes. The disappearance of sea animals (colourful fish, turtle), degrading coral and decreasing water quality negatively influence their aesthetic assessment, which can reduce tourist visitation in the long-term. Hence, sustainable tourism development in the GBR regions can only be achieved when government support for environmental management is strengthened. Conservation programs of the GBR should expand beyond coral restoration for controlling water quality, reducing pollution and protecting aesthetically appealing sea animals.

ARTICLE HISTORY
Received 11 October 2018
Accepted 12 June 2019

KEYWORDS
Aesthetic; conjoint analysis; Great Barrier Reef; natural beauty; World Heritage; tourism; sustainable development

Introduction

The beauty of nature-based attractions is vital for tourism development because tourist visitation is driven by human appreciation of natural aesthetics (Awaritefe, 2004; Beh & Bruyere, 2007; Yoon & Uysal, 2005). Tourists often search for and use aesthetic information to make a destination choice (Vogt, Fesenmaier, & MacKay, 1994). Indeed, tourist aesthetic assessment of natural attractions influences overall satisfaction of a place visit and revisit intentions (Chi & Qu, 2008; del Bosque & San Martín, 2008; Lee, Jeon, & Kim, 2011). Overall, tourist perceived beauty of tourism destinations is instrumental in both stimulating travel and shaping satisfactory evaluations of travel experiences (Kirillova, Fu, Lehto, & Cai, 2014). The critical role of tourist aesthetic assessment in inspiring tourist visit behaviour is well established in tourism literature (Echtner & Ritchie, 1993; Hazen, 2009; Kock, Josiassen, & Assaf, 2016; O'Leary & Deegan, 2005).

The importance of aesthetics for tourism development is clearly demonstrated by the case of the Great Barrier Reef (GBR). The GBR was designated a World Heritage Area in 1981 for its superlative natural beauty (Criterion vii) among other natural listing criteria (Vercelloni et al.,

CONTACT Dung Le dung.le@griffithuni.edu.au

2018). Aesthetics are ranked as the most important value of the GBR by tourists, residents, indigenous locals and tourism businesses (Marshall et al., 2018). "Beautiful" was the most frequently cited word in a survey of 9000 participants when answering the question of what first comes to mind about the GBR (Marshall et al., 2016). The outstanding aesthetics make the GBR an iconic tourism destination in Australia (Piggott-McKellar & McNamara, 2017) with 2.68 million visitor days only in 2017 (GBRMPA, 2018). The aesthetic value of a landscape is, thus, recognised as an important ecosystem service, and as such provides additional impetus for the conservation of ecosystems (Swaffield & McWilliam, 2013), especially when tourism is used as the main lever by conservation groups to protect the Reef from alternative and relatively more extractive uses (Liburd & Becken, 2017). Decreasing GBR aesthetics could negatively influence tourists' interest in the Reef, with implications for both visitation behaviour and Reef protection (Coghlan & Prideaux, 2009).

The GBR aesthetics have been negatively influenced by human-driven impacts (e.g. reduced water quality) and climate change impacts such as rising sea temperature (GBRMPA, 2014). The record-breaking marine heatwaves in 2016 and 2017 caused large-scale coral bleaching on the GBR, catastrophic coral die-off and ecological transformations (Hughes, Kerry, Baird, et al., 2018). This is the most severe event in the GBR's recent history, affecting up to 91% of the Reef (Hughes, Kerry, & Simpson, 2018). Up to 51% of reductions in live coral cover and consistent declines in the diversity of fishes were observed one year after the bleaching event (Stuart-Smith, Brown, Ceccarelli, & Edgar, 2018). These environmental changes have negative impacts on tourist aesthetic assessment of GBR underwater scenery, leading to serious challenges to sustainable tourism development in the Reef regions (Marshall et al., 2019). Meanwhile, research to identify and quantify exactly what makes an underwater ecosystem aesthetically pleasing is insufficient at present (Vercelloni et al., 2018). In fact, the aesthetics of underwater environments are possibly the least studied of all landscapes (Haas et al., 2015; Tribot et al., 2016).

Against this background, the current research aims to fill the knowledge gap in the literature and address the particular issue of understanding tourists' aesthetic assessment of environmental changes in the GBR underwater ecosystem. Aesthetic research is vital to ensure sustainable tourism development because both tourist visitation (Hazen, 2009; Kirillova et al., 2014) and tourist conservation behaviour (Brady, 2006; Skibins, Dunstan, & Pahlow, 2017; Stokes, 2007) are motivated by tourist aesthetic assessment of nature-based destinations. The overarching goal of our research is achieved by pursuing three specific aims. The first aim is to identify key aesthetic attributes of GBR underwater scenery using advanced eye-tracking technology. The second aim is to quantify how environmental changes related to these key attributes are aesthetically evaluated by tourists. Conjoint analysis, a widely used method in consumer and tourist preference research (Chen, Hsu, & Lin, 2010; Suh & McAvoy, 2005), was applied for quantification purpose. The third aim is to translate research findings into practical marketing and conservation suggestions for GBR stakeholders that support sustainable tourism development. Organisations that proactively seek to improve the Reef's protection and conservation such as the GBR Marine Park Authority (GBRMPA) or the GBR foundation can use the current research to advocate for future conservation programs in favour of tourism development.

Literature review

There are two main paradigms in conceptualising beauty: objectivist versus subjectivist. The objectivist paradigm derives from the 18th century Kantian idea of disinterestedness and picturesque. Objective beauty is inherent in the physical landscape and not subject to an observer's evaluation (Beardsley, 1975). Human aesthetic assessment of natural scenery involves the recognition of its intrinsic, objective beauty (Hagman, 2002) and is convergent among the audience (Dinsdale & Fenton, 2006). Natural beauty is, therefore, explained by a number

of environmental factors (Haas et al., 2015). In the 20th century, there was a paradigmatic shift to a subjectivist approach to human aesthetic assessment (Todd, 2009). The subjectivist paradigm regards beauty as a product of the mental processes of the beholders (Kirillova et al., 2014) because aesthetics of natural landscapes cannot be framed or separated from the viewers (Hepburn, 1966). Aesthetic assessment, thus, reflects human responses to a scene involves one's prior knowledge, experiences, values, emotional state and desires (Datta, Joshi, Li, & Wang, 2006).

The objectivist paradigm underlies expert surveys of physical landscapes, while the subjectivist paradigm underlies studies of observer preferences for natural sceneries (Lothian, 1999). It is worth noting that human aesthetic assessment and environmental preference are used interchangeably in the literature (Kirillova et al., 2014). Research applying the objective (vs. subjective) paradigm results in the identification of environmental (vs. individual) determinants of human aesthetic assessment.

Determinants of landscape aesthetics

An influential framework in landscape aesthetic research is the four-domain model of Kaplan, Kaplan, and Brown (1989). It includes four groups of environmental factors: land cover (i.e. forest, woodlawn); informational (i.e. complexity, mystery, coherence, legibility); perceptual (i.e. openness, smoothness, locomotion) and physical (i.e. relief, height). Later studies adopted this model but focused only on a small number of factors such as naturalness (Breiby & Slåtten, 2015; Frank, Fürst, Koschke, Witt, & Makeschin, 2013; Nassauer, 1995); openess (Arriaza, Cañas-Ortega, Cañas-Madueño, & Ruiz-Aviles, 2004; Chen, Sun, Liao, Chen, & Luo, 2016); vegetation or landcover by green plants (Fyhri, Jacobsen, & Tømmervik, 2009; Rogge, Nevens, & Gulinck, 2007); water spaces (Coeterier, 1996; White et al., 2010); colour contrast (Arriaza et al., 2004; Lindemann-Matthies, Junge, & Matthies, 2010; Yao et al., 2012); diversity (Kirillova et al., 2014; Schirpke, Tasser, & Tappeiner, 2013; Van den Berg, Vlek, & Coeterier, 1998; van der Jagt, Craig, Anable, Brewer, & Pearson, 2014) and the presence/harmony of human elements (Fyhri et al., 2009; Sevenant & Antrop, 2010). Some of these factors also relate closely to the ecological health of an ecosystem (e.g. diversity), indicating that aesthetic and ecological values could be closely aligned (Yang, Luo, Lin, Qiu, & Luo, 2014).

The objectivist research stream provides a general picture of human aesthetic preference of landscape environments. Diversity and naturalness of landscapes are two key factors which can explain a considerable proportion of changes in viewers' aesthetic judgments (Frank et al., 2013). Overall, people appreciate the aesthetics of natural landscapes that offer wider vistas, water spaces, high colour contrast and diversity (Van den Berg et al., 1998; Yao et al., 2012). The presence of human elements has positive or negative impacts, depending on how these elements are developed and maintained in harmony with nature (Breiby, 2014; Sevenant & Antrop, 2010).

The subjectivist research stream provides clarifications on individual differences in aesthetic assessment. Specifically, it is found that individual familiarity or experiences with judged landscapes (DeLucio & Múgica, 1994; Strumse, 1996; Van den Berg et al., 1998); profession (Rogge et al., 2007); actual living environment (Sevenant & Antrop, 2010); aesthetic distance between tourist destination and hometown (Kirillova & Lehto, 2015); environmental attitude and behaviour (Howley, 2011; Howley, Donoghue, & Hynes, 2012; Sevenant & Antrop, 2010) and demographic characteristics such as age and level of education (Howley et al., 2012; Strumse, 1996) differentiate human aesthetic assessment of the same landscape scenery.

Determinants of underwater aesthetics

Despite a rich body of literature on human aesthetic assessment of landscapes, aesthetic research of underwater scenery remains limited (Haas et al., 2015). Underwater scenes were given similar ratings to rural, green landscapes in terms of aesthetic preference, affective

responses and perceived restoration (White, Cracknell, Corcoran, Jenkinson, & Depledge, 2014). Regarding environmental factors, similar determinants of underwater aesthetics were found compared to landscape studies. The beauty of underwater scenery is characterised by three main factors: diversity (Marshall et al., 2019; Tribot et al., 2016); colour (Vercelloni et al., 2018) and water quality (Esparon, Stoeckl, Farr, & Larson, 2015; Johnston & Smith, 2014; Marshall et al., 2019).

First, underwater images showing species richness and abundance are rated relatively more positively in terms of attractiveness (Cracknell, White, Pahl, & Depledge, 2017; Polak & Shashar, 2013). Fish and coral are two key elements of underwater aesthetics, resulting in diver enjoyment of reef systems (Uyarra, Watkinson, & Cote, 2009). Coral topography (i.e. coral of high structural complexity) is strongly related to aesthetic evaluation (Marshall et al., 2019; Vercelloni et al., 2018). Other iconic marine species such as whales, dolphins and turtles also positively contribute to the aesthetic value of the Reef (Esparon et al., 2015). Second, reduced water quality (less visible) due to poor weather has a negative impact on tourist overall evaluation (Coghlan & Prideaux, 2009). Third, fauna and flora living in healthy reef system surpass all other ecosystems in their display of colour (Kaufman, 2005; Marshall, 2000) which leads to human aesthetic preference for underwater scenery (Haas et al., 2015).

There are only a few studies investigating individual differences in assessing underwater aesthetics. In a study comparing three groups with different experiences with coral reefs (i.e. experienced divers, citizens and marine scientist), no significant differences were found in their perceived beauty of the reef (Vercelloni et al., 2018). However, aesthetic preferences for fishes with different shapes differ between divers and non-divers (Tribot et al., 2018).

Based on the literature review, the current research applies a subjectivist approach to study tourist aesthetic assessment of underwater scenery, considering both environmental factors (diversity, colour, water quality) and tourist characteristics (gender, age, travel experiences to GBR, and snorkelling or diving experiences).

Methodology

Conjoint analysis is applied in this study to quantify the influences of environmental changes on tourist aesthetic assessment of the GBR underwater scenery (Green & Srinivasan, 1990). Conjoint analysis is a decompositional approach that employs an overall evaluation of a set of attributes to determine human preference structure. The basic conjoint model used in this research is: $Y = X_1 + X_2 + X_3 + \ldots + X_n$; where Y represents the total utility of the respondent's aesthetic preferences for an underwater scenery and X_i represents the specific utility for the correspondent aesthetic attribute (Hair, Black, Babin, Anderson, & Tatham, 1998). The relative importance of an attribute is calculated by dividing each attribute's range of utility by the sum of all range values across attributes (Chen et al., 2010). The merit of conjoint analysis methodology has been widely supported by various marketing (Ares & Deliza, 2010; Silayoi & Speece, 2007) and tourism research (Huertas-Garcia, Laguna García, & Consolación, 2014; Thyne, Lawson, & Todd, 2006).

In order to apply conjoint analysis, a multistage research was conducted: (1) identification of key GBR aesthetic attributes using eye-tracking technology; (2) preliminary study of aesthetic attribute manipulation; (3) design of survey materials and pre-test; (4) survey using the Qualtrics platform (www.qualtrics.com) and distribution service; and (5) data analysis using IBM SPSS for quantitative data and Leximancer for qualitative data. Details of each stage are discussed below.

Stage 1: Identification of the GBR aesthetic attributes

In this stage, eye-tracking technology was employed to identify key aesthetic attributes of the GBR underwater scenery. Given that aesthetic research to date almost exclusively focused on visual attributes and visual cues (Haas et al., 2015; Johnston & Smith, 2014), eye-tracking technology

Photoshopped Picture 1 Photoshopped Picture 2

Figure 1. Pictures included in the preparatory research.

is effective in identifying important visual aesthetic attributes of GBR underwater scenes (Scott, Zhang, Le, & Moyle, 2017). Sixty-six participants were recruited in the eye-tracking experiment to assess 21 GBR pictures on a 10-point aesthetic scale (1-Not beautiful at all, 10-Extremely beautiful). The eye-tracking experiment revealed a significant correlation between attention and aesthetic scores of the GBR pictures (Scott, Le, Becken, & Connolly, Published online). Pictures showing colourful fish, colourful coral, turtle and high water visibility attract more attention and gain higher aesthetic scores. Fish, coral, turtle and water visibility are hence selected as key aesthetic attributes of the GBR underwater scenery for further examination (Esparon et al., 2015; Uyarra et al., 2009).

Stage 2: Preliminary research

Following the eye-tracking experiment, it is hypothesised that the presence of an aesthetically attractive feature, such as turtle or fish, can significantly improve tourist aesthetic assessment of GBR underwater scenery. This hypothesis was tested in a preliminary study. The image of a swimming turtle was added to two overtly unattractive GBR images rated by participants in the previous eye-tracking experiment (see Figure 1). These pictures were each rated by six new participants. The photoshopped picture 1 was still rated similarly at 3 out of 10-point beauty scale as the original picture. Meanwhile, the average beauty score for picture 2 significantly increased from 3.6 for the original picture (without turtle) to 7 out of 10-point beauty scale for the photoshopped version (with turtle). The reason for somewhat mixed results was revealed in the after-rating interviews with participants: Picture 1 looked fake (e.g. "It must be photoshopped") while Picture 2 looked natural/original. This preliminary study highlights the caution in photoshopping images used for follow-up research.

Stage 3: Survey material design

Building on the literature review and eye-tracking research outcomes, four aesthetic attributes (turtle, fish, coral and contrast) were manipulated to explore how environmental changes related to biodiversity, water quality and colour are aesthetically evaluated by tourists. Biodiversity was examined by manipulating the presence/absence of coral and marine species (turtle and fish). Colour was investigated by comparing colourful versus non-colourful fish and coral. Picture contrast was adjusted to reflect high versus low water visibility: high (low) contrast picture is related to high (low) water visibility by enhancing (reducing) the clarity of picture elements. In brief, four aesthetic attributes (contrast, coral, fish and turtle) were manipulated as follows: picture contrast (high vs. low), coral (no coral, non-colourful coral, colourful coral); fish (no fish, non-colourful fish, colourful fish); turtle (presence vs. absence).

These four attributes and their levels give rise to 36 possible combinations ($2 \times 3 \times 3 \times 2$), possibly leading to information overload on respondents (Green & Srinivasan, 1990). Therefore, the Orthoplan subroutine in SPSS was used to produce an orthogonal main-effects design, ensuring the absence of multicollinearity between attributes (Silayoi & Speece, 2007). Following nine attribute combinations recommended by SPSS Orthoplan, nine pictures were created by photoshopping GBR key aesthetic attributes (Figure 2). In order to avoid possible bias, these nine

*Plan.sav [DataSet2] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Extensions Window Help

	Contrast	Fish	Coral	Turtle	STATUS_	PICTURE_
1	Low	Non-colourful fish	Non-colourful coral	Turtle	Design	1
2	High	No fish	Colourful coral	Turtle	Design	2
3	High	Colourful fish	Non-colourful coral	No turtle	Design	3
4	Low	No fish	Non-colourful coral	No turtle	Design	4
5	High	Non-colourful fish	No coral	No turtle	Design	5
6	Low	Colourful fish	Colourful coral	No turtle	Design	6
7	Low	No fish	No coral	No turtle	Design	7
8	Low	Non-colourful fish	Colourful coral	No turtle	Design	8
9	Low	Colourful fish	No coral	Turtle	Design	9

Picture 1 Picture 2 Picture 3

Picture 4 Picture 5 Picture 6

Picture 7 Picture 8 Picture 9

Figure 2. Orthogonal main-effects design for conjoint analysis.

pictures include similar attributes (fish, coral, turtle, background) extracted from four GBR original pictures. Other potential determinant factors of tourist aesthetic judgment such as openness, naturalness, human elements, were kept constant. Ten experts were invited to review the materials and provided feedback to improve the materials until all pictures were well photoshopped (i.e. looking natural).

Stage 4: Questionnaire design and data collection

The survey questionnaire included three main sections: section 1 containing demographic questions (such as gender, age), section 2 consisting of the image ranking task (i.e. participants were asked to rank nine GBR pictures from the most beautiful picture to the least beautiful picture) and section 3 including one open-ended question on determinant factors of their aesthetic judgment ("From your point of view, what are the factors that make a picture of Great Barrier Reef beautiful?") and two questions related to their travel experiences to the Great Barrier Reef, and diving and snorkelling experiences. In section 2, nine GBR pictures to be ranked were shown to participants in random order to avoid any bias related to picture positions.

The survey was launched under the ethical approval GU 2017/537 in October 2017, targeting Australians over 18-year old living in all states of the country. A total of 705 survey completions were recorded after one month of data collection. Participants were evenly distributed among six age groups: 12.5% were between 18- and 24-year old; 19.9% were between 25- and 34-year old; 17.7% were between 35- and 44-year old; 17.0% were between 45- and 54-year old; 15.5 were between 55- and 54-year old; and 17.4% were above 65-year old. Regarding gender, 48.9% were female, 50.9% were male, and 0.1% belonged to other genders. Of the respondents, 40% had previously visited the GBR, and 46.5% had some diving or snorkelling experience.

Stage 5: Data analysis

Quantitative data collected from the survey were imported into IBM SPSS statistics software (version 24). Conjoint analysis was performed to calculate the importance value and the utility of each aesthetic attribute. Next, MANOVA analysis was performed to test individual differences in aesthetic assessment between different respondent groups of age, gender, visit experiences, diving/snorkelling experiences. MANOVA is appropriate to investigate several theoretically related dependent variables and to reduce the likelihood of a Type I error and controls for correlations among the dependent variables (Andereck, Valentine, Knopf, & Vogt, 2005).

Qualitative data collected from the open-ended question in the questionnaire survey was imported to Leximancer software for thematic and content analysis. This software enables counts of word frequency, as well as analysis of the meanings within passages of text, by extracting the main concepts and ideas (Scott and Smith, 2005). Several steps in Leximancer operation were used to develop concept maps: (1) eliminating meaningless words such as "and," "or," "etc."; (2) grouping and coding similar words as a concept; (3) repeating the second step with modifications to achieve satisfactory coding of text meanings; and (4) visualising relevant concepts into different themes (Scott et al., 2017; Tseng, Wu, Morrison, Zhang, & Chen, 2015).

Results

Tourist aesthetic assessment of environmental changes in the GBR ecosystem

Conjoint analysis results clarify how environmental changes are aesthetically evaluated by tourists (Table 1). The importance value represents the relative contribution of one attribute to tourist aesthetic assessment compared to others. Fish is the most important attribute of the Reef

Table 1. Results of the conjoint analysis ($n = 705$).

Attribute	Level	Utility score	Importance value (%)
Fish	No fish	−1.191	32.03
	Non-colourful fish	−0.630	
	Colourful fish	1.822	
Coral	No coral	−1.080	25.10
	Non-colourful coral	.043	
	Colourful coral	1.037	
Contrast	High	1.114	22.23
	Low	−1.114	
Turtle	No turtle	−1.012	20.64
	Turtle	1.012	

aesthetics based on importance value (32%), indicating that fish-related changes have the greatest impact on tourist aesthetic assessment. Coral is the second most important aesthetic attribute (25.1%), followed by picture contrast (22.23%) and turtle (20.64%).

Utility scores provide more details on the influences of attribute-related changes on tourist aesthetic assessment. A positive score means a positive influence, while a negative score represents a negative influence (Green & Srinivasan, 1978). Colourful fish, colourful coral, the presence of turtle and high picture contrast have positive contributions to the GBR aesthetics based on positive utility scores. Non-colourful coral has a nearly neutral utility (.043), showing that in general non-colourful coral decreases tourist aesthetic assessment compared to colourful coral scenery, but increases tourist aesthetic assessment compared to no coral scenery. In contrast, non-colourful fish has a negative utility (–0.63), indicating negative aesthetic appeal of non-colourful fish in GBR pictures. The utility scores for no turtle, no fish and no coral are all negative, clearly stating that the absence of any sea feature reduces tourist aesthetic assessment of the Reef. Pictures showing a bio-diverse reef ecosystem are more beautiful in tourists' eyes.

Individual differences in aesthetic judgment

MANOVA analysis was performed to test whether socio-demographic characteristics (age, gender) and familiarity with GBR underwater scenery (GBR experiences and diving and snorkelling experiences) could affect tourist aesthetic assessment of underwater scenes (Table 2). Among independent variables, age has a significant impact on tourist aesthetic assessment ($p < .01$). The importance weight of fish-related changes in determining tourist aesthetic assessment increases while the importance weight of coral-related changes decreases when tourists get older (see Figure 3). Even though travel experiences with the GBR has also a statistically significant influence on the importance weight of coral ($p = .05$) but the effect size is limited ($\eta^2 p = .008$). Hence, travel experiences do not play a considerable role in differentiating tourist aesthetic assessment.

Confirmatory research on environmental determinants of GBR aesthetics

Thematic analysis of qualitative data using Leximancer software resulted in a concept map representing five major themes: colours (359 occurrences), coral and other marine features (325 occurrences), diversity of marine life (175 occurrences), water quality (167 occurrences) and natural beauty (109 occurrences; Figure 4). Most participants mentioned more than one aesthetic factor. The most frequently mentioned theme is colour, indicating participants' aesthetic preference for bright and vibrant colours of sea features (in particular fish) and blue seawater. The two next themes indicate that tourist perceived beauty of the Reef is strongly influenced by the diversity of sea life (e.g. the presence of coral and other marine features). Another considerable theme is water quality refecting tourist aesthetic preference for GBR underwater images showing clean,

Table 2. MANOVA results.

MANOVA Model (Age): V = 0.919, F = 4.01, p = .000							*F (p)*	η^2_p
				Means[a]				
	18–24 years	25–34 years	35–44 years	45–54 years	55–64 years	65+ years		
Colour	23.9	22.25	22.34	22.37	21.62	21.28	0.911 (0.474)	.006
Fish	27.32	29.36	30.88	33.77	34.76	35.51	10.048 (.000)**	.067
Coral	29.24	27.73	26.2	23.91	21.75	22.13	5.834 (.000)**	.040
Turtle	19.51	20.66	20.58	19.94	21.85	21.06	0.754 (0.584)	.005
MANOVA Model (Gender): V = 0.999, F = 0.66, p = .999							***F (p)***	$\boldsymbol{\eta^2_p}$
				Means[a]				
	Male		Female		Other			
Colour	22.13		22.32		22.73		.037 (0.963)	.000
Fish	32.17		31.9		27.28		0.144 (0.866)	.000
Coral	24.99		25.2		27.27		.035 (0.966)	.000
Turtle	20.7		20.56		22.72		.040 (0.961)	.000
MANOVA Model (Travel experiences): V = 0.986, F = 01.079, p = 0.115)							***F (p)***	$\boldsymbol{\eta^2_p}$
				Means[a]				
	Never		One or two times		More than 3 times			
Contrast	22.34		22.43		20.41		1.057 (0.348)	.003
Fish	31.82		32.33		32.21		0.170 (0.844)	.000
Coral	25.85		23.48		27.01		3.008 (0.050)*	.008
Turtle	19.98		21.75		20.63		2.618 (0.074)	.007
MANOVA Model (Diving/snorkelling experiences): V = 0.987, F = 1.513, p = 0.170							***F (p)***	$\boldsymbol{\eta^2_p}$
				Means[a]				
	Never		One or two times		More than 3 times			
Contrast	22.45		22.44		20.68		1.368 (0.255)	.004
Fish	32.69		31.61		30.32		0.255 (0.152)	.005
Coral	24.77		24.63		27.75		1.887 (0.140)	.006
Turtle	20.07		21.3		21.23		0.152 (0.254)	.004

[a]Means with the same superscript are not significantly different at the .05 level.
*Significant at .05 level.
**Significant at .01 level.

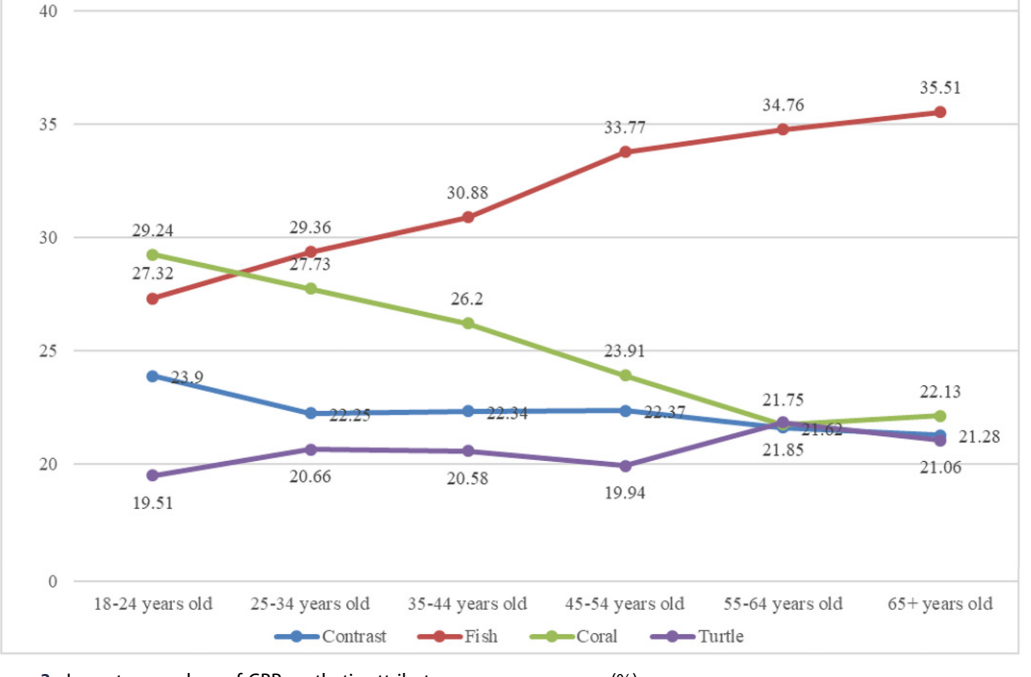

Figure 3. Importance values of GBR aesthetic attributes across age groups (%).

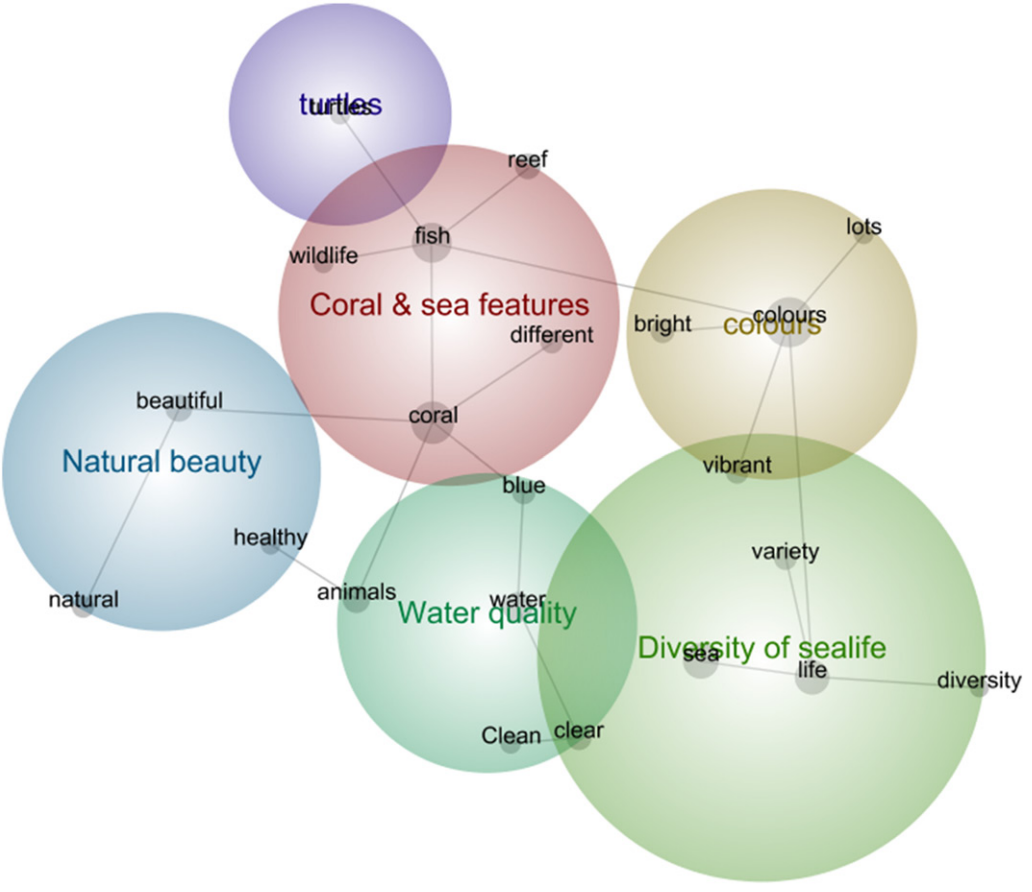

Figure 4. Thematic analysis by Leximancer.

clear and blue sea water. The last theme is natural beauty. Participants appreciate the naturalness of the GBR scenery characterised by beautiful and healthy reef features (i.e. coral and a wide range of marine species, or sea animals). Therefore, environmental changes such as degrading water quality/clarity, decreasing number of sea animals and unhealthy Reef elements negatively influence tourist aesthetic assessment of the GBR, threatening tourism growth in the Reef regions.

Discussion

The current research advances the literature by exploring how environmental changes in the GBR ecosystem are evaluated aesthetically by tourists. The contributions of key aesthetic attributes (fish, coral, turtle, water quality) to the reef beauty are quantified, showing that they have different aesthetic appeal. Results indicate that tourist aesthetic assessment of the GBR is subjective and varies across age groups. Research outcomes are hence discussed in relation to the literature to suggest marketing and conservation implications for GBR stakeholders.

Advancing knowledge of tourist aesthetic assessment

This study contributes to tourism literature by providing insights into tourist aesthetic assessment of underwater scenery. First, the disappearance of any feature (fish, turtle and coral)

decreases tourist aesthetic assessment, confirming the vital role of biodiversity in determining tourist perceived beauty of the Reef. Tourist aesthetic preference for bio-diverse environments including underwater sceneries (Cracknell, Pahl, White, & Depledge, 2018; Cracknell et al., 2017; Polak & Shashar, 2013; Tribot et al., 2016; White et al., 2017) and landscapes (Breiby & Slåtten, 2015; Frank et al., 2013; van der Jagt et al., 2014) indicates a link between multiple ecosystem services (Swaffield & McWilliam, 2013). It is worth noting that the current study investigates a prescribed set of variables representing key features of the reef and does not account for the diversity of species within these variables (e.g. fish abundance).

Second, the presence of colourful features positively increase tourist aesthetic assessment of underwater scenery compared to non-colourful features (see Table 1), aligning with previous research on human aesthetic preference for brightly colourful objects (Junge, Jacot, Bosshard, & Lindemann-Matthies, 2009; Lindemann-Matthies, Briegel, Schüpbach & Junge, 2010). Given that bright colours have signalled food sources for humans throughout evolution (Heerwagen & Orians, 1993; Lindemann-Matthies et al., 2010), the presence of colourful features makes underwater scenery more aesthetically attractive (Haas et al., 2015; Scott et al., in press).

Interestingly, fish colour is related to aesthetic appeal but does not necessarily signal its economic value. Non-colourful fish characterised by silver colour in this study represents the many pelagic species (a term meaning fish swimming in schools above the coral reefs). Non-colourful fish have, on average, negative aesthetic appeal, but many of these types of fish are important economically. For example, the Queensland school mackerel (*Scomberomorus queenslandicus*) forms the basis of a commercial fishery on the Great Barrier Reef (Begg, Cameron, & Sawynok, 1997). In contrast, colourful fish of the Reef (e.g. Maori Wrasse or clownfish), which is more aesthetically appealing because of their blue and yellow colours (Marshall et al., 2018), have negligible value for the fishing industry.

Moreover, colourful coral has positive aesthetic appeal while non-colourful coral does not. Coral near the water surface is characterised by a display of colour (Kaufman, 2005; Marshall, 2000) but the coral colour appears duller with increasing water depth. Hence, coral in deep water or coral in an unhealthy state such as bleaching and dying is less aesthetically appealing due to its fade colours. However, underwater scenery containing non-colourful coral may still be aesthetically appreciated by tourists if colourful fish and other sea animals (e.g. turtle) are present (see Table 1).

Third, water visibility significantly influences tourist aesthetic assessment of GBR underwater scenery. Reduced water visibility negatively influences tourist aesthetic assessment, and thus, decreases tourist satisfaction with GBR visit experiences (Coghlan & Prideaux, 2009). Water quality is an important determinant of the Reef beauty (Marshall et al., 2019), providing an important lever to encourage the involvement of the government and other production industries in pollution control in favour of sustainable tourism development.

Overall, the current research reveals tourist aesthetic preference for fish over coral. Human appreciation of fish species beyond simply keeping fish as a source of food has been previously recorded (Bridges, 1970; Cracknell et al., 2018). From a tourist perspective, "a coral reef without fish is like a playground without the laughter" (Marshall et al., 2019, p. 12). Tourists have more empathy and connection with fish because they are unlikely to consider coral as a living organism (Marsden, 2018). Fish are more lively and active, providing psychological benefits such as calmness, relaxation and stress-reduction (Kidd & Kidd, 1999; Langfield & James, 2009). Such an engagement quality of fish is a key reason explaining why people have fish tanks at home and make regular visits to aquaria (Gusset & Dick, 2011). Tourist aesthetic preference for fish over coral is supported by a number of studies (Giglio, Luiz, & Schiavetti, 2015; Leujak & Ormond, 2007; Williams & Polunin, 2000) while the opposite trend (human preference for coral over fish) has also been recorded (Shafer & Inglis, 2000). However, there is agrement that fish and coral are key aesthetic elements of the Reef, contributing viewers enjoyment (Uyarra et al., 2009).

Furthermore, the current research supports a subjectivist approach in studying human aesthetic assessment. Tourist aesthetic assessment is complex and depends on innate biological/evolutionary mechanisms, learned cultural influences and individual histories (Bourassa, 1990; White et al., 2014). This study shows that tourist aesthetic assessment of GBR underwater scenery varies across age groups, aligning with other landscape studies (Howley, 2011; Howley et al., 2012; Sevenant & Antrop, 2010; Strumse, 1996). The importance value of fish attribute increases along with participants' age, indicating that older tourists are more sensitive to fish-related changes in appreciating the GBR aesthetics (see Table 2). In contrast, coral-related changes have a stronger impact on younger tourists' beauty assessment. This is possibly because young tourists access more regularly environmental education and conservation information and hence more aware of coral bleaching (Connell, Fien, Lee, Sykes, & Yencken, 1999).

GBR aesthetics as a key criterion for sustainable tourism development

This study shows that tourist aesthetic assessment is sensitive to environmental changes in the reef ecosystem even though they may not be able to have accurate assessments of the reef health. The link between tourist aesthetic evaluations and reef health is not obvious, reflected in somewhat various research findings. Marshall, Marshall, and Smith (2017) found a significant correlation between tourist aesthetic assessment and the reef health evaluated by experts, which is, however, not supported by another research (Vercelloni et al., 2018). Therefore, understanding tourists' aesthetic assessment of environmental changes in the reef ecosystem is crucial in designing effective marketing and conservation messages targeting tourists whose travel intentions and conservation behaviour are motivated by their aesthetic preference (Kirillova et al., 2014; Skibins et al., 2017).

Aesthetic tourism marketing for the GBR

The research findings explain why the use of promotional images showing bio-diverse, colourful underwater scenes with high levels of water visibility are effective in attracting tourists to the GBR regions. Tourists travel, in part, because these GBR images are aesthetically appealing. Mass media coverage of coral bleaching events in 2016 and 2017 had negative impacts on the GBR image as well as tourism development in the Reef regions (Prideaux, Carmody, & Pabel, 2017). Our research findings suggest that tourism marketing organisations such as Tourism and Events Queensland should acknowledge coral bleaching while exploiting other aesthetic aspects of the reef such as its marine life or clean/blue sea water. Despite coral bleaching events, the GBR regions remain aesthetically attractive to tourists when marine animals such as colourful fish, turtle remain (Williams & Polunin, 2000).

GBR aesthetics for conservation planning

Aesthetic marketing is just a short-term solution to attract tourists, but conservation planning and tourist conservation support are essential for sustainable tourism development in GBR regions. The current research suggests that colourful fish can play the role of flagship animals in encouraging tourist conservation behaviour such as increasing donations to conservation programs and/or reducing waste during a visit to the GBR. Human conservation efforts are frequently motivated by aesthetic preferences, particularly for charismatic megafauna (Brady, 2006; Skibins et al., 2017; Stokes, 2007). Acknowledging human tendency to protect aesthetically pleasing species, World Wide Fund for Nature (WWF) has adopted the panda as a symbol for conservation programs due to its charismatic characteristics (Leader-Williams & Dublin, 2000). The use of panda images attracts mass media coverage and has influenced the development of protected areas in China (Liu et al., 2016). Similarly, the use of "big 5" flagship species is effective

in inspiring tourist conservation behaviour in African parks (Skibins, Powell, & Hallo, 2016). Tourist aesthetic preference for fish, therefore, can positively inspire their conservation intentions to protect fish and its home, the Reef. Conservation messages of the Reef should go beyond the dominant themes of coral bleaching and coral health. It is necessary to direct the audience attention and media storylines to the bigger picture of Reef health: how anthropogenic effects threaten the life of beautiful and charismatic sea animals (such as colourful fish) by destroying their natural habitat. Human empathy (Marsden, 2018) and compassion (Weaver & Jin, 2016) are effective in motivating tourists' responsible behaviour.

This study highlights the necessity of further conservation initiatives to improve the global quality of the reef ecosystem. Coral restoration programs have been a mainstay in the conservation portfolio of reef management planning all over the world (Van Oppen et al., 2017) and recently adopted in GBR conservation program. The investment in coral restoration is vital to improve the aesthetic value of reef sites for tourism by repairing the natural habitat of marine animals and thus repopulating the area (Prideaux & Pabel, 2018). Biodiversity plays a vital role in delighting tourists with fish as a satisfier factor and coral as a dissatisfier factor (Coghlan, 2012). Hence, conservation programs for the GBR should build on coral restoration programs with expansions for protecting aesthetically attractive species of the reef and controlling sea water quality. Our research can be used to advocate for further governmental support in implementing a more comprehensive conservation planning that secures sustainable tourism development in the GBR regions.

Conclusion

This study investigates tourists' aesthetic assessment of environmental changes in the GBR underwater ecosystem, suggesting how conservation planning should be implemented to achieve sustainable tourism development. Aesthetics can be used as an important criterion of environmental management in order to maintain aesthetically pleasing places, which attract and sustain the number of tourists, with the argument that tourism ultimately supports conservation (Brady, 2006; Liburd & Becken, 2017; Marshall et al., 2017).

Research on the aesthetics of nature-based destinations is an area that needs further examination, providing valuable implication for conservation planning and sustainable tourism development. First, the potential for mutual development between tourism and the fishing industry should be investigated in future research. This study shows that non-colourful fish, which are of high economic value for the fishing industry, does not necessarily contribute to the reef beauty. Further investigation based on the pioneering study by Tribot et al. (2018) to classify aesthetic and ecological functions of GBR fish is necessary for building a multivalue collaborative strategy for tourism, fishing and conservation. Second, the current research shows significant differences between tourists of different age groups in assessing the Reef beauty, suggesting the caution in adjusting conservation messages to target different age groups (Peake, Innes, & Dyer, 2009). Young tourists are more sensitive to coral-changes, and when their age increases, tourist aesthetic assessment of underwater scenery is more sensitive to fish-changes. Future studies can experimentally test different conservation messages and their effects on different tourist age groups. Third, only the visual aspect of tourist aesthetic assessment is investigated in this study, while tourist aesthetic assessment should engage all senses (Kirillova et al., 2014). Future aesthetic research should investigate all sensory aspects of tourist aesthetic evaluations using modern technologies (e.g. virtual reality) or interviews with tourists on site (Johnston & Smith, 2014).

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This project was funded through a National Environment Science Program (NESP) fund, within the Tropical Water Quality Hub.

Notes on contributors

Dung Le is a PhD student at Griffith University. Her research interests include the study of tourism experiences, destination marketing, and aesthetics.

Noel Scott is Adjunct Professor, Sustainability Research Centre, University of the Sunshine Coast. At the time of this study, he was Professor and Deputy Director, Griffith Institute for Tourism at Griffith University, Gold Coast, Australia. His research interests include the study of tourism experiences, destination management and marketing, and stakeholder organisation.

Susanne Becken is Professor and Director, Griffith Institute for Tourism at Griffith University, Gold Coast, Australia. Her research interests include tourism and climate change, global challenges for tourism, disaster management and tourism and tourist behaviours.

Rod Connolly is Professor in the School of Environment and the Coast and Estuaries group in the Australian Rivers Institute. Through his work on resilience and ecosystem protection, Rod is helping to find sustainable solutions to the issues of urbanisation, food security, ecosystem services and climate variability.

References

Andereck, K., Valentine, K., Knopf, R., & Vogt, C. (2005). Residents' perceptions of community tourism impacts. *Annals of Tourism Research*, *32*, 1056–1076. doi:10.1016/j.annals.2005.03.001

Ares, G., & Deliza, R. (2010). Studying the influence of package shape and colour on consumer expectations of milk desserts using word association and conjoint analysis. *Food Quality and Preference*, *21*, 930–937. doi:10.1016/j.foodqual.2010.03.006

Arriaza, M., Cañas-Ortega, J. F., Cañas-Madueño, J. A., & Ruiz-Aviles, P. (2004). Assessing the visual quality of rural landscapes. *Landscape and Urban Planning*, *69*(1), 115–125. doi:10.1016/j.landurbplan.2003.10.029

Awaritefe, O. (2004). Motivation and other considerations in tourist destination choice: A case study of Nigeria. *Tourism Geographies*, *6*, 303–330. doi:10.1080/1461668042000249638

Beardsley, M. (1975). *Aesthetics from classical Greece to the present*. University of Alabama Press.

Begg, G., Cameron, D., & Sawynok, W. (1997). Movements and stock structure of school mackerel (Scomberomorus queenslandicus) and spotted mackerel (S. munroi) in Australian east-coast waters. *Marine and Freshwater Research*, *48*, 295–301. doi:10.1071/MF97006

Beh, A., & Bruyere, B. (2007). Segmentation by visitor motivation in three Kenyan national reserves. *Tourism Management*, *28*, 1464–1471. doi:10.1016/j.tourman.2007.01.010

Bourassa, S. (1990). A paradigm for landscape aesthetics. *Environment and Behavior*, *22*, 787–812. doi:10.1177/0013916590226004

Brady, E. (2006). Aesthetics in practice: Valuing the natural world. *Environmental Values*, *15*, 277–291. doi:10.3197/096327106778226202

Breiby, M. (2014). Exploring aesthetic dimensions in a nature-based tourism context. *Journal of Vacation Marketing*, *20*, 163–173. doi:10.1177/1356766713514243

Breiby, M., & Slåtten, T. (2015). The effects of aesthetic experiential qualities on tourists positive emotions and loyalty: A case of a nature-based context in Norway. *Journal of Quality Assurance in Hospitality & Tourism*, *16*, 323–346. doi:10.1080/1528008X.2015.1016591

Bridges, W. (1970). A guide to representative fishes, aquatic invertebrates, reptiles, birds, and mammals. In *The New York aquarium book of the water world* (pp. 9–10). New York: New York Zoological Society American Heritage Press.

Chen, Y., Sun, B., Liao, S., Chen, L., & Luo, S. (2016). Landscape perception based on personal attributes in determining the scenic beauty of in-stand natural secondary forests. *Annals of Forest Research*, *59*(1), 91–103. doi:10.15287/afr.2015.440

Chen, Y.-H., Hsu, I. C., & Lin, C.-C. (2010). Website attributes that increase consumer purchase intention: A conjoint analysis. *Journal of Business Research*, *63*, 1007–1014. doi:10.1016/j.jbusres.2009.01.023

Chi, C., & Qu, H. (2008). Examining the structural relationships of destination image, tourist satisfaction and destination loyalty: An integrated approach. *Tourism Management*, *29*, 624–636. doi:10.1016/j.tourman.2007.06.007

Cini, F., Leone, L., & Passafaro, P. (2012). Promoting Ecotourism Among Young People: A Segmentation Strategy. *Environment and Behavior*, *44*(1), 87–106. doi:10.1177/0013916510389313
Coeterier, J. (1996). Dominant attributes in the perception and evaluation of the Dutch landscape. *Landscape and Urban Planning*, *34*(1), 27–44. doi:10.1016/0169-2046(95)00204-9
Coghlan, A. (2012). Facilitating reef tourism management through an innovative importance-performance analysis method. *Tourism Management*, *33*, 767–775. doi:10.1016/j.tourman.2011.08.010
Coghlan, A., & Prideaux, B. (2009). Welcome to the Wet Tropics: The importance of weather in reef tourism resilience. *Current Issues in Tourism*, *12*, 89–104. doi:10.1080/13683500802596367
Connell, S., Fien, J., Lee, J., Sykes, H., & Yencken, D. (1999). If it doesn't directly affect you, you don't think about it': A qualitative study of young people's environmental attitudes in two Australian cities. *Environmental Education Research*, *5*(1), 95–113. doi:10.1080/1350462990050106
Cracknell, D., Pahl, S., White, M., & Depledge, M. (2018). Reviewing the role of aquaria as restorative settings: How subaquatic diversity in public aquaria can influence preferences, and human health and well-being. *Human Dimensions of Wildlife*, *23*, 1–15. doi:10.1080/10871209.2018.1449039
Cracknell, D., White, M., Pahl, S., & Depledge, M. (2017). A preliminary investigation into the restorative potential of public aquaria exhibits: A UK student-based study. *Landscape Research*, *42*(1), 18–32. doi:10.1080/01426397.2016.1243236
Datta, R., Joshi, D., Li, J., & Wang, J. Z. (2006, May). *Studying aesthetics in photographic images using a computational approach*. Paper presented at the European Conference on Computer Vision, Graz, Austria.
del Bosque, I. R., & San Martín, H. (2008). Tourist satisfaction a cognitive-affective model. *Annals of Tourism Research*, *35*, 551–573. doi:10.1016/j.annals.2008.02.006
DeLucio, J., & Múgica, M. (1994). Landscape preferences and behaviour of visitors to Spanish national parks. *Landscape and Urban Planning*, *29*, 145–160. doi:10.1016/0169-2046(94)90024-8
Dinsdale, E., & Fenton, M. (2006). Assessing coral reef condition: Eliciting community meanings. *Society and Natural Resources*, *19*, 239–258. doi:10.1080/08941920500460815
Echtner, C., & Ritchie, B. (1993). The measurement of destination image: An empirical assessment. *Journal of Travel Research*, *31*, 3–13. doi:10.1177/004728759303100402
Esparon, M., Stoeckl, N., Farr, M., & Larson, S. (2015). The significance of environmental values for destination competitiveness and sustainable tourism strategy making: Insights from Australia's Great Barrier Reef World Heritage Area. *Journal of Sustainable Tourism*, *23*, 706–725. doi:10.1080/09669582.2014.998678
Frank, S., Fürst, C., Koschke, L., Witt, A., & Makeschin, F. (2013). Assessment of landscape aesthetics—Validation of a landscape metrics-based assessment by visual estimation of the scenic beauty. *Ecological Indicators*, *32*, 222–231. doi:10.1016/j.ecolind.2013.03.026
Fyhri, A., Jacobsen, J. K. S., & Tømmervik, H. (2009). Tourists' landscape perceptions and preferences in a Scandinavian coastal region. *Landscape and Urban Planning*, *91*, 202–211. doi:10.1016/j.landurbplan.2009.01.002
GBRMPA. (2014). *Great Barrier Reef Outlook Report*. Great Barrier Reef Marine Park Authority. Townsville, Australia. Retrieved from http://elibrary.gbrmpa.gov.au/jspui/bitstream/11017/2856/5/InBrief_accessible_low%20res.pdf
GBRMPA. (2018). *Great Barrier Reef tourist numbers*. Retrieved from http://www.gbrmpa.gov.au/our-work/reef-strategies/visitor-contributions/gbr_visitation/numbers
Giglio, V., Luiz, O., & Schiavetti, A. (2015). Marine life preferences and perceptions among recreational divers in Brazilian coral reefs. *Tourism Management*, *51*, 49–57. doi:10.1016/j.tourman.2015.04.006
Green, P., & Srinivasan, V. (1978). Conjoint analysis in consumer research: Issues and outlook. *Journal of Consumer Research*, *5*, 103–123. doi:10.1086/208721
Green, P., & Srinivasan, V. (1990). Conjoint analysis in marketing: New developments with implications for research and practice. *The Journal of Marketing*, *54*, 3–19. doi:10.1177/002224299005400402
Gusset, M., & Dick, G. (2011). The global reach of zoos and aquariums in visitor numbers and conservation expenditures. *Zoo Biology*, *30*, 566–569. doi:10.1002/zoo.20369
Haas, A. F., Guibert, M., Foerschner, A., Co, T., Calhoun, S., George, E., … Rohwer, F. (2015). Can we measure beauty? Computational evaluation of coral reef aesthetics. *PeerJ*, *3*, e1390. doi:10.7717/peerj.1390
Hagman, G. (2002). The sense of beauty. *The International Journal of Psychoanalysis*, *83*(Pt 3), 661–674.
Hair, J., Black, W., Babin, B., Anderson, R., & Tatham, R. (1998). *Multivariate data analysis* (Vol. *5*). UK: Pearson Education Limited
Hazen, H. (2009). Valuing natural heritage: Park visitors' values related to World Heritage sites in the USA. *Current Issues in Tourism*, *12*, 165–181. doi:10.1080/13683500802538260
Hepburn, R. (1966). Contemporary aesthetics and the neglect of natural beauty. In *British analytical philosophy* (pp. 285–310). London, UK: Routledge & Kegan Paul Ltd.
Howley, P. (2011). Landscape aesthetics: Assessing the general publics' preferences towards rural landscapes. *Ecological Economics*, *72*, 161–169. doi:10.1016/j.ecolecon.2011.09.026
Howley, P., Donoghue, C. O., & Hynes, S. (2012). Exploring public preferences for traditional farming landscapes. *Landscape and Urban Planning*, *104*(1), 66–74. doi:10.1016/j.landurbplan.2011.09.006

Huertas-Garcia, R., Laguna García, M., & Consolación, C. (2014). Conjoint analysis of tourist choice of hotel attributes presented in travel agent brochures. *International Journal of Tourism Research*, *16*(1), 65–75. doi:10.1002/jtr.1899

Hughes, T., Kerry, J., & Simpson, T. (2018). Large-scale bleaching of corals on the Great Barrier Reef . *Ecology*, *99*(2), 501. doi:10.1002/ecy.2092

Hughes, T. P., Kerry, J. T., Baird, A. H., Connolly, S. R., Dietzel, A., Eakin, C. M., … Torda, G. (2018). Global warming transforms coral reef assemblages. *Nature*, *556*(7702), 492. doi:10.1038/s41586-018-0041-2

Johnston, C., & Smith, A. (2014). Beautiful one day: Assessing the world heritage aesthetic values of the Great Barrier Reef. *Historic Environment*, *26*, 54–71.

Junge, X., Jacot, K. A., Bosshard, A., & Lindemann-Matthies, P. (2009). Swiss people's attitudes towards field margins for biodiversity conservation. *Journal for Nature Conservation*, *17*(3), 150–159.

Kaplan, R., Kaplan, S., & Brown, T. (1989). Environmental preference. *A comparison of four domains of predictors*. Environment and Behavior, *21*, 509–530. doi:10.1177/0013916589215001

Kaufman, L. (2005). One fish two fish red fish blue fish: Why are coral reefs so colorful. *National Geographic*, *207*, 86–109.

Kidd, A., & Kidd, R. (1999). Benefits, problems, and characteristics of home aquarium owners. *Psychological Reports*, *84*, 998–1004. doi:10.2466/pr0.1999.84.3.998

Kirillova, K., Fu, X., Lehto, X., & Cai, L. (2014). What makes a destination beautiful? Dimensions of tourist aesthetic judgment. *Tourism Management*, *42*, 282–293. doi:10.1016/j.tourman.2013.12.006

Kirillova, K., & Lehto, X. (2015). An existential conceptualization of the vacation cycle. *Annals of Tourism Research*, *55*(Supplement C), 110–123. doi:10.1016/j.annals.2015.09.003

Kock, F., Josiassen, A., & Assaf, G. (2016). Advancing destination image: The destination content model. *Annals of Tourism Research*, *61*(Supplement C), 28–44. doi:10.1016/j.annals.2016.07.003

Langfield, J., & James, C. (2009). Fishy tales: Experiences of the occupation of keeping fish as pets. *British Journal of Occupational Therapy*, *72*, 349–356. doi:10.1177/030802260907200805

Leader-Williams, N., & Dublin, H. (2000). Charismatic megafauna asflagship species'. In A. Entwistle & N. Dunstone (Eds.), *Priorities for the conservation of mammalian diversity* (pp. 53–84). Cambridge, UK. Cambridge University Press.

Lee, S., Jeon, S., & Kim, D. (2011). The impact of tour quality and tourist satisfaction on tourist loyalty: The case of Chinese tourists in Korea. *Tourism Management*, *32*, 1115–1124. doi:10.1016/j.tourman.2010.09.016

Leujak, W., & Ormond, R. (2007). Visitor perceptions and the shifting social carrying capacity of South Sinai's coral reefs. *Environmental Management*, *39*, 472–489. doi:10.1007/s00267-006-0040-1

Liburd, J., & Becken, S. (2017). Values in nature conservation, tourism and UNESCO World Heritage Site stewardship. *Journal of Sustainable Tourism*, *25*, 1719–1735. doi:10.1080/09669582.2017.1293067

Lindemann-Matthies, P., Briegel, R., Schüpbach, B., & Junge, X. (2010). Aesthetic preference for a Swiss alpine landscape: The impact of different agricultural land-use with different biodiversity. *Landscape and Urban Planning*, *98*(2), 99–109. doi:10.1016/j.landurbplan.2010.07.015.

Lindemann-Matthies, P., Junge, X., & Matthies, D. (2010). The influence of plant diversity on people's perception and aesthetic appreciation of grassland vegetation. *Biological Conservation*, *143*(1), 195–202. doi:10.1016/j.biocon.2009.10.003

Liu, W., Vogt, C. A., Lupi, F., He, G., Ouyang, Z., & Liu, J. (2016). Evolution of tourism in a flagship protected area of China. *Journal of Sustainable Tourism*, *24*, 203–226. doi:10.1080/09669582.2015.1071380

Lothian, A. (1999). Landscape and the philosophy of aesthetics: Is landscape quality inherent in the landscape or in the eye of the beholder? *Landscape and Urban Planning*, *44*, 177–198. doi:10.1016/S0169-2046(99)00019-5

Marsden, A. (2018). *It's time to put the Great Barrier Reef first*. Paper presented at the 2018 Global Eco Asia-Pacific Tourism Conference Program, Townsville.

Marshall, J. (2000). Communication and camouflage with the same 'bright'colours in reef fishes. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, *355*, 1243–1248.

Marshall, N., Barnes, M. L., Birtles, A., Brown, K., Cinner, J., Curnock, M., … Tobin, R. (2018). Measuring what matters in the Great Barrier Reef. *Frontiers in Ecology and the Environment*, *16*, 271–277. doi:10.1002/fee.1808

Marshall, N., Marshall, P., Curnock, M., Pert, P., Smith, A., & Visperas, B. (2019). Identifying indicators of aesthetics in the Great Barrier Reef for the purposes of management. *PLoS One*, *14*, e0210196. doi:10.1371/journal.pone.0210196

Marshall, N., Marshall, P., & Smith, A. (2017). *Managing for aesthetic values in the Great Barrier Reef: Identifying indicators and linking reef aesthetics with reef health*. Cairns, Australia. Retrieved from https://nesptropical.edu.au/wp-content/uploads/2018/09/NESP-TWQ-Project-3.2.4-Final-Report.pdf

Marshall, N. A., Bohensky, E., Curnock, M., Goldberg, J., Gooch, M., Nicotra, B., … Tobin, R. C. (2016). Advances in monitoring the human dimension of natural resource systems: An example from the Great Barrier Reef. *Environmental Research Letters*, *11*, 114020. doi:10.1088/1748-9326/11/11/114020

Nassauer, J. I. (1995). Culture and changing landscape structure. *Landscape Ecology*, *10*, 229–237.

O'Leary, S., & Deegan, J. (2005). Ireland's image as a tourism destination in France: Attribute importance and performance. *Journal of Travel Research*, *43*, 247–256. doi:10.1177/0047287504272025

Peake, S., Innes, P., & Dyer, P. (2009). Ecotourism and conservation: Factors influencing effective conservation messages. *Journal of Sustainable Tourism*, *17*(1), 107–127. doi:10.1080/09669580802276000

Piggott-McKellar, A., & McNamara, K. (2017). Last chance tourism and the Great Barrier Reef. *Journal of Sustainable Tourism*, *25*, 397–415. doi:10.1080/09669582.2016.1213849

Polak, O., & Shashar, N. (2013). Economic value of biological attributes of artificial coral reefs. *ICES Journal of Marine Science*, *70*, 904–912. doi:10.1093/icesjms/fst014

Prideaux, B., Carmody, J., & Pabel, A. (2017). *Impacts of the 2016 and 2017 mass coral bleaching events on the Great Barrier Reef tourism industry and tourism-dependent coastal communities of Queensland. Cairns, Australia. Report to the Reef and Rainforest Research Centre Limited*.

Prideaux, B., & Pabel, A. (2018). *Coral reefs: Tourism, conservation and management*. Australia: Routledge.

Rogge, E., Nevens, F., & Gulinck, H. (2007). Perception of rural landscapes in Flanders: Looking beyond aesthetics. *Landscape and Urban Planning*, *82*, 159–174. doi:10.1016/j.landurbplan.2007.02.006

Schirpke, U., Tasser, E., & Tappeiner, U. (2013). Predicting scenic beauty of mountain regions. *Landscape and Urban Planning*, *111*, 1–12. doi:10.1016/j.landurbplan.2012.11.010

Scott, N., & Smith, A. E. (2005). Use of Automated Content Analysis Techniques for Event Image Assessment. *Tourism Recreation Research*, *30*(2), 87–91. doi:10.1080/02508281.2005.11081477.

Scott, N., Le, D., Becken, S., & Connolly, R. (Published online). Measuring perceived beauty of the Great Barrier Reef using eye-tracking technology. *Current Issues in Tourism*. https://doi.org/10.1080/13683500.2019.1626812

Scott, N., Zhang, R., Le, D., & Moyle, B. (2017). A review of eye-tracking research in tourism. *Current Issues in Tourism*, *22*(10), 1244–1261. doi:10.1080/13683500.2017.1367367

Sevenant, M., & Antrop, M. (2010). The use of latent classes to identify individual differences in the importance of landscape dimensions for aesthetic preference. *Land Use Policy*, *27*, 827–842. doi:10.1016/j.landusepol.2009.11.002

Shafer, S., & Inglis, G. (2000). Influence of social, biophysical, and managerial conditions on tourism experiences within the Great Barrier Reef World Heritage Area. *Environmental Management*, *26*(1), 73–87. doi:10.1007/s002670010072

Silayoi, P., & Speece, M. (2007). The importance of packaging attributes: A conjoint analysis approach. *European Journal of Marketing*, *41*, 1495–1517. doi:10.1108/03090560710821279

Skibins, J., Dunstan, E., & Pahlow, K. (2017). Exploring the Influence of Charismatic Characteristics on Flagship Outcomes in Zoo Visitors. *Human Dimensions of Wildlife*, *22*, 157–171. doi:10.1080/10871209.2016.1276233

Skibins, J., Powell, R., & Hallo, J. (2016). Lucky 13: Conservation implications of broadening "Big 5" flagship species recognition in East Africa. *Journal of Sustainable Tourism*, *24*, 1024–1040. doi:10.1080/09669582.2015.1101126

Stokes, D. (2007). Things we like: Human preferences among similar organisms and implications for conservation. *Human Ecology*, *35*, 361–369. doi:10.1007/s10745-006-9056-7

Strumse, E. (1996). Demographic differences in the visual preferences for agrarian landscapes in western Norway. *Journal of Environmental Psychology*, *16*(1), 17–31. doi:10.1006/jevp.1996.0002

Stuart-Smith, R., Brown, C., Ceccarelli, D., & Edgar, G. (2018). Ecosystem restructuring along the Great Barrier Reef following mass coral bleaching. *Nature*, *560*, 92. doi:10.1038/s41586-018-0359-9

Suh, Y. K., & McAvoy, L. (2005). Preferences and trip expenditures—a conjoint analysis of visitors to Seoul, Korea. *Tourism Management*, *26*, 325–333. doi:10.1016/j.tourman.2003.11.015

Swaffield, S., & McWilliam, W. (2013). Landscape aesthetic experience and ecosystem services. In J. Dymond (Ed.), *Ecosystem Services in New Zealand–Conditions and Trends* (pp. 349–362). Lincoln, New Zealand: Manaaki Whenua Press.

Thyne, M., Lawson, R., & Todd, S. (2006). The use of conjoint analysis to assess the impact of the cross-cultural exchange between hosts and guests. *Tourism Management*, *27*, 201–213. doi:10.1016/j.tourman.2004.09.003

Todd, C. (2009). Nature, beauty and tourism. In J. Tribe (Ed.), *Philosophical issues in tourism* (pp. 154–170). Bristol, UK: Channel View Publishing.

Tribot, A.-S., Carabeux, Q., Deter, J., Claverie, T., Villéger, S., & Mouquet, N. (2018). Confronting species aesthetics with ecological functions in coral reef fish. *Scientific Reports*, *8*(11733), 1-7. doi:10.1038/s41598-018-29637-7

Tribot, A.-S., Mouquet, N., Villéger, S., Raymond, M., Hoff, F., Boissery, P., … Deter, J. (2016). Taxonomic and functional diversity increase the aesthetic value of coralligenous reefs. *Scientific Reports*, *6*(34299), 1–12. doi:10.1038/srep34229

Tseng, C., Wu, B., Morrison, A., Zhang, J., & Chen, Y.-C. (2015). Travel blogs on China as a destination image formation agent: A qualitative analysis using Leximancer. *Tourism Management*, *46*, 347–358. doi:10.1016/j.tourman.2014.07.012

Uyarra, M., Watkinson, A., & Cote, I. (2009). Managing dive tourism for the sustainable use of coral reefs: Validating diver perceptions of attractive site features. *Environmental Management*, *43*(1), 1–16. doi:10.1007/s00267-008-9198-z

Van den Berg, A., Vlek, C., & Coeterier, F. (1998). Group differences in the aesthetic evaluation of nature development plans: A multilevel approach. *Journal of Environmental Psychology*, *18*, 141–157. doi:10.1006/jevp.1998.0080

van der Jagt, A., Craig, T., Anable, J., Brewer, M. J., & Pearson, D. G. (2014). Unearthing the picturesque: The validity of the preference matrix as a measure of landscape aesthetics. *Landscape and Urban Planning*, *124*, 1–13. doi:10.1016/j.landurbplan.2013.12.006

Van Oppen, M. J. H., Gates, R. D., Blackall, L. L., Cantin, N., Chakravarti, L. J., Chan, W. Y., … Putnam, H. M. (2017). Shifting paradigms in restoration of the world's coral reefs. *Global Change Biology*, *23*, 3437–3448. doi:10.1111/gcb.13647

Vercelloni, J., Clifford, S., Caley, M. J., Pearse, A. R., Brown, R., James, A., … Peterson, E. E. (2018). Using virtual reality to estimate aesthetic values of coral reefs. *Royal Society Open Science*, *5*, 172226. doi:10.1098/rsos.172226

Vogt, C., Fesenmaier, D., & MacKay, K. (1994). Functional and aesthetic information needs underlying the pleasure travel experience. *Journal of Travel & Tourism Marketing*, *2*, 133–146. doi:10.1300/J073v02n02_09

Weaver, D. B., & Jin, X. (2016). Compassion as a neglected motivator for sustainable tourism. *Journal of Sustainable Tourism*, *24*, 657–672. doi:10.1080/09669582.2015.1101130

White, M., Cracknell, D., Corcoran, A., Jenkinson, G., & Depledge, M. (2014). Do preferences for waterscapes persist in inclement weather and extend to sub-aquatic scenes? *Landscape Research*, *39*, 339–358. doi:10.1080/01426397.2012.759919

White, M., Smith, A., Humphryes, K., Pahl, S., Snelling, D., & Depledge, M. (2010). Blue space: The importance of water for preference, affect, and restorativeness ratings of natural and built scenes. *Journal of Environmental Psychology*, *30*, 482–493. doi:10.1016/j.jenvp.2010.04.004

White, M., Weeks, A., Hooper, T., Bleakley, L., Cracknell, D., Lovell, R., & Jefferson, R. (2017). Marine wildlife as an important component of coastal visits: The role of perceived biodiversity and species behaviour. *Marine Policy*, *78*, 80–89. doi:10.1016/j.marpol.2017.01.005

Williams, I., & Polunin, N. (2000). Differences between protected and unprotected reefs of the western Caribbean in attributes preferred by dive tourists. *Environmental Conservation*, *27*, 382–391. doi:10.1017/S0376892900000436

Yang, D., Luo, T., Lin, T., Qiu, Q., & Luo, Y. (2014). Combining aesthetic with ecological values for landscape sustainability. *PLoS One*, *9*, e102437. doi:10.1371/journal.pone.0102437

Yao, Y., Zhu, X., Xu, Y., Yang, H., Wu, X., Li, Y., & Zhang, Y. (2012). Assessing the visual quality of green landscaping in rural residential areas: The case of Changzhou, China. *Environmental Monitoring and Assessment*, *184*, 951–967. doi:10.1007/s10661-011-2012-z

Yoon, Y., & Uysal, M. (2005). An examination of the effects of motivation and satisfaction on destination loyalty: A structural model. *Tourism Management*, *26*(1), 45–56. doi:10.1016/j.tourman.2003.08.016