Science of the Total Environment 903 (2023) 166283

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

How do weather conditions and environmental characteristics influence aesthetic preferences of freshwater environments?

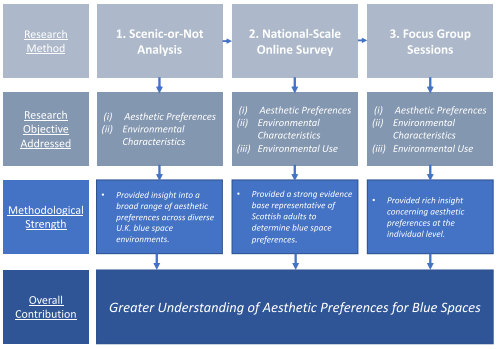
Megan J. Grace [a,*], Jen Dickie [a], Phil J. Bartie [b], Caroline Brown [c], David M. Oliver [a]

[a] Biological and Environmental Sciences, Faculty of Natural Sciences, University of Stirling, Stirling, UK
[b] Mathematical and Computer Sciences, Heriot-Watt University, Edinburgh, UK
[c] The Urban Institute, School of Energy, Geoscience, Infrastructure and Society, Heriot-Watt University, Edinburgh, UK

HIGHLIGHTS

- Mixed-methods research provided robust insight into freshwater aesthetic preferences.
- Remote inland blue spaces were preferred by survey and focus group participants.
- Appearance of nearby green space impacts aesthetic preference for inland blue spaces.
- Weather conditions had limited impact on overall inland blue space aesthetic ratings.

GRAPHICAL ABSTRACT



ARTICLE INFO

Editor: Jay Gan

Keywords:
Health and wellbeing
Green and blue space
Natural environments
Landscape aesthetics
Environmental exposure outcomes

ABSTRACT

Freshwater (inland) blue space environments provide a range of public health benefits to visitors. However, health related exposure outcomes are dynamic and can vary depending on several factors, including the environmental characteristics of freshwater environments and their surroundings. Developing and managing inland blue spaces to promote health and wellbeing therefore requires an understanding of whether specific freshwater attributes, and prevailing weather conditions, enhance or devalue landscape aesthetics. The aim of this study was to utilise a mixed-methods research approach to investigate aesthetic preferences of inland blue spaces. A three-phase data collection method was adopted involving (i) analysis of a national-scale landscape image dataset; in combination with (ii) a national-scale online survey; and (iii) a series of in-person focus groups. We found environmental characteristics associated with the waterbody itself, as well as the characteristics of the nearby green space, to have a significant impact on the overall aesthetic appeal of inland blue spaces. Strong preference was demonstrated for inland blue spaces perceived to be of a high environmental quality and which have a natural, rather than human-modified, appearance. The findings highlight the need to conserve the quality of both the waterbody and waterside environment to encourage frequent recreational use and maintain the beneficial public health outcomes associated with inland blue spaces.

* Corresponding author.
E-mail address: m.j.grace@stir.ac.uk (M.J. Grace).

https://doi.org/10.1016/j.scitotenv.2023.166283
Received 26 June 2023; Received in revised form 11 August 2023; Accepted 11 August 2023
Available online 14 August 2023

1. Introduction

Inland blue spaces, or freshwater environments, have been shown to improve mental health and wellbeing outcomes at the individual and population level (McDougall et al., 2021; Garrett et al., 2019). The enhancement of blue space environments through regeneration projects - such as the restoration of fountains; the introduction of riverside parks; and the reopening of canals – are associated with significant health benefits (Vert et al., 2019; Tieges et al., 2020; Satariano, 2022; Brückner et al., 2022). However, blue spaces and associated regeneration projects have not been utilised effectively as public health resources and interventions (Brückner et al., 2022; Zhang et al., 2022). To assist with the introduction of evidence-based public health policies, a greater understanding of the extent to which environmental characteristics influence perceptions of, and health outcomes associated with, inland blue spaces is required (Beute et al., 2020). The perceived aesthetic appearance of an environment can significantly impact an individual's behaviour (Wu and He, 2021) and influence how regularly an individual uses an environment (Ball et al., 2001). Environmental aesthetics may therefore have a significant impact on environmental exposure outcomes (Seresinhe et al., 2015; Hoyle et al., 2017).

Higher ratings of environmental attractiveness and an increased perception of nature are associated with the presence of water in a landscape image (White et al., 2010; Luo et al., 2021). There is however a degree of variability, as specific features of blue space environments, such as the colour, size and type of waterbody can impact perceived environmental aesthetics and exposure outcomes (Lengen, 2015; Pitt, 2018; Smith et al., 2022; McDougall et al., 2022). One environmental characteristic that may influence the aesthetic appearance of blue spaces is the availability and appearance of nearby green space. The presence of trees and bushes at outdoor spaces has been identified as a key factor affecting environmental appearance and people's perception of nature, as well as the extent to which the blue space and surrounding vegetation are maintained (Williams et al., 2019; Luo et al., 2021). A greater proportion of green space near blue space can lead to increased ratings of aesthetic appeal; with more biodiverse green space associated with improved preference for blue space environments (Luo et al., 2021; Ćwik et al., 2021; White et al., 2010). Given the variation within, and diversity of green and blue space environments, there is a need to develop a detailed understanding of how the quality and characteristics of nearby green space can impact aesthetic ratings of freshwater environments.

How prevailing weather conditions can affect aesthetic ratings of blue space environments is poorly understood, despite substantially changing the view and appearance of water and surrounding areas (White et al., 2020). Photo-based research has identified that adverse weather conditions can reduce preference for blue space environments (White et al., 2014) and a correlation between adverse weather conditions and reduced levels of outdoor physical activity has been reported (Wagner et al., 2019). For inland blue spaces, increased windspeeds have been linked with a reduction in time spent near freshwater (Elliott et al., 2019). However, the impact of weather is multifaceted with qualitative findings demonstrating that on occasions, the experience of adverse weather conditions, such as rain, can enhance an individual's blue space experience by establishing a connection with nature (Smith et al., 2022). Mixed research findings in combination with altering weather patterns due to climate change signals a need to improve understanding of the impact of weather on environmental exposure outcomes.

Environmental aesthetics is a growing research field and as such several different research methodologies have been developed to determine aesthetic appeal, including machine learning and social media data analytics (Jahani et al., 2022; Langemeyer et al., 2018). One way to effectively evaluate public perception of environmental characteristics and aesthetics is through the analysis of crowdsourced data. The online resource, 'Scenic-or-Not' (Data Science Lab, 2009) offers a novel open-access dataset of users' opinions on the appearance of geotagged photographs from across the United Kingdom. This dataset has previously determined that greater levels of happiness and higher levels of self-reported health are observed for inhabitants of more scenic regions (Seresinhe et al., 2015; Seresinhe et al., 2019). The Scenic-or-Not dataset has not yet been applied to investigate public perception of inland blue spaces, with such analysis offering opportunities to advance the current blue space research field.

This paper utilises the Scenic-or-Not dataset as part of a three-phase mixed-methods research approach to evaluate the extent to which the physical features of the environment can impact aesthetic preference for inland blue spaces. Broad aesthetic trends were identified across a large range of blue space environments through analysis of the Scenic-or-Not dataset. A complementary nation-wide online survey was also deployed to gain a comprehensive understanding of freshwater scenic ratings at the population level. Finally, a series of focus group discussions were held with small community groups to gain further insight into aesthetic preferences at the individual level. The three key research objectives were to: (i) investigate aesthetic preferences for freshwater environments; (ii) determine the extent to which weather conditions, alongside blue space and nearby green space characteristics, can impact the overall scenic ratings of freshwater environments; and (iii) assess how recreational use of blue spaces might vary depending on environmental aesthetics and characteristics.

2. Materials and methods

A three-phased data collection approach was adopted to capture a wide range of perspectives on blue space aesthetic preferences. The research design and methods were approved by the General University Ethics Panel at the University of Stirling.

2.1. Scenic-or-Not dataset interrogation

Scenic ratings of images were obtained from the Scenic-or-Not website where online users are invited to anonymously rate, from 1 to 10, how scenic they consider an image to be; with 1 indicating the image is 'not scenic' and 10 indicating the image is 'very scenic'. The images included on this site have been obtained from the Geograph website (https://www.geograph.org.uk). A total of 217,000 photographs taken from different environments across the United Kingdom are included in the Scenic-or-Not dataset and a total of 1,536,054 scenic votes have been submitted, averaging 7 votes per image. The corresponding images were downloaded from Geograph and processed using Places365-CNN software (Zhou et al., 2017) to generate a list of scene classifications per image (e.g. pond, river, canal, park, water-tower). The Places365-CNN software can classify images in up to 365 different categories. The categories determined by the software were then used to select only those records that contained freshwater (2045 images). These were manually checked to ensure they portrayed freshwater environments and the location of each photo was viewed on an Ordnance Survey map to verify it was a photograph of a recognised freshwater area. In total, 1015 freshwater Scenic-or-Not photos remained following manual cross-checking.

To analyse the Scenic-or-Not dataset, R Studio Version 4.1.1 was utilised with p values <0.05 considered significant. The date each image was taken, and the type of blue space shown was obtained from a corresponding record on the Geograph web-based resource. Analysis of variance (ANOVA) was used to assess the extent that scenic scores varied in relation to the season in which each photograph was taken and the type of blue space photographed. The seasons were classified by month, according to UK Met Office definitions for the northern hemisphere. Only freshwater blue space types (e.g. waterfalls, lakes, rivers, canals) that had at least twenty-five associated Scenic-or-Not images were included in the analysis. Scenic scores were tested for distribution and homogeneity of variances before parametric tests were conducted. In

instances where assumptions were not met, Welch's ANOVA was used. Across the 1015 freshwater images, the most common image attributes classified by the Places365-CNN software that were of relevance to the research question (relating to weather, blue space, green space, and surroundings), were identified. To compare the effect of the image attributes on scenic scores, Welch's *t*-test was used, and the effect-size (Cohen's d) was calculated for each t-test. Due to the nature of the software, there was a limit to how much the Places365-CNN generated image attributes could discern between different weather conditions, therefore for the Scenic-or-Not dataset interrogation, 'sunny' or 'cloudy' were the only comparable weather types.

2.2. Nationwide online survey

To complement the Scenic-or-Not database and provide an overview of the impact of environmental characteristics on aesthetic preferences, an online nationally representative survey was conducted using the Qualtrics UK platform (https://www.qualtrics.com). Using a Qualtrics online panel that consists of individuals who have previously agreed to be contacted by companies for research purposes, the survey was distributed to 1015 members of the Scottish adult population. An initial pilot study was carried out with 50 respondents to provide the opportunity to refine any questions for increased clarity. The main data collection period occurred between 07/06/22 to 29/06/22. Recruitment rates were managed by the Qualtrics UK platform, with key demographic information, namely age and gender, regularly reviewed to ensure the sample was representative of the Scottish adult population.

Before completing the survey, participants were required to complete an electronic consent form. Screening questions were used to confirm eligibility for the study (i.e., residing in Scotland and over the age of 18), after which panel members were directed to the survey. Socio-demographic information on gender, age, location and how often an individual participated in outdoor activities was collected. The main body of the survey focused on three images selected from the Scenic-or-Not Database. The images were selected because they all included a similar blue space (in this case a small stream, i.e., running water) but accommodated variations in waterside vegetation and surroundings (Table 1) to enable a comparison of the influence of the surrounding environment on blue space ratings. A total of three images were used in the survey as this enabled the impact of variation in the appearance of vegetation and environmental surroundings to be considered in detail, whilst minimising participant fatigue. All images were taken from ground-level, with an eye-level perspective and had a similar image quality, taken between 2006 and 2007 in the United Kingdom. The survey questions deliberately asked participants to focus on the landscape portrayed in the image rather than the image itself.

Within the survey, participants were shown the three images and asked to indicate how scenic they considered each photograph to be. The scoring approach was the same as that used in the Scenic-or-Not website with participants asked to rate images, from 1 to 10, with 1 being 'not

Table 1
Scenic-or-Not images selected for online survey.

Image Number	Image	Environmental Features of Interest
1		• Remote landscape • Natural appearance of grass • Monoculture of trees • Light blue sky colour
2		• Remote landscape • Short grass • Deciduous and coniferous trees • Strong blue sky colour
3		• Suburban landscape • Combination of long and manicured grass • White sky colour • Reflections in water

scenic' and 10 being 'very scenic'. Participants were also asked to consider the three images and select their most and least favourite image. For each image, respondents were asked three Likert scale questions to determine perceptions of how weather conditions, the appearance of the green space and the suitability of the environment for recreation influenced the aesthetic appeal of each image.

Statistical analysis of the nationwide online survey was carried out using R Studio Version 4.1.1 and involved the use of Tukey's range test to compare differences between scenic ratings of the three selected Scenic-or-Not images (Table 1). Associations between the image displayed and the respondent's level of agreement with each statement was determined using the chi-squared test. Associations between scenic ratings, environmental conditions and recreational usage were tested for using Ordinal Logistic Regression and were reported as Odds Ratios (OR) with 95 % confidence intervals (CIs). Three ordinal logistic regression models were developed, one for each image. All models were controlled for age, gender, and the location of the participant (rural, urban or suburban). Within each of the three models, all independent variables were included to account for the overall effect of environmental attributes on scenic scores. Spearman's Rank Correlation Test was used to determine associations (ρ) between environmental conditions and recreational usage. For all statistical tests, p values <0.05 were considered significant.

2.3. Focus group sessions

Four focus groups were held in different communities across Scotland from June to September 2022, with 20 participants taking part across the four groups. Most individuals involved were recruited from general community interest groups; however, those involved in group 4, all had a specific interest in hydrology and freshwater environments. For all focus groups a structured topic guide was followed, and the average length of each focus group session was 60 minutes. Each focus-group session was audio-recorded.

Demographic information for each participant was obtained using a short survey at the start of each focus group. The focus group began with an introductory map-based question where participants identified their favourite freshwater environments across Scotland. Participants were then asked to draw and discuss what they considered a scenic freshwater environment to be, before considering what factors would deter visits to inland blue spaces. Subsequent discussion centred around 15 photos taken from the 'Scenic or Not' database (See Supplementary Information, Table S3), and participants were asked a series of three ranking questions that generated discussion regarding the reasoning behind aesthetic preferences. The 15 photos were chosen to represent a range of freshwater types, weather conditions and to display urban, rural and suburban environments. Four of the fifteen selected photos did not contain water and therefore provided 'control' scenarios. To focus discussions on the physical environment, no photos that contained animals or people were included. Before taking part in the research, informed consent was required from all participants and no incentives were offered for taking part in the study.

To analyse the focus group discussions, all audio recordings were transcribed to Microsoft Word documents. Qualitative analysis was carried out once all focus group sessions had taken place. A six-stage reflexive thematic analysis approach was used as outlined by Terry and Hayfield (2021). The discussions from each focus group session were studied in detail before identifying codes, themes and commonalities across the four transcripts. Throughout the analysis process, codes and themes were repeatedly adjusted to develop a robust representation of the data.

3. Results

3.1. Scenic-or-Not dataset findings

The mean scenic score of 1015 freshwater images obtained from the Scenic-or-Not dataset was 5.48 out of 10. There was a significant difference in the mean scenic scores for images taken across different seasons ($p < 0.001$; Fig. S1); scenic scores for images taken in summer were significantly higher than for images taken in winter ($p < 0.001$). The scenic scores recorded for images taken in autumn were significantly higher than winter images ($p = 0.01$). A significant difference was also observed across the mean scenic scores associated with inland blue space types ($p < 0.001$) (Fig. 1). Images that displayed waterfalls scored significantly higher scenic scores (mean = 6.74) than all other blue space types ($p < 0.001$). Lakes were associated with significantly higher scenic scores (mean = 5.32) than canals, ponds, rivers and streams ($p < 0.001$) as well as reservoirs ($p = 0.002$).

Analysis of the Places-365-CNN tags identified that specific image attributes influenced scenic ratings (Table 2). Strong significant effect sizes were observed for blue-space environments that were considered to have 'man-made' characteristics (negative effect, $d = -1.03$; $p < 0.001$) and for areas with running water (positive effect, $d = 1.03$; $p < 0.001$).

3.2. Online nationwide survey results

A total of 1015 Scottish adults completed the online survey in full (Table S1). From the three images presented (Table 1), 59.6 % of respondents rated image 2 as their favourite and 83.3 % rated image 3 as their least favourite. There was a significant difference in the scenic scores attributed to the three photos (image 1: mean = 6.61; image 2: mean = 7.14; image 3: mean = 4.38; Fig. S2; $p < 0.001$); with the scenic rating for image 3 found to be significantly lower relative to the scenic rating of images 1 and 2 ($p < 0.001$).

The mean scenic scores obtained from the survey were compared with the original score obtained from the Scenic-or-Not database. A significant difference between the survey score and the original score was only identified for image one (Survey Score = 6.81/10, Scenic-or-Not Score = 4/10, $p = 0.01$). For images 2 and 3, the larger survey population had a similar opinion of scenic rating compared to the users of the Scenic-or-Not website ($p > 0.05$).

There was a significant association between the image displayed and the respondent's ratings of the green space, weather conditions and recreational opportunity ($p < 0.001$). The environment shown in image 2 was preferred for recreation with 76.94 % of participants indicating they would visit the environment for recreational purposes (Strongly Agree and Agree category), compared to 70.24 % for image 1 and 30.04 % for image 3 (Fig. 2c). Similarly, the weather conditions and green space shown in image 2 were also preferred relative to other images. For green space, 79.11 % of respondents considered the vegetation shown in image 2 to be aesthetically pleasing as opposed to 72.41 % for image 1 and 34.77 % for image 3 (Fig. 2a). Additionally, 86.40 % of participants considered the weather conditions to be pleasant in image 2, compared with 70.02 % for image 1 and 52.02 % for image 3 (Fig. 2b).

Ordinal regression models were used to develop an understanding of the reasoning behind the scenic scores assigned to each image. Each model was adjusted for age, gender and whether the respondent lives in a rural, urban or suburban location (Table 3, 4 and 5).

With regards to green space, the ordinal regression findings indicated that individuals who agreed or strongly agreed that the green space in an image was aesthetically pleasing were significantly more likely to rate the image with a higher scenic score ($p < 0.001$; Table 3, 4 and 5). Likewise, for image 3, those who strongly disagreed that the green space was aesthetically pleasing, were significantly less likely to rate the image with a high scenic score ($p < 0.001$).

Respondents who strongly agreed that the weather conditions shown in images 1 and 2 were pleasant were significantly more likely to rate the

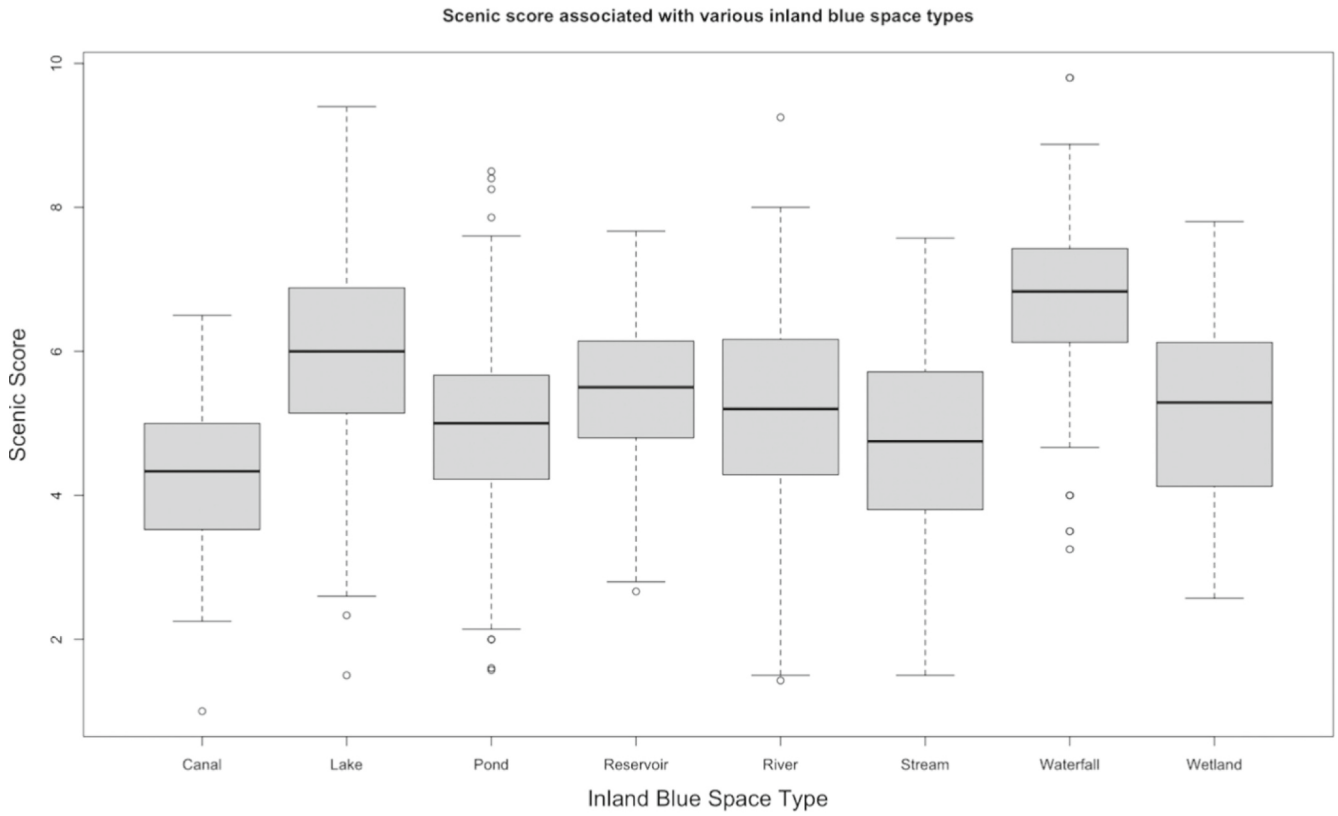


Fig. 1. Variation of scenic scores across the Scenic-or-Not dataset depending on the type of inland blue space shown in each image. Centre horizontal dash, box and whiskers represent median, interquartile range and upper and lower limits, respectively.

Table 2
Effect of key image attributes of interest on scenic scores. All image attributes were categorised by the Places-365-CNN software. The term 'man-made' in this instance refers to the presence of any infrastructure, such as bridges, roads, fences and buildings. In each case, the p-value and Cohen's d value are obtained from comparing the subset of images which contain the attribute of interest with the remaining images from the dataset which do not contain the attribute of interest.

Image attribute	Mean scenic score	Mean scenic score of photos without image attribute	Effect size - Cohen's d
Weather			
Sunny	5.28***	5.74	−0.32
Clouds	5.26	5.50	−0.17
Blue space			
Running water	6.80***	5.37	1.03
Still water	5.23***	5.59	−0.25
Green space			
Vegetation	5.43*	5.69	−0.18
Trees	5.33***	5.61	−0.2
Grass	5.15***	5.71	−0.4
Surroundings			
Man-made	4.45***	5.81	−1.03
Rugged scene	6.45***	5.27	0.86

Effect size: 0.2 = small; 0.5 = medium; 0.8 = large.
*** $p < 0.001$.
* $p < 0.05$.

image with a higher scenic score (Table 3 and 4) (image 1: OR 2.66, 95 % CI 1.51–4.7, $p < 0.001$; image 2: OR 2.34, 95 % CI 1.06–5.22, $p < 0.05$). However, the association between the weather conditions and scenic scores was weaker than that observed for green space and scenic scores. For image 3, no significant association was observed between strongly agreeing that the weather conditions were pleasant and rating the image with a higher scenic score. Respondents who strongly agreed that they would use the area for recreational purposes were significantly more likely to rank the image with a higher scenic score for images 1 and 3 ($p < 0.001$).

From responses to the Likert scale questions, Spearman's rank correlation was used to assess the relationship between willingness to use the environment for recreation and opinions on weather and green space for each image (Table 6). A positive relationship was found between rating green space as aesthetically pleasing and willingness to use the environment for recreation. Similarly, a positive relationship was found between considering the weather conditions to be pleasant and willingness to use the environment for recreation.

3.3. Focus group findings

Out of the twenty individuals who took part in the focus group sessions, most lived in a rural area. Participant demographics alongside the Scenic-or-Not images used to stimulate discussion are included in the supplementary information (Tables S1, S2 and S3). The thematic analysis of focus group discussions centred around two themes: the importance of environmental characteristics on the appearance of blue spaces; and recreational use of inland blue space.

3.3.1. Thematic analysis: environmental characteristics

Participants highlighted the overarching influence that green spaces had on scenic ratings. Green spaces that encouraged the presence of wildlife near freshwater areas were highly valued. Similarly, the presence of native plants and deciduous trees near freshwater environments were viewed positively during all focus group sessions. Participants disliked environments such as parklands, agricultural areas and forestry

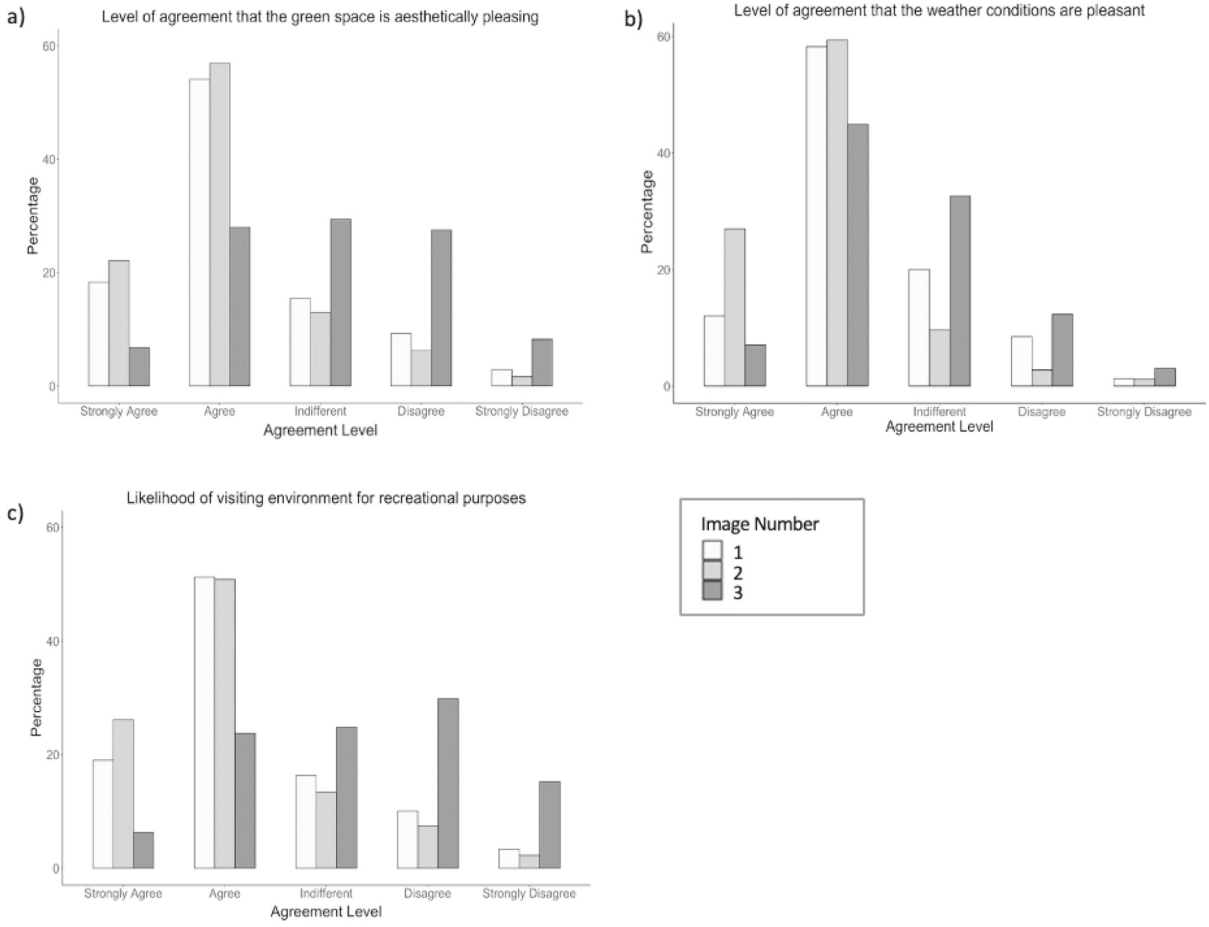


Fig. 2. Likert-scale responses for each image to three environmental statements, namely: "The grass and trees shown are aesthetically pleasing."; "The weather conditions are pleasant."; and "This is the kind of environment I would use for recreational purposes.".

which they perceived to be 'manufactured' or 'staged'. Coniferous plantations were considered to be dark, gloomy, and a blight on the landscape. When describing their ideal freshwater environment, one participant from a rural area stated they would prefer to have "*no forests around, but actual trees, nice trees" (Participant 1, Group 1, Female, 45–54)*. Another participant said they would have "*none of your pine tree nonsense" (Participant 2, Group 1, Female, 45–54)*.

Across the focus groups, there was a shared preference for areas of flowing water, rather than still or standing water. In line with this, rivers and waterfalls were highly regarded. For some, this preference arose because of the sound associated with flowing water. As one participant explained, the blue space didn't have to be "*a huge majestic waterfall but just to stand beside it, a burn that's gurgling and even a wee one, I think that's a really really peaceful place to be.*" *(Participant 3, Group 3, Female, 65–74)*.

Similar to the preference for green spaces to be natural and unmanaged, participants preferred for inland blue spaces to be unaffected by human populations. Rivers that were free to change course and meander, were regarded as scenic. Participants disliked the presence of built infrastructure that affected the course of the river or quality of the water. Pipes were associated with pollution and consequently had a negative impact on the aesthetic value of a freshwater environment. Industrial, agricultural and domestic pollution sources were frequently mentioned by participants as having a detrimental effect on freshwater areas.

During focus group 4, where individuals all had a specific interest in freshwater environments, participants highlighted how their education had altered their perception of the scenic value of blue spaces. One individual explained how they used to enjoy weirs because they provided a challenge when kayaking. However, since learning about the impact of weirs on the movement of fish and eels they no longer approve of these constructions. Participants in this focus group agreed that *"if some of the things that happened to fish and life in the river were more visible, like they would be in the countryside, then there'd be an outpouring of 'we need to do something about this'." (Participant 4, Group 4, Male, 65–74)*.

Whilst the presence of man-made constructions in natural environments was typically viewed negatively by participants, bridges were associated with benefitting blue space experiences. Bridges were regarded as adding interest to blue spaces and provided the opportunity to explore freshwater environments further.

3.3.2. Thematic analysis: the impact of environmental aesthetics on recreational use of blue space

During group discussions it became apparent that participants felt that living in the Scottish countryside provided them with better access to inland blue space. It was assumed that individuals living in urban areas or in England would not be able to benefit from the same levels of access. Rural blue spaces were regarded as high-quality environments,

Table 3
Ordinal logistic regression model for the factors influencing scenic ratings of image 1. A higher odds ratio indicates the variable contributed to a greater likelihood of a high scenic score.

Image 1				
Statement	Level of agreement	Odds ratio	2.5 %	97.5 %
Green space – *"The grass and trees shown are aesthetically pleasing"*	Strongly disagree	0.80	0.34	1.89
	Disagree	(ref)	–	–
	Indifferent	1.64*	1.03	2.63
	Agree	3.03***	1.93	4.74
	Strongly agree	4.57***	2.65	7.89
Weather – *"The weather conditions are pleasant"*	Strongly disagree	3.66*	1.15	11.99
	Disagree	(ref)	–	–
	Indifferent	1.47	0.93	2.33
	Agree	2.11**	1.35	3.29
	Strongly agree	2.66***	1.51	4.70
Recreation – *"This is the kind of environment I would use for recreational purposes"*	Strongly disagree	0.45*	0.22	0.96
	Disagree	(ref)	–	–
	Indifferent	1.05*	0.68	1.64
	Agree	1.50	1.00	2.25
	Strongly agree	2.50***	1.51	4.12

*** $p < 0.001$.
** $p < 0.01$.
* $p < 0.05$.

Table 4
Ordinal logistic regression model for the factors influencing scenic ratings of image 2. A higher odds ratio indicates the variable contributed to a greater likelihood of a high scenic score.

Image 2				
Statement	Level of agreement	Odds ratio	2.5 %	97.5 %
Green space – *"The grass and trees shown are aesthetically pleasing"*	Strongly disagree	3.16*	1.06	9.64
	Disagree	(ref)	–	–
	Indifferent	1.27	0.72	2.25
	Agree	2.99***	1.72	5.18
	Strongly agree	6.49***	3.39	12.37
Weather – *"The weather conditions are pleasant"*	Strongly disagree	0.32	0.08	1.25
	Disagree	(ref)	–	–
	Indifferent	1.17	0.53	2.57
	Agree	2.11	0.99	4.51
	Strongly agree	2.34*	1.06	5.22
Recreation – *"This is the kind of environment I would use for recreational purposes"*	Strongly disagree	0.43	0.18	1.06
	Disagree	(ref)	–	–
	Indifferent	0.79	0.47	1.34
	Agree	1.19	0.73	1.96
	Strongly agree	1.62	0.94	2.84

*** $p < 0.001$.
* $p < 0.05$.

in comparison, shopping trolleys, litter and other forms of pollution were frequently associated with urban blue spaces.

"I think we're quite fortunate in Scotland, I think if you were doing the same thing somewhere in Manchester it would be a completely different set of criteria that you're dealing with" (Participant 5, Group 3, Male, 65–74).

A key aspect that distinguished Scottish blue space from English blue space for participants was the 'right-to-roam'. The right-to-roam, introduced in the Land Reform Scotland Act (2003), is the right for

Table 5
Ordinal regression model for the factors influencing scenic ratings of image 3. A higher odds ratio indicates the variable contributed to a greater likelihood of a high scenic score.

Image 3				
Statement	Level of agreement	Odds ratio	2.5 %	97.5 %
Green space – *"The grass and trees shown are aesthetically pleasing"*	Strongly disagree	0.40***	0.24	0.65
	Disagree	(ref)	–	–
	Indifferent	1.50*	1.09	2.07
	Agree	2.35***	1.64	3.38
	Strongly agree	3.36***	1.70	6.68
Weather – *"The weather conditions are pleasant"*	Strongly disagree	2.15	1.0	4.65
	Disagree	(ref)	–	–
	Indifferent	1.29	0.88	1.89
	Agree	1.54	1.05	2.26
	Strongly agree	1.15	0.59	2.22
Recreation – *"This is the kind of environment I would use for recreational purposes"*	Strongly disagree	0.62*	0.42	0.91
	Disagree	(ref)	–	–
	Indifferent	1.61**	1.18	2.19
	Agree	1.84***	1.31	2.60
	Strongly agree	3.15***	1.64	6.08

*** $p < 0.001$.
** $p < 0.01$.
* $p < 0.05$.

Table 6
Spearman's rank correlation results for each image.

Image number	Relationship	Spearman's ρ
1	Weather and recreation	0.39***
	Greenspace and recreation	0.58***
2	Weather and recreation	0.48***
	Greenspace and recreation	0.62***
3	Weather and recreation	0.33***
	Greenspace and recreation	0.60***

Spearman's ρ: 0.01–0.19 = No or negligible relationship; 0.20–0.29 = Weak relationship; 0.30–0.39 = Moderate relationship; 0.40–0.69 = Strong relationship; ≥ 0.70 = Very strong relationship.
*** $p < 0.001$.

responsibly behaved individuals to access land and inland waters across Scotland, with a few exceptions such as quarries, railways, and farmyards. No focus-groups were directly asked about the right-to-roam; however, all four focus-groups discussed it in detail. The right is not established by law in England and participants observed the stark difference in access it created. As one participant explained; *"Well last year I was down in Coldstream and you walk across the bridge, you walk into England, the first thing you see is a sign 'private no entry'." (Participant 6, Group 3, Male, 75 years or older).*

Although participants valued the accessibility granted by the right-to-roam, they highlighted that due to landowner hostility, it was not always possible to access Scottish inland blue spaces. Landowner hostility was discussed in numerous forms, from direct confrontation with landowners to the presence of off-putting signs. A wide range of signs were reported by participants, including ones that warned of 'Bull in Field' when there was no apparent presence of cattle and ones that banned dogs from accessing footpaths. There was a strong consensus that these signs significantly impacted their blue space visits and had a detrimental impact on the appearance of environments.

Within focus-group discussions, it became evident that quiet, remote, blue space environments were highly valued. Being able to access these areas without encountering other people was regarded as a key benefit.

However, whilst participants valued quiet freshwater areas, some individuals did enjoy seeing others engage with inland blue spaces. Specific demographic groups, such as children and families were a welcome sight at freshwater areas and there was a recognition of the importance of encouraging younger generations to engage with nature. Regardless of demographic groups, if other users were behaving in what the participant's considered to be an appropriate manner, then their presence did not have a detrimental effect on the experience.

"I do enjoy the loch when you get families who've obviously come out from the city, you can tell and they've got their picnic and they've got their family and the kids are all running. I do enjoy that, yeah" (Participant 7, Group 4, Female, 65–74).

Participants found it off-putting if they saw adults who were behaving recklessly in the water, for instance using inflatables, and not wearing buoyancy aids when taking part in watersports. Additionally, those who did not respect the countryside and used disposable barbecues or littered were regarded as having a strong negative impact on the environment.

"I think in Scotland, I say as an Englishman, I think we have some of the most beautiful scenic areas that are wonderful and I would agree that they are damaged by other people's lack of care really" (Participant 8, Group 2, Male, 25–34).

There was a general consensus that the most appropriate way to encourage greater access to freshwater environments would be through increased public transport and investment in appropriate transport infrastructure. Two focus groups discussed public transport in detail and emphasised the significant repercussions they felt government funding restrictions had on access to the Scottish countryside. Yosemite Valley was highlighted as an example of a natural area where the effective introduction of shuttle buses has enabled visitors to access the area without the use of cars.

4. Discussion

Through the application of a mixed-methods research approach, this study has provided detailed layered insight into the subjective nature of aesthetic preferences for blue space environments. The analysis of the Scenic-or-Not dataset alongside the application of an online survey and focus group sessions enabled a triangulation of research findings and demonstrated the significant impact of environmental characteristics on the aesthetic value of blue spaces. Three key factors were considered, namely weather conditions, blue space characteristics and nearby green space. However, the combination of research methods enabled aesthetic appeal to be considered from multiple perspectives and highlighted an extensive range of additional environmental factors that can impact the appearance and enjoyment of inland blue spaces (Fig. 3).

Research into environmental psychology suggests that humans exhibit an inherent preference for specific types of environments; preferences can however alter across time and are dependent on a range of factors including cultural and societal factors as well as familiarity with landscapes (Hartmann and Apaolaza-Ibáñez, 2010; Moura et al., 2018; Falk and Balling, 2009; Townsend and Barton, 2018). Over the past two

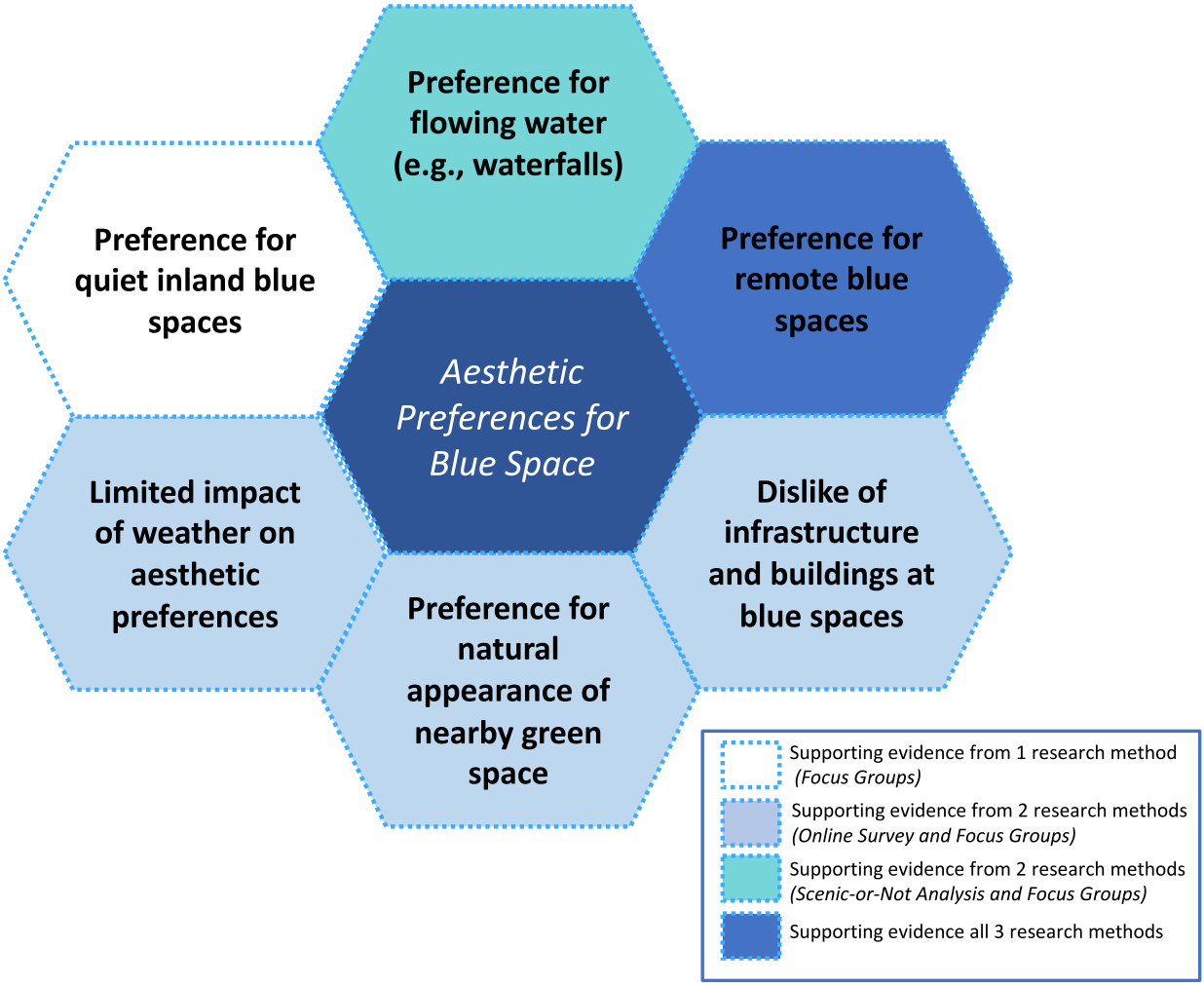


Fig. 3. Triangulation of key findings from the three research methods used in the mixed-methods research approach.

decades, key factors that may have altered environmental preferences are the onset of the Anthropocene and consequently the effects of climate change (Auer, 2019; McCumber and Davis, 2022). With higher population densities and greater awareness of human impact on natural environments, there is growing interest in visiting environments which are perceived as 'isolated' or 'remote' (Chylińska, 2022; McCumber and Davis, 2022). The results from the current study further highlight the significant value attributed to remote blue space environments, with the Scenic-or-Not data-analysis and the nationally representative online survey illustrating this broad trend. Qualitative insight gained from focus group sessions also indicates that rural blue spaces with lower levels of human impact, are highly valued. However, given the tendency for environmental preferences to evolve, further longitudinal research would help to assess the extent that environmental preferences for blue spaces alter and the effect this has on recreational use. Social media data analytics are one research method that offers the potential to effectively track changes in public perception of landscape aesthetics over time and space (Havinga et al., 2021).

Despite the increasing recognition that environmental aesthetics can evolve over time, land use planning strategies have remained comparatively stagnant. As demonstrated by the thematic analysis, participants would not actively choose to visit 'manufactured' blue space environments. This reflects the challenge of successfully integrating nature and biodiversity into built-up areas (Hernandez-Santin et al., 2023). The incorporation of natural environments within cities typically provides 'passive beauty', following similar landscape designs regardless of the geographical and cultural context (Laurian et al., 2022). The current research findings, alongside previous research, demonstrate that blue space management strategies should incorporate a degree of re-wilding, through allowing greater freedom for ecological processes, such as enabling waterbodies to change shape and nearby vegetation to grow (Brierley et al., 2022; Usher et al., 2020). This will not only provide ecological benefits, but may also improve aesthetic appearance, helping to provide positive health-related exposure outcomes (Milligan, 2022; Brierley et al., 2023; Usher et al., 2020). Re-wilding, however, incorporates a broad spectrum of land-use changes; equally broad are the emotional responses to re-wilding projects (Tanasescu, 2017; Wynne-Jones, 2022). Often when discussing re-wilding, participants were referring to smaller-scale blue space changes that they perceived to be aesthetically pleasing, such as growing native trees. Future research should focus on the practicalities of developing land-use management strategies to sustainably align aesthetic preferences with ecological benefits.

The research findings from the online survey and focus groups demonstrated a strong relationship between the appearance of nearby green space and the environmental appeal of inland blue space. However, results from the Scenic-or-Not data analysis were less consistent, with trees, grass and vegetation all found to have a negative effect on scenic scores. This discrepancy between the three data collection methods is likely because the Places-365-CNN software, used to test for the presence of green space in the Scenic-or-Not dataset analysis, cannot determine green-space quality or biodiversity levels. The quality of green spaces, in terms of diversity of species and the presence of litter, can have a significant impact on perceptions and use of natural environments, with members of the public willing to pay to preserve waterside environments (McDougall et al., 2020; Talal et al., 2021; Arnberger and Eder, 2015; Luo et al., 2021). The focus group findings demonstrated the importance of high quality nearby green space for creating scenic inland blue space environments, with the presence of native species and a high biodiversity of plants being strongly valued by participants. In line with this, the BlueHealth Environmental Assessment Tool (BEAT) for comparing the quality of blue space environments, places a strong emphasis on the importance of vegetation for determining the overall quality of blue spaces (Mishra et al., 2021).

The fluidity of water has previously been ascribed as one of the key aspects contributing to the therapeutic nature of blue spaces; with areas of flowing water like rivers and canals associated with positive well-being outcomes (Strang, 2006; Pitt, 2018; McDougall et al., 2022; Volker and Kistemann, 2013; Vaeztavakoli et al., 2018). Findings from this research demonstrate that while flowing waterbodies in general were highly valued, meandering rivers and waterfalls were preferred. The aesthetic appeal of waterfalls has been extensively explored in arts and literary fiction, and the economic benefits of these areas in terms of tourism are clear (Hudson, 2000; Hudson, 2006; Haghe, 2011; Oyelami et al., 2023); however, inland blue space research has not yet focused on waterfalls in detail. Given the positive response to images of waterfalls, further research into the potential health benefits associated with exposure to waterfalls is now warranted. Additional research will help to better inform blue space management strategies and create greater opportunities utilizing dynamic environmental management strategies at inland blue spaces.

Alongside the type of inland blue space, the perceived quality of the water was also important to focus-group participants. Frequency of recreational visits to blue spaces have been linked with water quality and pollution levels (Börger et al., 2021; Tienhaara et al., 2021). Similarly, high levels of pollution and the presence of litter in the water were identified as key factors that would deter participants from visiting a blue space environment. Most focus group participants lived in rural Scotland and felt this provided them with a clear advantage in terms of access to high quality blue space environments. Participants suggested that urban blue spaces were more likely to be polluted than their rural counterparts. Globally, urban waters have been shown to contain high levels of water pollution (Davis et al., 2022; McGrane, 2016; Hasan et al., 2021). However, there is a lack of blue space research into urban and rural differences in terms of relative access to and usage of high-quality blue space environments. This form of research would be particularly beneficial in Scotland, where public transport is limited in rural areas and so access to a car can significantly affect an individual's ability to visit natural environments. To assess the extent of environmental injustices, it would be worthwhile comparing perceptions of urban and rural inland blue spaces with a varied sample group from rural, urban and suburban areas.

In contrast to other environmental characteristics, such as the quality of green and blue space, focus group participants only briefly discussed the impact of weather conditions. Similarly, the weather conditions had a lesser effect on online survey respondents' willingness to visit an environment for recreational purposes than the appearance of nearby green space did. Previous research has identified that sunshine and warm weather, increases the aesthetic value of blue spaces and can encourage visitors (Grzyb and Kulczyk, 2023; White et al., 2014). However, given the complex range of weather conditions and the subjective opinions associated with them, further research is required to assess the relative importance of weather on blue space experiences and aesthetic appeal. It would be beneficial to deploy in-situ methodologies such as walking interviews and ethnography to gain detailed insight into the dynamic impact of weather conditions on blue space experiences.

The Scenic-or-Not dataset analysis and online survey provided insight into the relative importance of environmental characteristics, such as green space quality, on the aesthetic appeal of inland blue spaces. The discussions from the focus group sessions further emphasised the impact of these environmental characteristics; however, they also highlighted the multi-dimensional nature of blue space experiences. Furthermore, while environmental aesthetics impacted participants willingness to visit blue spaces, their personal experiences informed repeat visits. The sounds associated with an environment such as the noise of cars and wildlife had a significant impact on participants' experience. Peaceful and quiet landscapes were preferred, aligning with the significant body of research documenting natural and quiet soundscapes as valuable environmental characteristics for promoting well-being outcomes (Pijanowski et al., 2011; Thorne and Shepherd, 2013; Uebel et al., 2022). In addition to soundscapes, interactions with other blue space users also had an impact, with hostile landowners cited as a

key factor contributing to negative experiences. Green space research has highlighted how due to socio-cultural relations different parks can be perceived as belonging to a specific community group, thus deterring other groups from using the environment (Collier, 2022; Hoffimann et al., 2017). The majority of blue space research investigating environmental injustices has so far focused on urban areas, documenting the significant impact of socioeconomic status on blue space access (Wessells, 2014; Haeffner et al., 2017; Korpilo et al., 2021). This current research highlights the need to assess the influence of power-dynamics in determining access to rural blue spaces.

Whilst the three-phase data collection approach provided novel insight into inland blue space aesthetic preferences, the limitations of the research should be acknowledged. Since environmental aesthetics are highly subjective and dependent on various cultural factors, the findings may not be generalisable to other contexts (Keleg et al., 2021). Additionally, as highlighted by focus group participants, there is an inherent limitation in the ability of a photograph to portray the nuances of an environment. Soundscapes, wildlife, and the presence of others all influence the overall appeal of an environment (Uebel et al., 2022; Fisher et al., 2021). Therefore, complementary future research into aesthetic preferences for inland blue spaces could focus on the application of in-situ methodologies, such as walking interviews, to capture the multisensory nature of inland blue spaces.

5. Conclusion

This study contributes important findings to a growing inland blue space evidence base by providing detailed insight into public perceptions on the appearance of freshwater environments. Whilst a diverse range of environmental preferences were recorded across the three data collection methods, key commonalities emerged. In relation to both the blue space and the surrounding green space, there was a common preference for natural environments that were not overly managed, and which were unaffected by pollution. The current research findings indicate that there is a need to preserve the quality of blue spaces to ensure that exposure to these environments continues to provide individuals with positive mental and physical health outcomes. In addition to this, sustainable blue space planning and management strategies should be introduced to re-wild aspects of urban and suburban blue spaces to increase the aesthetic appeal of these environments and encourage individuals to use inland blue spaces for recreational purposes.

CRediT authorship contribution statement

Conceptualisation: MJG, PJB, CB, JD, DMO. Methodology: MJG, PJB, CB, JD, DMO. Formal analysis: MJG. Writing – Original Draft: MJG. Writing – Review & Editing: MJG, PJB, CB, JD, DMO. Supervision – DMO.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

The IAPETUS Doctoral Training Partnership provided funding to support this research, with additional CASE support funding provided by the Scottish Environment Protection Agency. We would like to thank all survey respondents and focus group participants for their contributions to the project.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.scitotenv.2023.166283.

References

Arnberger, A., Eder, R., 2015. Are urban visitors' general preferences for green-spaces similar to their preferences when seeking stress relief? Urban For. Urban Green. 14 (4), 872–882. https://doi.org/10.1016/j.ufug.2015.07.005.

Auer, M.R., 2019. Environmental aesthetics in the age of climate change. Sustainability 11 (18).

Ball, K., Bauman, A., Leslie, E., Owen, N., 2001. Perceived environmental aesthetics and convenience and company are associated with walking for exercise among Australian adults. Prev. Med. 33, 434–440. https://doi.org/10.1006/pmed.2001.0912.

Beute, F., Davies, Z., de Vries, S., Glanville, J., Keune, H., Lammel, A., Andreucci, M., B., 2020. A Report of the EKLIPSE Expert Working Group on Biodiversity and Mental Health to Provide Recommendations for the Conservation, Planning, Design, and Management of Urban Green and Blue Infrastructures. U. C. f. E. Hydrology.

Börger, T., Campbell, D., White, M.P., Elliott, L.R., Fleming, L.E., Garrett, J.K., Taylor, T., 2021. The value of blue-space recreation and perceived water quality across Europe: a contingent behaviour study. Sci. Total Environ. 771, 145597 https://doi.org/10.1016/j.scitotenv.2021.145597.

Brierley, G., Fuller, I., Williams, G., Hikuroa, D., Tilley, A., 2022. Re-imagining wild rivers in Aotearoa New Zealand. Land 11 (8).

Brierley, G.J., Hikuroa, D., Fuller, I.C., Tunnicliffe, J., Allen, K., Brasington, J., Measures, R., 2023. Reanimating the strangled rivers of Aotearoa New Zealand. WIREs Water 10 (2), e1624. https://doi.org/10.1002/wat2.1624.

Brückner, A., Falkenberg, T., Heinzel, C., Kistemann, T., 2022. The regeneration of urban blue spaces: a public health intervention? Reviewing the evidence [policy and practice reviews]. Front. Public Health 9. https://doi.org/10.3389/fpubh.2021.782101.

Chylińska, D., 2022. Escape? But where? About 'escape tourism'. Tour. Stud. 22 (3), 262–289. https://doi.org/10.1177/14687976221092220.

Collier, B., 2022. Not my green space? White attitudes towards black presence in UK green spaces. An auto-ethnography. In: Plüschke-Altof, B., Sooväli-Sepping, H. (Eds.), Whose Green City?: Contested Urban Green Spaces and Environmental Justice in Northern Europe. Springer International Publishing, pp. 41–58. https://doi.org/10.1007/978-3-031-04636-0_3.

Ćwik, A., Wójcik, T., Ziaja, M., Wójcik, M., Kluska, K., Kasprzyk, I., 2021. Ecosystem services and disservices of vegetation in recreational urban blue-green spaces—some recommendations for greenery shaping. Forests 12 (8).

Data Science Lab, 2009. Scenic Or Not. Rate Great Britain's Pretty Places. Data Science Lab. https://scenicornot.datasciencelab.co.uk.

Davis, L.J., Milligan, R., Stauber, C.E., Jelks, N.T.O., Casanova, L., Ledford, S.H., 2022. Environmental injustice and Escherichia coli in urban streams: potential for community-led response. WIREs Water 9 (3), e1583. https://doi.org/10.1002/wat2.1583.

Elliott, L.R., White, M.P., Sarran, C., Grellier, J., Garrett, J.K., Scoccimarro, E., Fleming, L.E., 2019. The effects of meteorological conditions and daylight on nature-based recreational physical activity in England. Urban For. Urban Green. 42, 39–50. https://doi.org/10.1016/j.ufug.2019.05.005.

Falk, J.H., Balling, J.D., 2009. Evolutionary influence on human landscape preference. Environ. Behav. 42 (4), 479–493. https://doi.org/10.1177/0013916509341244.

Fisher, J.C., Irvine, K.N., Bicknell, J.E., Hayes, W.M., Fernandes, D., Mistry, J., Davies, Z. G., 2021. Perceived biodiversity, sound, naturalness and safety enhance the restorative quality and wellbeing benefits of green and blue space in a neotropical city. Sci. Total Environ. 755 (13), 143095. https://doi.org/10.1016/j.scitotenv.2020.143095.

Garrett, J.K., White, M.P., Huang, J., Ng, S., Hui, Z., Leung, C., Wong, M.C.S., 2019. Urban blue space and health and wellbeing in Hong Kong: results from a survey of older adults. Health Place 55, 100–110. https://doi.org/10.1016/j.healthplace.2018.11.003.

Grzyb, T., Kulczyk, S., 2023. How do ephemeral factors shape recreation along the urban river? A social media perspective. Landsc. Urban Plan. 230, 104638 https://doi.org/10.1016/j.landurbplan.2022.104638.

Haeffner, M., Jackson-Smith, D., Buchert, M., Risley, J., 2017. Landscape and urban planning. Landsc. Urban Plan. 167, 136–146. https://doi.org/10.1016/j.landurbplan.2017.06.008.

Haghe, J.-P., 2011. Do waterfalls have value in themselves? A metamorphosis in the values of the Gimel waterfall in France. Polic. Soc. 30 (4), 249–256. https://doi.org/10.1016/j.polsoc.2011.10.008.

Hartmann, P., Apaolaza-Ibáñez, V., 2010. Beyond savanna: an evolutionary and environmental psychology approach to behavioral effects of nature scenery in green advertising. J. Environ. Psychol. 30 (1), 119–128. https://doi.org/10.1016/j.jenvp.2009.10.001.

Hasan, M.F., Nur-E-Alam, M., Salam, M.A., Rahman, H., Paul, S.C., Rak, A.E., Towfiqul Islam, A.R.M., 2021. Health risk and water quality assessment of surface water in an urban river of Bangladesh. Sustainability 13 (12).

Havinga, I., Marcos, D., Bogaart, P.W., Hein, L., Tuia, D., 2021. Geo-data for mapping scenic beauty: exploring the potential of remote sensing and social media. In: 2021 IEEE International Geoscience and Remote Sensing Symposium IGARSS, 11–16 July 2021.
Hernandez-Santin, C., Amati, M., Bekessy, S., Desha, C., 2023. Integrating biodiversity as a non-human stakeholder within urban development. Landsc. Urban Plan. 232, 104678 https://doi.org/10.1016/j.landurbplan.2022.104678.
Hoffimann, E., Barros, H., Ribeiro, A.I., 2017. Socioeconomic inequalities in green space quality and accessibility—evidence from a southern European City. Int. J. Environ. Res. Public Health 14 (8).
Hoyle, H., Hitchmough, J., Jorgensen, A., 2017. All about the 'wow factor'? The relationships between aesthetics, restorative effect and perceived biodiversity in designed urban planting. Landsc. Urban Plan. 164, 109–123. https://doi.org/10.1016/j.landurbplan.2017.03.011.
Hudson, B.J., 2000. The experience of waterfalls. Aust. Geogr. Stud. 38 (1), 71–84. https://doi.org/10.1111/1467-8470.00101.
Hudson, B.J., 2006. Waterfalls, tourism and landscape. Geography 91 (1), 3–12. https://doi.org/10.1080/00167487.2006.12094145.
Jahani, A., Saffariha, M., Barzegar, P., 2022. Landscape aesthetic quality assessment of forest lands: an application of machine learning approach. Soft. Comput. 27 https://doi.org/10.1007/s00500-022-07642-3.
Keleg, M., Butina Watson, G., Salheen, M.A., 2021. The path to resilience: change, landscape aesthetics, and socio-cultural identity in rapidly urbanising contexts. The case of Cairo, Egypt. Urban For. Urban Green. 65, 127360 https://doi.org/10.1016/j.ufug.2021.127360.
Korpilo, S., Kajosaari, A., Rinne, T., Hasanzadeh, K., Raymond, C.M., Kyttä, M., 2021. Coping with crisis: green space use in Helsinki before and during the COVID-19 pandemic [original research]. Front. Sustain. Cities 3. https://doi.org/10.3389/frsc.2021.713977.
Langemeyer, J., Calcagni, F., Baro, F., 2018. Mapping the intangible: using geolocated social media data to examine landscape aesthetics [Article] Land Use Policy 77, 542–552. https://doi.org/10.1016/j.landusepol.2018.05.049.
Laurian, L.A., Sternberg, E., Voigt da Mata, N., 2022. The transgressive urban forest. J. Am. Plan. Assoc. 88 (3), 405–412. https://doi.org/10.1080/01944363.2021.1975556.
Lengen, C., 2015. The effects of colours, shapes and boundaries of landscapes on perception, emotion and mentalising processes promoting health and well-being. Health Place 35, 166–177. https://doi.org/10.1016/j.healthplace.2015.05.016.
Luo, S., Xie, J., Furuya, K., 2021. Assessing the preference and restorative potential of urban park blue space. Land 10 (11). https://doi.org/10.3390/land10111233.
McCumber, A., Davis, A., 2022. Elite environmental aesthetics: placing nature in a changing climate. Am. J. Cult. Sociol. https://doi.org/10.1057/s41290-022-00179-w.
McDougall, C.W., Hanley, N., Quilliam, R.S., Needham, K., Oliver, D.M., 2020. Valuing inland blue space: a contingent valuation study of two large freshwater lakes [article]. Sci. Total Environ. 715 (13), 136921 https://doi.org/10.1016/j.scitotenv.2020.136921.
McDougall, C.W., Hanley, N., Quilliam, R.S., Bartie, P.J., Robertson, T., Griffiths, M., Oliver, D.M., 2021. Neighbourhood blue space and mental health: a nationwide ecological study of antidepressant medication prescribed to older adults. Landsc. Urban Plan. 214, 104132 https://doi.org/10.1016/j.landurbplan.2021.104132.
McDougall, C.W., Hanley, N., Quilliam, R.S., Oliver, D.M., 2022. Blue space exposure, health and well-being: does freshwater type matter? Landsc. Urban Plan. 224, 104446 https://doi.org/10.1016/j.landurbplan.2022.104446.
McGrane, S.J., 2016. Impacts of urbanisation on hydrological and water quality dynamics, and urban water management: a review. Hydrol. Sci. J. 61 (13), 2295–2311. https://doi.org/10.1080/02626667.2015.1128084.
Milligan, B., 2022. Accelerated and decelerated landscapes. Places. https://doi.org/10.22269/220208. February 2022.
Mishra, H.S., Bell, S., Grellier, J., White, M.P., 2021. Testing the reliability and effectiveness of a new tool for assessing urban blue spaces: the BlueHealth environmental assessment tool (BEAT). Health Place 68, 102526. https://doi.org/10.1016/j.healthplace.2021.102526.
Moura, J.M.B., Ferreira Júnior, W.S., Silva, T.C., Albuquerque, U.P., 2018. The influence of the evolutionary past on the mind: an analysis of the preference for landscapes in the human species. Front. Psychol. 9 https://doi.org/10.3389/fpsyg.2018.02485.
Oyelami, C.A., Kolawole, T.O., Kolawole, M.S., Olaonipekun, Z., Ogundana, A.K., 2023. Evaluation of three geosites within ilesha schist belt Southwest Nigeria as a potential geoheritage site for sustainable regional development. Geoheritage 15 (2), 48. https://doi.org/10.1007/s12371-023-00818-9.
Pijanowski, B.C., Farina, A., Gage, S.H., Dumyahn, S.L., Krause, B.L., 2011. What is soundscape ecology? An introduction and overview of an emerging new science. Landsc. Ecol. 26 (9), 1213–1232. https://doi.org/10.1007/s10980-011-9600-8.
Pitt, H., 2018. Muddying the waters: what urban waterways reveal about bluespaces and wellbeing. Geoforum 92, 161–170. https://doi.org/10.1016/j.geoforum.2018.04.014.
Satariano, B., 2022. Recreating a therapeutic blue urban space through the architectural restoration of the Triton Fountain in Valletta, Malta. Cities Health 6 (6), 1094–1105. https://doi.org/10.1080/23748834.2020.1863105.
Seresinhe, C.I., Preis, T., Moat, H.S., 2015. Quantifying the impact of scenic environments on health. Sci. Rep. 5 (1), 16899. https://doi.org/10.1038/srep16899.
Seresinhe, C.I., Preis, T., MacKerron, G., Moat, H.S., 2019. Happiness is greater in more scenic locations. Sci. Rep. 9 (1), 4498. https://doi.org/10.1038/s41598-019-40854-6.
Smith, N., Georgiou, M., King, A.C., Tieges, Z., Chastin, S., 2022. Factors influencing usage of urban blue spaces: a systems-based approach to identify leverage points. Health Place 73, 102735. https://doi.org/10.1016/j.healthplace.2021.102735.
Strang, V., 2006. Introduction: fluidscapes: water, identity and the senses. Worldviews 10 (2), 147–154.
Talal, M.L., Santelmann, M.V., Tilt, J.H., 2021. Urban park visitor preferences for vegetation – an on-site qualitative research study. Plants People Planet 3 (4), 375–388. https://doi.org/10.1002/ppp3.10188.
Tanasescu, M., 2017. Field notes on the meaning of rewilding. Ethics Policy Environ. 20 (3), 333–349. https://doi.org/10.1080/21550085.2017.1374053.
Terry, G., Hayfield, N., 2021. Essentials of Thematic Analysis. American Psychological Association, Washington DC.
Thorne, R., Shepherd, D., 2013. Quiet as an environmental value: a contrast between two legislative approaches. Int. J. Environ. Res. Public Health 10 (7), 2741–2759.
Tieges, Z., McGregor, D., Georgiou, M., Smith, N., Saunders, J., Millar, R., Chastin, S., 2020. The impact of regeneration and climate adaptations of urban green-blue assets on all-cause mortality: a 17-year longitudinal study. Int. J. Environ. Res. Public Health 17(12), Article 4577. https://doi.org/10.3390/ijerph17124577.
Tienhaara, A., Lankia, T., Lehtonen, O., Pouta, E., 2021. Heterogeneous preferences towards quality changes in water recreation: latent class model for contingent behavior data. J. Outdoor Recreat. Tour. 35, 100386 https://doi.org/10.1016/j.jort.2021.100386.
Townsend, J.B., Barton, S., 2018. The impact of ancient tree form on modern landscape preferences. Urban For. Urban Green. 34, 205–216. https://doi.org/10.1016/j.ufug.2018.06.004.
Uebel, K., Rhodes, J.R., Wilson, K., Dean, A.J., 2022. Urban park soundscapes: spatial and social factors influencing bird and traffic sound experiences. People Nat. 4 (6), 1616–1628. https://doi.org/10.1002/pan3.10409.
Usher, M., Huck, J., Clay, G., Shuttleworth, E., Astbury, J., 2020. Broaching the brook: daylighting, community and the 'stickiness' of water. Environ. Plan. E: Nat. Space 4 (4), 1487–1514. https://doi.org/10.1177/2514848620959589.
Vaeztavakoli, A., Lak, A., Yigitcanlar, T., 2018. Blue and green spaces as therapeutic landscapes: health effects of urban water canal areas of Isfahan. Sustainability 10 (11), 4010. https://doi.org/10.3390/su10114010.
Vert, C., Nieuwenhuijsen, M., Gascon, M., Grellier, J., Fleming, L.E., White, M.P., Rojas-Rueda, D., 2019. Health benefits of physical activity related to an urban riverside regeneration. Int. J. Environ. Res. Public Health 16(3), Article 462. https://doi.org/10.3390/ijerph16030462.
Volker, S., Kistemann, T., 2013. "I'm always entirely happy when I'm here!" Urban blue enhancing human health and well-being in Cologne and Dusseldorf, Germany. Soc. Sci. Med. 78, 113–124. https://doi.org/10.1016/j.socscimed.2012.09.047.
Wagner, A.L., Keusch, F., Yan, T., Clarke, P.J., 2019. The impact of weather on summer and winter exercise behaviors. J. Sport Health Sci. 8 (1), 39–45. https://doi.org/10.1016/j.jshs.2016.07.007.
Wessells, A.T., 2014. Urban blue space and "the project of the century": doing justice on the Seattle waterfront and for local residents. Buildings 4 (4), 764–784.
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. J. Environ. Psychol. 30 (4), 482–493. https://doi.org/10.1016/j.jenvp.2010.04.004.
White, M.P., Cracknell, D., Corcoran, A., Jenkinson, G., Depledge, M.H., 2014. Do preferences for waterscapes persist in inclement weather and extend to sub-aquatic scenes? Landsc. Res. 39 (4), 339–358. https://doi.org/10.1080/01426397.2012.759919.
White, M.P., Elliott, L.R., Gascon, M., Roberts, B., Fleming, L.E., 2020. Blue space, health and well-being: a narrative overview and synthesis of potential benefits. Environ. Res. 191, 110169 https://doi.org/10.1016/j.envres.2020.110169.
Williams, J.B., Jose, R., Moobela, C., Hutchinson, D.J., Wise, R., Gaterell, M., 2019. Residents' perceptions of sustainable drainage systems as highly functional blue green infrastructure. Landsc. Urban Plan. 190, 103610 https://doi.org/10.1016/j.landurbplan.2019.103610.
Wu, C., He, X., 2021. Environmental aesthetic value influences the intention for moral behavior: changes in behavioral moral judgment. Int. J. Environ. Res. Public Health 18 (12). https://doi.org/10.3390/ijerph18126477.
Wynne-Jones, S., 2022. Rewilding: an emotional nature. Area 00, 1–9. https://doi.org/10.1111/area.12810.
Zhang, H., Nijhuis, S., Newton, C., 2022. Freshwater blue space design and human health: a comprehensive research mapping based on scientometric analysis. Environ. Impact Assess. Rev. 97, 106859 https://doi.org/10.1016/j.eiar.2022.106859.
Zhou, B., Lapedriza, A., Khosla, A., Oliva, A., Torralba, A., 2017. Places: A 10 Million Image Database for Scene Recognition. IEEE Transactions on Pattern Analysis and Machine Intelligence.