RESEARCH ARTICLE

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A place-based participatory mapping approach for assessing cultural ecosystem services in urban green space

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Abstract

1. Cultural Ecosystem Services (CES) encompass a range of social, cultural and health benefits to local communities, for example recreation, spirituality, a sense of place and local identity. However, these complex and place-specific CES are often overlooked in rapid land management decisions and assessed using broad, top–down approaches.

2. We use the Toolkit for Ecosystem Service Site-based Assessment (TESSA) to examine a novel approach to rapid assessment of local CES provision using inductive, participatory methods. We combined free-listing and participatory geographic information systems (GIS) techniques to quantify and map perceptions of current CES provision of an urban green space. The results were then statistically compared with those of a proposed alternative scenario with the aim to inform future decision-making.

3. By identifying changes in the spatial hotspots of CES in our study area, we revealed a spatially specific shift towards positive sentiment regarding several CES under the alternative state with variance across demographic and stakeholder groups. Response aggregations in areas of proposed development reveal previously unknown stakeholder preferences to local decision-makers and highlight potential trade-offs for conservation management. Free-listed responses revealed deeper insight into personal opinion and context.

4. This work serves as a useful case study on how the perceptions and opinions of local people regarding local CES could be accounted for in the future planning of an urban greenspace and how thorough analysis of CES provision is important to fully inform local-scale conservation and planning for the mutual benefit of local communities and nature.

KEYWORDS
CES, chalk stream, cultural benefits, decision-making, perceptions, TESSA

1 | INTRODUCTION

Green spaces are crucial features in urban environments, providing local communities access to a variety of benefits from ecosystem services, derived from natural processes (Dickinson & Hobbs, 2017; Maller et al., 2009; MEA, 2005). While research into the use, conservation and management of ecosystem services has proliferated in the last 20 years and much of the focus has been on more easily quantified services such as provisioning (e.g. food, raw materials) and regulating services (e.g. air and water quality, pollination; Bennett, Peterson, & Gordon, 2009; Costanza et al., 1997; Nelson et al., 2009), whereas cultural ecosystem services have received less attention (Chan, Satterfield, & Goldstein, 2012; Queiroz et al., 2017; Tew, Simmons, & Sutherland, 2019). Cultural Ecosystem Services (CES) can be defined as the benefits arising from a mutualistic relationship of culture, heritage and the environment, including cultural identity and heritage, spirituality and religion, inspiration and aesthetic appreciation as well as more marketable recreation and tourism benefits (MEA, 2005).

While urban green spaces provide a rich variety of biological and anthropogenic ecosystem services, research has indicated that access to green space has significant positive effects on social cohesion, cultural memory, health and well-being benefits associated with the residents' lived experience in the urban areas (Cox, Shanahan, Hudson, Fuller, & Gaston, 2018; Hartig et al., 2011; Pereira et al., 2013; Soga & Gaston, 2016). The development of connections to nature in an age of rapid urbanisation is increasingly important for supporting local peoples' physical and mental well-being and enhancing quality of life (Cox et al., 2018; Maas, Verheij, Groenewegen, Vries, & Spreeuwenberg, 2006; Shanahan et al., 2017). However, evidence suggests that connectedness to nature is diminishing, especially in urbanizing regions, leading to an ongoing 'extinction of experience' of the natural world and the cultural benefits that accompany it (Soga, Gaston, Koyanagi, Kurisu, & Hanaki, 2016; Soga, Gaston, Yamaura, Kurisu, & Hanaki, 2016). The so-called 'nature-deficit disorder' has been found to incur negative effects on human health, well-being and overall happiness, with indirect impacts on conservation interest (Alfonso, Zorondo-Rodríguez, & Simonetti, 2016; Louv, 2005). The links between connectedness to nature, well-being and conservation exemplify the often unnoticed importance of urban green spaces in our everyday lives and the need for quantifying CES provided by green space for better management of urban land (Raymond, Giusti, & Barthel, 2018).

Management efforts to maintain and improve urban green spaces are often carried out to enhance the visitors' experience, with increasing interest in the effect on ecosystem service provision for the benefit of local communities. Rapid assessment of ecosystem services is required to make efficient, balanced and effective management decisions at a site-scale, especially under economic and time pressures. However, CES is particularly challenging to measure using traditional techniques as it departs from the original linear ecosystem service framework (Chan et al., 2011). While market-based valuations are insufficient for capturing the

Research highlights

1. Urban greenspaces are increasingly important sources of cultural ecosystem services.
2. Perceptions and personal value of CES are locally specific and heterogeneous.
3. Local-scale, participatory research is crucial to understand cultural context.
4. Future management should aim to conserve CES for all stakeholders and minimize potential trade-offs.

full range of social values, qualitative methods also often lack robust statistical analysis or a spatial element (Milcu, Hanspach, Abson, & Fischer, 2013). To solve the problem of quantifying and mapping CES on a fine scale, there has been significant interest in creating novel methods. This includes the use of social media photographs with geo-tagging (Guerrero, Møller, Olafsson, & Snizek, 2016; Oteros-Rozas, Martin-Lopez, Fagerholm, Bieling, & Plieninger, 2018; Richards & Friess, 2015), and participatory methods such as participatory geographic information systems (PPGIS) techniques (Rall, Hansen, & Pauleit, 2019; Tew et al., 2019; Viirret, Raatikainen, Fagerholm, Käyhkö, & Vihervaara, 2019), as well as and experiential methods, designed to collect the personal intensity of CES experience on a spatial plane (Teff-Seker & Orenstein, 2018). A move towards spatial, participatory techniques for practical CES assessment framework will allow land managers to match cultural values to landscape characteristics and assess how they are impacted by different management options.

Our study aims to explore management options to control the levels of the River Itchen at its tidal confluence within Riverside Park in Southampton, UK The flow of the Itchen into the estuary is currently controlled by a sluice gate which has reached a critical condition and is no longer economically viable to maintain. Working alongside the Environment Agency, we aimed to provide a rapid comparative assessment of the CES for Southampton's Riverside Park, comparing the current state and a proposed alternative management option. The proposed alternative management option centres around the decommissioning of the sluice gate and conservation of the significant local cultural, economic and environmental importance of Riverside Park and the River Itchen as a chalk stream habitat. To achieve this, we adopted the Toolkit for Ecosystem Service Site-based Assessment (TESSA) for rapid assessment of cultural ecosystem service provision by the park in its current state and in its most plausible alternative state under a different management option (Peh et al., 2013, 2017). TESSA was selected over alternative tools as a low-cost written step-by-step approach with a dedicated section focussed on CES assessment which was specifically designed for comparing the impact of contrasting scenarios at the site scale (Neugarten et al., 2018). Following several previous CES studies (Fagerholm, Käyhkö, Ndumbaro, & Khamis, 2012; Fish et al., 2016; Klain & Chan, 2012), we used a place-based inductive, participatory mapping approach that

complements the language, values and knowledge of the local population to gain perspective and context of their perceptions of both states. Participation of local residents was essential given the social importance of the park to them, fulfilling the previous recommendations for iterative frameworks for participatory engagement (Chan et al., 2012; Dickinson & Hobbs, 2017).

2 | MATERIALS AND METHODS

2.1 | Study area

Riverside Park (hereafter 'the park') comprises a 32-hectare public green space situated along the River Itchen, found within the greater Bitterne Park area in Southampton, Hampshire (50.933853, −1.374796), UK. The park contains diverse public facilities (playing fields, children playground, carpark, etc.), and is managed by Southampton City Council. As a chalk stream, the River Itchen is designated as a Special Area of Conservation (SCA) and a Site of Special Scientific Interest (SSSI), recognized as an important freshwater habitat for many rare species. The River Itchen is of great cultural importance owing to its aesthetic quality with 'gin-clear waters' (Vallings, 1885), diverse wildlife and iconic local heritage accessible via the Itchen Navigation Trail. The Trail follows the Itchen for 17 km from the headwaters through its termination in Riverside Park. Angling rights upon the approximately 1 km section of the River Itchen are managed by the UK Environment Agency (EA), a governmental organization that is responsible for conservation and the environment. The River Itchen is amongst the world's most famous dry fly-fishing rivers, a sport which is thought to have originated in Hampshire's chalk streams, thanks to the clean, clear waters and abundant with wild trout and salmon, adding significant heritage and tourism value (Greene, 1936).

The imminent failure of a major sluice gate at the confluence of the Itchen Navigation and Solent Estuary threatens the park and the river ecosystem (Environment Agency, 2018). Should the gate fail, the lower Itchen would become tidal, resulting in a 2-m drop in river levels at low tide. Local ecology would transition from a biodiverse freshwater system to intertidal marine silt beds and the current and historical views of the Itchen would be significantly transformed. As the sluice gate is expensive to replace and maintain, there is debate as to whether the structure should be decommissioned. One option would involve replacing the old sluice gate completely; and another would involve blocking off the existing sluice gate and creating a new white-water canoe course with a dedicated salmon pass incorporated in the design. Potential improvements at the park are being co-ordinated by the EA and Groundwork South, a charity organization working towards sustainable communities. Sluice gate replacement to maintain the current state of the river and park would incur significant financial cost, hence this study compares the CES provided by current state of the park with another plausible and cost-effective 'alternative state'. In this alternative scenario, the current sluice gate is permanently closed and approximately 90% of the current river flow is diverted through a white-water canoeing facility through the grounds of a sports complex, maintaining

current river levels and aiding salmon passage. Additionally, the old course of the Itchen will be unblocked; and the currently culverted section would be 'daylighted' to create a new stream into the estuary with improved paths and landscaping options (see Appendices S1 and S2 for maps/images).

2.2 | Cultural ecosystem service assessment

The key principles behind our data collection primarily follow TESSA protocols for CES assessment and build on previous participatory mapping techniques (Ingwall-King et al., 2017). A summary of the TESSA rapid assessment process was adapted to suit the study aims specifically (Figure 1). We employed a public participation geographic information system (PPGIS) approach, using an inductive free-listing questionnaire in which participants were encouraged to map cultural benefits for both the current state and an envisioned alternative state onto ordinance survey (OS) maps for later spatial analysis (see Appendices S2 and S3). Paired scenario and PPGIS techniques enables cognitive focussing, engaging both explicit and implicit experiences and provides statistical power to qualitative techniques through relative weighting (Teff-Seker & Orenstein, 2018). The data were then supplemented and authenticated by a wider online survey that took place concurrently. We collected all data in the spring and summer months (from March to July 2017) to control for seasonal differences in land use on public perception of the park's cultural significance. All survey participants and online respondents were the residents of Southampton who used the park and all data was anonymous. Ethical approval for all methods was granted by the University of Southampton Faculty of Science and Medicine ethics committee, approval ERGO code 26,655. The online survey began with an ethics statement, while all participants taking the participatory questionnaire received a Participant Information Sheet (PIS) outlining the methods and ethical considerations before signing a Research Consent Form.

2.2.1 | Online questionnaire survey

We carried out an online questionnaire survey from May to July 2017 to gain a wider insight of the cultural benefits provided by the current state of the park; and to supplement the findings of the experimental free-listing exercise. The online questionnaire was created on Southampton University's iSurvey platform, consisting of multiple choice and open-ended questions. The questionnaire was designed to extract information on the users' visitation frequency, favourite features, primary use and choice between the current and alternative states. Groundwork South and the EA used social media such as Facebook and Twitter to advertise this online survey which could be accessed via their website. The attendants of the River Itchen consultation events could also take part in the survey using small electronic tablets provided by Groundwork South.

2.2.2 | Scoping and mapping exercises

We conducted a preliminary scoping exercise by piloting a free-listing method with nine residents who attended a local stakeholder

Method step	Step objectives/questions	Description and/or method(s) used in this study
1. Preliminary ideas	Define objective	Provide optimal ecosystem service outcomes for all stakeholders during park renovation
	Define site parameters	Demographics, cultural ecosystem services, preferences
	Investigate local policy	Liason with land owners, local council and Environment Agency representatives
2. Rapid appraisal	Identify stakeholders	Identify key stakeholder groups through public consultation and piloting
	Identify key drivers of change	Meetings with EA project leaders to understand project drivers, time pressure and objectives
	Identify services currently provided	Pilot study including mapping exercise with local stakeholder experts
3. Determine alternative state	What are the key issues and changes?	CES importance spatial heterogenous - depends on demographics, distance travelled, family structure and preferences
	Define and envisage alternative scenario	Project organisers create description, images of potential scenario and reasons for choices in terms of ES provision and economic viability
4. Select methods	Select key services and best methods for assessment	Free listing to gather personal perceptions and allow use of local language. Participatory mapping to capture spatial heterogeneity
	Select method to convey envisaged alternative state	High quality printed images and diagrams. Data collection within park to encourage visualisation of change
4. Data collection	Collect data for current and alternative states	Analogous freelisting and mapping questionnaires used for both states in one sitting to allow direct comparison
	Collect supporting data	Online questionnaire with large local sample size verified outcomes of current state free-listing survey
5. Analyse and communicate findings	Compare and contrast results from current and alternative states	CES categorised and mapped into spatial zones. Comparative statistical and sentiment analysis identified CES hotspots
	Communicate findings to stakeholders and wider public	Presented results and conclusions to policy-makers for inclusion in policy document. Publishing study

FIGURE 1 Flow diagram of the rapid cultural ecosystem service assessment process adapted from the Toolkit for Ecosystem Service Site-based Assessment toolkit (Peh et al., 2013), breaking down the five key steps into main questions/objectives and the specific steps taken in this study

meeting on 22 March 2017. We first introduced the participants to the concept of ecosystem services in layman's terms. Then we gave each participant a free-listing form and an up-to-date topographical OS map with land-use, public access and leisure points of interest highlighted for spatial context. We encouraged them – by referring to the OS map – to consider which benefits they 'appreciated' about the park in its current state. The benefits under consideration should include both tangible CES (such as recreation and heritage) and intangible services (such as spiritual and aesthetic value), as well as the practices they engaged in (such as angling, water sports and walking).

Free-listing and mapping exercises were further piloted using a second group of stakeholders at the University of Southampton. A total of nine staff and students took part in this trial, enabling the evaluation of methods for feasibility, improvement of free-listing
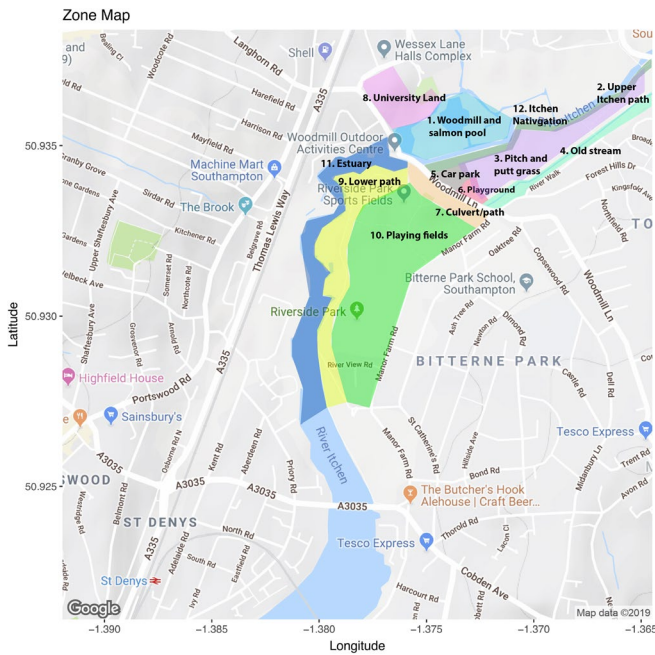
FIGURE 2 Geographic information systems plot of Riverside Park study area indicating zones named according to land use as determined by local stakeholders in the first pilot study

questionnaire and further refinement of the primer and discussion style. Neutral, unbiased language was key for the explanation of the data collection process and the alternative state of the park so as to achieve objectivity among the respondents.

Both preliminary free-listing exercises used local terminology, vocabulary and historical context for the discussion of the park's geography, primary land use and culture. This was helpful for maintaining a focus on the park for this site-based study (Johansson, Pedersen, & Weisner, 2019). We used the data derived from these exercises to classify the park into key zones based on the land cover and usage (Figure 2). The use of zones within the park allowed us to identify pattern of intensity, richness and diversity in terms of CES appreciation and provision, and map CES 'hotspots' and 'coldspots' (areas of relative high/ 'hot' and low/ 'cold' CES provision) within the park.

2.2.3 | Free-listing exercises

We performed the full free-listing exercises at the River Itchen 'River Fest' festival and two consultation events held by both EA and Groundwork South on 14 and 18 June 2017. These meetings – advertised by Groundwork South using social media, posters and hand-posted flyers –aimed to present the park's scenarios (i.e. the current state and alternative state) to the general public in order to ascertain which management option people felt most appropriate for the park. At each meeting, we commenced the free-listing exercise with an introduction to the purpose of the study and the concept of cultural ecosystem services (based on Common International Classification of Ecosystem Services; https://cices.eu/; Potschin & Haines-Young, 2016) using simple language for the non-experts. The free-listing

form included a short questionnaire survey to obtain information on the respondent's age, gender, occupation, visitation rate per month, time travelled and primary use of the park (see Appendix S2).

To ensure consistency, we asked all participants to think of themselves as an individual as well as a part of the wider community and individually list all aspects, uses and areas of the park that they currently appreciate in their own words; and then mark their entries on an OS map. Continuous routes generated by activities such as walking, jogging and cycling could not have a pinpoint location and they were marked by the respondents' preferred points along that route as mentioned in their free-listing.

To introduce the participants to the proposed alternative state, we used artistic impressions and map overlays together with oral explanation. Given this information, we asked the stakeholders to envision their use and appreciation of the counterfactual and carry out another free-listing and mapping exercise (see Appendix S3). We encouraged the participants to consider the park as a whole under the alternative state to prevent erroneous focus towards the new structures and changes. Finally, to check that our sample was representative of the population of the area, we compared the age profile and gender ratio of our respondents with the demographic information of Southampton City and three wards local to Riverside park obtained from the National 2011 census (https://www.ons.gov.uk/census/2011census).

2.2.4 | Data analysis

We categorized each respondent into nine stakeholder groups (angler, cyclist, dog walker, family/community use, green-space, nature, swimmer, walker and water sports) based on participants' primary use of the park. We considered each free-listing entry of each person as a response. Each response was transcribed, assigned to its associated zone of the park and encoded to its associated cultural benefit type as in Table 1. For both current and alternative states of the park, we counted the number of responses for each zone of the park, group of stakeholders and type of cultural benefits. We used Mann–Whitney tests to compare the number of responses between male and female users for the current state of the park; and make same-gender groups comparison between the two states of the park. Furthermore, we used Kruskal–Wallace tests to compare the number of responses across different age groups (18–30, 31–50, 51–65 and 65+) for both states of the park separately. We also used Chi-square test to determine if there was an association between an age group and a particular state of the park.

As an inductive survey, participants were encouraged to list all the CES 'appreciations' in their own words. Sentiment analysis was used to examine the qualitative response terms, aggregated at the synonym level, associated with the current state, as well as the alternative state of the park. We transcribed and uploaded the qualitative free-listing comments into NVivo Pro (version 11) which enabled us to analyse each transcription through the creation of nodes according to key concept, in this case a service type or zone. By combining the transcripts for all participants for the current

and alternative states, we could directly compare word frequency and sentiment for each state. Key words, stemmed words and synonyms were examined through word frequency counts, and complex word-trees divulged the context in which each word was used. The data from both states were compared for noteworthy differences in the language used, while giving crucial context to the corresponding spatial data. Most significantly, NVivo enabled quantitative analysis of text sentiment using an inbuilt scoring system. Each word containing sentiment has a predetermined sentimental score based on a Likert-style scale from 'very negative' to 'very positive' which depends on word placement and modifiers within the surrounding sentence. The creation of word clouds – a visual means of mind and concept mapping with viral structures – also enabled qualitative inspection of the data for key differences between the two opposing states. We also read and considered holistically the responses to obtain the integrated perceptions of the contrasting states. As all responses were written in the respondents' own words, it was important to consider the wider context of their perception from a less systematic perspective.

Finally, we employed RStudio (version 1.0.143, specifically packages 'ggplot2' and 'reshape2'; Wickham, 2007, 2009) to create confusion matrices of CES versus zone to illustrate: (a) the difference between the current and alternative states of the park in terms of the normalized response number (expressed in percentage) across different CES for each zone; (b) the difference between the two states of the park in terms of normalized response number (percentage) across different zones for each CES; and (c) the degree of positive sentiment (expressed in a ratio of positive sentiment score to negative sentiment score calculated within NVivo) of each CES in each zone for each state of the park. We used Google Maps to obtain the GPS coordinates of every response mapped onto the OS maps. We then created heat maps using these co-ordinate data to visualize response density.

3 | RESULTS

3.1 | Online questionnaire survey

A total of 587 respondents completed our online questionnaire survey. Nearly 50% of respondents visited the park at least once weekly, and over 96% at least once monthly. The top features of the park favoured by the users are River Itchen (93%), the open space (52%) and the flora and fauna (40%); while the activities the users mostly engaged are walking (59%), water sports (48%), relaxation/unwinding (36%), sitting by the river (35%) and wildlife spotting (33%). Finally, the alternative state of the park was favoured as the primary choice for 63% of respondents compared to the current state (Table 2).

3.2 | Free-listing exercises

In total, 51 participants gave 273 free-listing responses for the current state and 233 responses for the alternative state (Table 3), each mapped onto corresponding OS maps. Respondent age ranged between 18 and 76 years old (Table 3), broadly in line with the populations of Southampton city and the wards most local to Riverside Park (Appendix S4). The mean travel time to the park (±SD) was estimated at 9.92 min (±6.71) and the mean visitation frequency was 13.49 (±15.69) per month. The relatively low travel time and high visitation frequency confirmed that the visitors are mainly local residents. The gender ratio of our respondents was approximately equal. However, there was a gender bias among some primary activities engaged by the visitors. For example, angling and walking were two activities dominated by male visitors (Appendix S5).

Male respondents gave a total of 138 (average of 5.1 responses per male respondent) and 130 responses (average of 4.8 responses

TABLE 1 List of cultural benefits adapted from Toolkit for Ecosystem Service Site-based Assessment framework (Peh et al., 2013) with explanation of coding system used to analyse free-listing responses

Code	Cultural benefit	Description/exemplar use
SP	Spiritual and religious	I value this place for it spiritual or religious values.
CULT	Cultural heritage	This place has a historical past (social, natural) that links to my cultural heritage.
EST	Aesthetic	The area has aesthetic value (scenery, landscape, beauty, smells).
ISP	Inspirational, creative or artistic	This place is a source of inspiration (for photography, writing creative arts, etc.).
APP	Sense of place or identity	Area produces a feeling of familiarity/belonging or 'being home'.
REL	Social relations/community benefits	This place allows social interaction and relationship opportunities (friends, family and community cohesion).
ED	Education and ecological knowledge	This place enables development of ecological knowledge and environmental education.
HEA	Physical health	The area contributes to physical health (open-air activities).
MEN	Mental health	This area contributes to mental (therapeutic, emotional, relaxation) health.
RIC	Leisure, recreation and ecotourism	This place gives recreational/touristic opportunities (walk, run, dog, play with family, observe wildlife.
INT	Existence/bequest values	This place has its own intrinsic value, regarding my utility. I value the fact that this place exists and will do for future generations.

Description of cultural benefits as example usage in a typical sentence.

per male respondent) for the current and alternative states respectively. Female respondents gave a total of 135 responses (average of 5.4 responses per female respondent) for the current state and 103 responses (average of 4.1 responses per female respondent) for the alternative state. There was no significant intra-scenario difference between genders (current state: W = 8,707, p = .35; alternative state: W = 5,757.5, p = .062), however, both genders consistently assigned more responses to the current state compared to the alternative state (Male: W = 10,746, p < .05, Female: W = 8,337.5, p < .05).

Comparing the means (number of responses) across the four age groups (18–30, 31–50, 51–65, and 65+) for each state (i.e. current and alternative), there was a significant difference in the number of responses across the different age groups for both states of the park (current state: KW = 12.03, df = 3, p < .01; alternative state: KW = 17.14, df = 3, p < .01). However, no particular age group was associated with any state of the park in terms of number of responses (χ^2 = 0.158, p > .05).

3.3 | Qualitative free-listed text analyses

It is imperative to also investigate the free-listing responses themselves, as sentiment alone is difficult to analyse systematically without the context in which specific terms were specified. Word clouds (Appendix S6) were a useful tool for visually investigating the key differences in the data as the size and placement of the term within the cloud reflects word frequency in the aggregated free-listing responses (see Fish et al., 2016). Current state responses generally reinforced positive sentiment results and word frequency use of enjoyment, heritage and activities within the park, for example, 'We love taking our grandchildren out to the skate park…it is a real *highlight of our family history*'. Many emphasize a spatially explicit sense of place – for example, Respondent 'A', an angler, 'The salmon pool is one of the best fishing spots… there is an *ethereal quality* to the water' – or through specific memories of health or inspiration such as, 'My first [physiotherapy] walk after the operation was to a bench by the river and I will never forget the *motivation and strength* the open greenspace gave me', an insight into the impact of urban parks on physical health. Similarly, one respondent highlighted the universal importance of the green space to all members of society, 'Our brother likes to ride his bike on the practice roads. He has Down syndrome and can't cycle on the real roads so this is a *great experience*'.

When compared to alternative state a noteworthy divergence arises, in which respondents associated with different activities may give contrasting responses, but usually regarding a specific area or zone of the park. This again highlights the importance of a spatially explicit study. For example, back to respondent 'A', 'canoeing will dramatically *undermine and harm the culture and heritage* of this old fishing community'. Such contrast in response emphasises changes between states, important for future decision-making, however, as an angler it is unsurprising that the negativity stems from potential alteration of the river. It is therefore imperative that every response is regarded in context of zone, demographics and stakeholder group. As such, the zone in question (i.e. zone 1, Woodmill and salmon pool) also elicits positive responses under the alternative scenario from both canoeists, '[the] canoeing facility gives more *options to young people*', and anglers alike, '…*hope they change the area for the better but respected the heritage*'. Additional key quotes can be found in Appendix S7.

TABLE 2 Percentage of respondents that listed the following activities and favourite features of Riverside Park in an online questionnaire survey

Activity	%	Feature	%
Walks	59.1	The River Itchen	92.8
Water sports	47.9	The open space	51.6
Relaxation/ unwinding	36.3	The flora and fauna	40.0
Sitting by the river	35.3	Safe and secure	16.9
Wildlife spotting	32.9	Play areas	15.0
Meeting with friends	23.2	Skate park	3.4
Picnics by the river	19.1	Football pitches	2.4
Fishing	16.0	Cricket pitches	1.7
Other	1.4	Other	1.4

TABLE 3 Overall respondent profile (n = 51)

Respondent profile	%
Gender	
Male	53
Female	47
Age	
18–30	9.8
31–50	33.3
51–65	39.2
65+	17.6
Primary use of the park	
Angling	11.8
Cycling	3.9
Dog walking	11.8
Family/community	15.7
Green space	11.8
Nature	9.8
Swimming	3.9
Walking	17.6
Water sports	13.7
Appreciation increased?	
Yes	66.7
No	33.3
Visit more often?	
Yes	49.0
No	39.2
Non-applicable	11.8

3.4 | Mapping cultural appreciation and sentiment hotspots

Zones 1 (Woodmill and salmon pool), 2 (Upper Itchen path), 9 (Lower path) and 10 (Playing field) were identified as cultural appreciation hotspots of the park, with the highest number of mapped CES responses (Table 4). However, under the alternative state, zones 9 (Lower path – 11.6% decrease) and 10 (Playing fields – 13.4% decrease) saw the most dramatic declines in cultural service responses; even though these areas were not affected by proposed management plans (Table 4). Zones 2 (Upper Itchen path), 3 (pitch and putt grass), key areas of proposed renovation also declined by 7.6% and 5.1% respectively. By contrast, zone 1 (Woodmill and salmon pool) remained a hotspot, increasing number of responses by 13.3%, while 4 (Old stream) and 7 (Culvert/path) also emerged as hotspots for cultural importance, as numbers of CES responses increased by 9.6 and 14.0% respectively (Table 5).

Using NVivo, sentiment analysis revealed a decrease (an average decline of 14.3%) in positive sentiment from the current to the alternative state (Table 6). However, a Wilcoxon rank sum test comparing sentiment between current and alternative states reported no significant difference ($W = 104$, $p = .16$). Only zone 4 (the proposed new stream and landscaping area) reported an increase of 21% in positive sentiment responses. However, in certain regions we find likely opposition; the envisaged alternative state prompted a reduction of 19% in positive sentiment in zone 1 (Woodmill and salmon pool), a key area of proposed development.

A confusion matrix of the difference between percentage-normalized responses of the current versus the alternative state also reveals considerable trade-offs within each CES under the alternative state (Figure 3). For example, the number of responses for some CES increases in zones 1 (Woodmill and salmon pool), zone 7 (culvert/path) and zone 4 (old stream), most likely as a result of the planned white water facility, landscaping and redevelopment opportunities. However, the number of reponses for some CES proportionately decreases in zones 9 (Lower path) and 10 (playing field) especially in the number of responses regarding recreation services. A pair of confusion matrices (Figure 4a,b) – one for each state of the park displaying the ratio of positive sentiment scores to negative sentiment scores (i.e. positive sentiment gradient) in an array of CES versus each distinct zone of the park – indicates a higher degree of positive sentiment under the current state.

We theorize that symbiotic relationships between services may occur within zones (e.g. zone 7), in which the existence of one (such as aesthetics) may enable the appreciation of another (such as inspirational value), however, this was not explored quantitatively. On the other hand, the alternative state shows a lower degree of positive sentiments, especially in zones 1 (Woodmill and salmon pool) and 12 (Itchen navigation) regarding CES such as a sense of place and aesthetics. GIS-based heat maps of key hotspots and cold-spots across the park enable the visual identification of areas of high and low concentrations of responses (Figure 5). The responses are visibly more dispersed in the current state indicating a broad spatial scale of appreciation for the park, whereas the responses under the alternative state are more spatially refined around the key areas of potential development (e.g. Woodmill and salmon pool).

TABLE 4 Distribution of cultural ecosystem services (CES) mapped across 12 zones of Riverside Park, expressed in terms of number of CES mapped points per zone (i.e. response density)

Zone	Current state		Alternative state		% change from current to alternative
	No. of CES mapped points	Percentage	No. of CES mapped points	Percentage	
1. Woodmill and salmon pool	28	10.3	60	26.6	+13.3
2. Upper Itchen path	56	20.5	30	12.9	−7.6
3. Pitch and putt grass	21	7.7	6	2.6	−5.1
4. Old stream	3	1.1	25	10.7	+9.6
5. Car park	12	4.4	7	3.0	−1.4
6. Playground	1	0.4	2	0.9	+0.5
7. Culvert/path	4	1.5	36	15.5	+14.0
8. University land	1	0.4	0	0.0	−0.4
9. Lower path	48	17.6	14	6.0	−11.6
10. Playing fields	60	22.0	20	8.6	−13.4
11. Estuary	14	5.1	11	4.7	−0.4
12. Itchen navigation	25	9.2	20	8.6	−0.6

Note: Colours indicate percentage increase (green) or decrease (red) in number of mapped points from the current to the alternative state. Darker colours indicate larger changes.

**TABLE 5** NVivo analysis of free-listing text

| | Free-listing text | | | | |
| | **Current state** | | | **Alternative state** | |
Rank	**Term (includes synonyms)**	**%**		**Term (includes synonyms)**	**%**
1	Enjoy (enjoyment, love, use)	3.32		Stream (current, flow, flowing)	2.73
2	Park (green, parks)	3.23		Still (calm, even, tranquil)	2.59
3	Walking (walked, walking, walks)	2.99		Walk (walked, walking, walks)	2.47
4	Like (likes, potential, wish)	2.11		Park (green, parks)	2.41
5	Fun (play, playing, sporting)	1.82		Enjoy (enjoyment, use, lovely)	2.33
6	Exercise (practical, use, work)	1.73		New (fresh, new, young)	2.04
7	River	1.70		Area (areas)	1.78
8	Area (areas, country, fields)	1.61		Route (paths, path, road, routes)	1.70
9	Take (bring, involved, holds)	1.52		Like (potential)	1.64
10	Place (home, local, space)	1.38		River	1.55
11	Watching (catch, learn, view)	1.32		Good (beneficial, effective, well)	1.53
12	Family (families, home)	1.25		Continue (extend, keep, remain)	1.28
13	Play (games, recreation, running)	1.25		See (experience, visit, watch)	1.26
14	Dog	1.17		Water	1.26
15	Along	1.12		Change (changing, variety)	1.24
16	Kids (child)	1.06		Concerned (implication, worry)	1.21
17	See (experience, learn, meet)	1.03		Play (fun, games, recreation)	1.14
18	Fishing (fish)	1.00		Local (locally, place, section)	1.06
19	Water	1.00		Canoeing (canoe)	0.98
20	Paths (course, route, way)	0.97		Fishing (fish)	0.98

Note: Using the NVivo built-in sentiment scoring system, red highlighted text denotes negative sentiment and green highlighted text denotes positive sentiment in the context of the sentence modifiers and overall structure.

TABLE 6 Sentiment analysis of free-list responses across 12 zones of Riverside Park

| | **% positive** | | |
Zone	**Current state**	**Alternative state**	**Difference**
1. Woodmill and salmon pool	89.3	70.5	−18.8
2. Upper Itchen path	96.4	87.1	−9.3
3. Pitch and putt grass	76.2	60.0	−16.2
4. Old stream	66.7	87.5	20.8
5. Car park	100.0	100.0	0.0
6. Playground	0.0	0.0	0.0
7. Culvert/path	75.0	75.0	0.0
8. University land	100.0	0.0	−100.0
9. Lower path	100.0	92.9	−7.1
10. Playing field	98.3	85.0	−13.3
11. Estuary	92.9	91.7	−1.2
12. Itchen navigation	92.0	65.0	−27.0
Average	82.2	67.9	−14.3

Green text highlights an increase in the use of words with positive sentiment. Red text highlights a negative change in the use of words with positive sentiment.
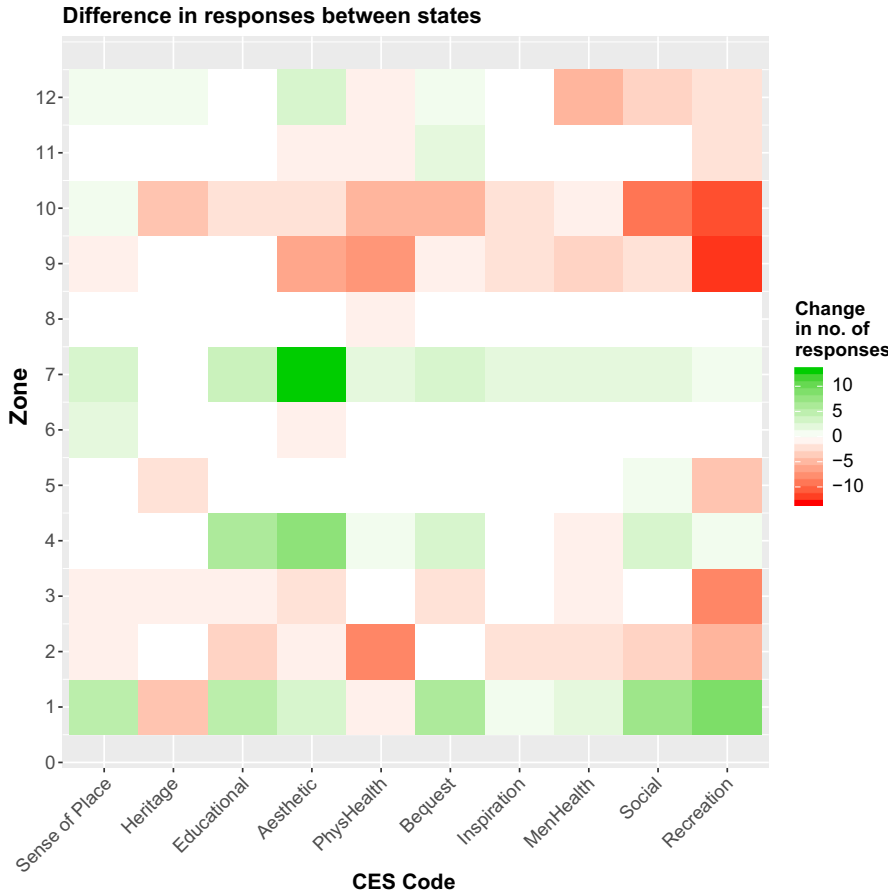
FIGURE 3 Confusion matrix displaying the difference between percentage-normalized responses of the current versus the alternative state, investigating Cultural Ecosystem Services (CES) Code versus Zone Number
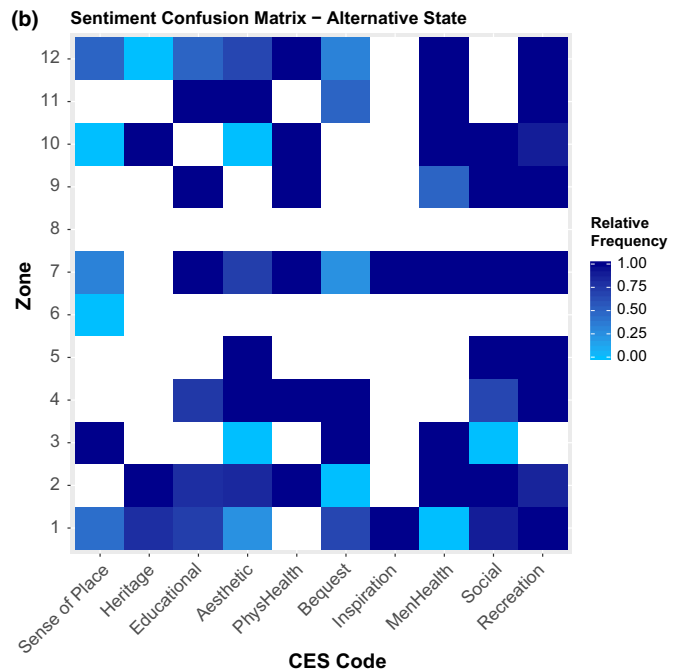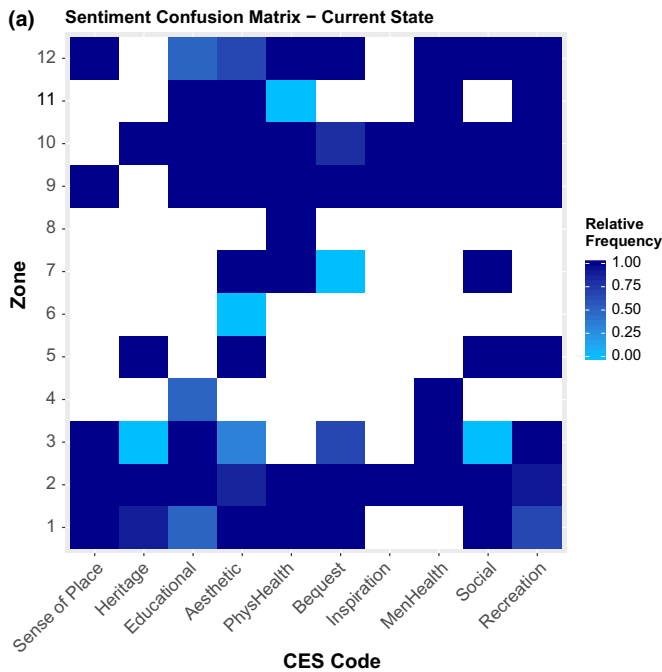

FIGURE 4 Pair of confusion matrices using the scale-normalized response of sentiment in the current versus the alternative state. Within each box, 1 is 100% positive (blue), 0 is 100% negative (red) and white represents no response (N/A), investigating Cultural Ecosystem Services (CES) Code versus Zone Number. Refer to Table 1 for CES code definitions

(a) Current State Heatmap
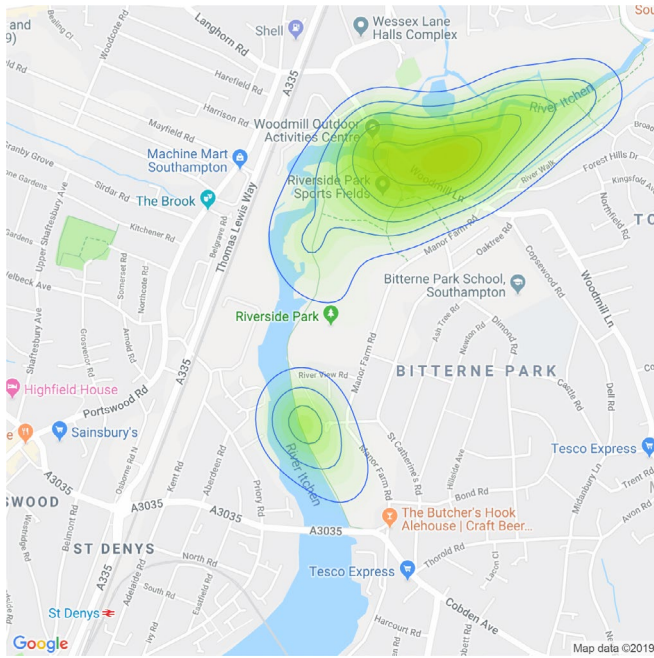
(b) Alternative State Heatmap
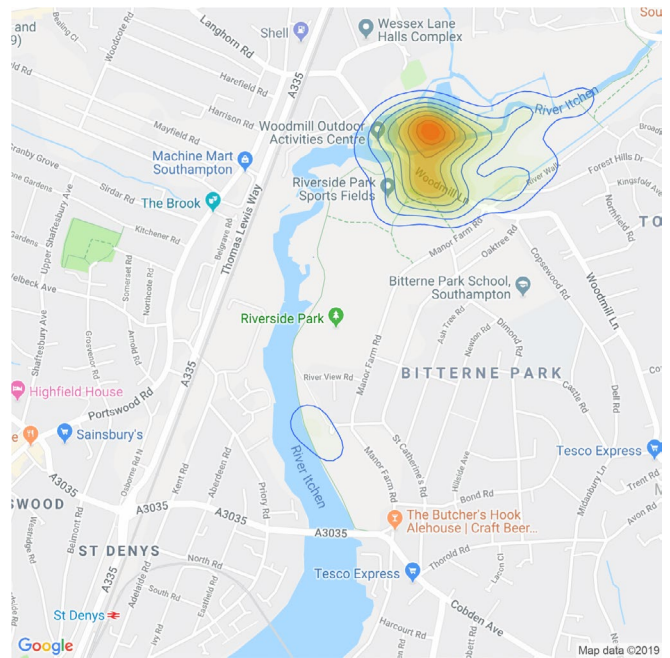
FIGURE 5 Cultural Ecosystem Services heat maps for all stakeholder groups of current state (a) and alternative state (b)

4 | DISCUSSION

This study assessed the current provision of cultural ecosystem services in an urban greenspace and investigated the potential impacts of a proposed alternative management scenario. We demonstrated how local respondents appreciate and value a frequently visited public park in Southampton, UK, in its current state by identifying 11 CES (spirituality, cultural heritage, aesthetics, inspirational value, sense of place, social/community benefit, education, physical health, mental well-being, recreation and existence/bequest values) using participatory, free-listing exercises regarding specific land-use areas or 'zones' within the park.

Our study demonstrates that the management scenario presented as the alternative state delivers widely accepted benefits but some compromises need to be considered by decision-makers in specific locations and for certain stakeholders. Responses for the current state were then statistically compared to responses regarding a proposed alternative state to identify hotspots and coldspots of CES provision, while free-listing responses reveal changes in sentiment between the states. Combining this data with personal information such as demographics and sport preferences contextualised preferences towards specific aspects of redevelopment. Additionally, PPGIS methods in combination with free-listing enabled participants to articulate personal perceptions, memories and ideas for specific areas in their own words, mapping CES in rich, local context. Nevertheless, statistical analyses of qualitative information must be interpreted with caution. While raw counts of responses give information of participant interest in specific areas, counts do not reveal positive or negative sentiment.

Allowing participants to free-list in their own words enables the analysis of spatially specific changes in sentiment and enables analysis of changing attitudes towards area redevelopment compared to the current state. Furthermore, raw counts of responses were biased towards areas of redevelopment in the alternative scenario, as participants were less likely to mention continued use of unchanged areas in the alternative scenario.

Results from our study will directly inform future management decisions and ensure that CES provision is well-recognised as a key measure of current and future importance of the urban green space. Our findings have proven useful for Environment Agency and Groundwork South, and directly contributed to the Woodmill Stakeholder Engagement Plan, highlighting the spatially specific sensitivity of local stakeholders to land-use change and the current and future importance of local biodiversity, aesthetic qualities and values (Environment Agency, 2018). In areas of potential conflicts of interest, further negotiations should aim to find an optimal compromise, to conserve local heritage and maintain their current 'sense of place' while benefitting maximum number of stakeholders. Alternatively, cultural values that are inevitably affected by the development could potentially be recreated in areas that are considered as cultural coldspots. Areas of the park that are currently under-utilized could provide scope for development to balance the provision of services for all stakeholders, throughout the park.

Our study demonstrates the versatility of TESSA when applied to a specific CES case study. According to a recent IUCN guideline on tools for measuring ecosystem services (Neugarten et al., 2018), ES assessment tools can be broadly categorized into two

groups: written step-by-step tools (e.g. TESSA, PA-BAT) and computer-based modelling (e.g. ARIES, InVEST). TESSA was chosen for this study as it is a free and publicly available tool, enabling a wide range of users to investigate the provision of local ES without formal training in GIS or modelling techniques. The toolkit includes a suite of eight biological and anthropocentric ecosystem services (including CES) allowing multidisciplinary site-based analysis using one cohesive framework (Peh et al., 2017). However, the use of any single tool may dictate the perspective of the study and the definitions by which ecosystem services are valued. The PPGIS approach driven by the TESSA framework enabled the capture of individual perceptions and values; as participants were able to convey their personal connection to the natural environment in their own words, a method that could apply to any language (Menzel & Teng, 2010; Rall et al., 2019). This method is especially significant in the context of spatially specific co-production of CES which was described as a 'co-dominating triangular relationship' of interlinking preference, virtue and principal-based methods, highlighting the need for place-based methods (Chan et al., 2011; Fish et al., 2016). However, while inductive and participatory methods including questionnaires and mapping techniques provide in-depth data, they are often time and resource-intensive, despite providing only a snapshot in time, highlighting the need for more streamlined approaches in current times of austerity imposed on land management. Alternatively, the rise of social media platforms and subsequent availability of geotagged images, is a growing area of research, enabling efficient collection of large quantities of data over larger spatiotemporal scales (Oteros-Rozas et al., 2018; Richards & Friess, 2015). However, as discussed by Retka et al., 2019 such methods may lead to the underrepresentation of certain CES (e.g. spiritual, educational and historical services) and personal perceptions and historical context may be discounted, hence a combined traditional survey and social media approach may provide a more robust solution.

This study also showed that baseline differences in the perception of a site can vary dramatically among different stakeholder groups and between specific locations within the site (see Canedoli, Bullock, Collier, Joyce, & Padoa-Schioppa, 2017; Garrido, Elbakidze, & Angelstam, 2017; Riechers, Noack, & Tscharntke, 2016) and such discrepancies can enrich our knowledge of the site from a local participatory exercise (Belaire, Westphal, Whelan, & Minor, 2015). In Hawaii, Gould et al. (2014) explore a similar site-specific complexity in which proposed change would result in the loss of fishing activities elicited concerns over the loss of local tradition, sense of place and bequest of practices; similar to concerns vocalized by Woodmill's angling community. Furthermore, the perceieved importance and quality of greenspace depends significantly upon location, as city dwellers are more likely to consider even the most managed of greenery in a built-up area an exposure to nature (Wolch, Byrne, & Newell, 2014). Riechers et al. (2016) highlight the supreme influence of site-specific variation on local perception and opinion due to variation in personal definitions of cultural value and relative value of all ecosystem services.

As human co-produced values, CES assessment should always consider the 'mind of the observer' as well as their interactions with the biophysical environment (Chan et al., 2012; Ives et al., 2017; Scholte, Teeffelen, & Verburg, 2015). However, while this could be remedied using predefined label methods such as stated preference, this undermines the purpose of an inductive approach, exposing revealed preference as a more informative measure of respondent perception (Dallimer et al., 2014). Future study should therefore seek to explore and analyse locally specific definitions and perceptions of CES and the links to local greenspace value. Understanding historical context, predisposed opinion and communication barriers as well as the key factors motivating personal needs, beliefs and perceptions of the local environment would help to contextualise the beliefs of every respondent and understand the spatially explicit demands for CES (Chenail, 2011; Creswell & Miller, 2000).

5 | CONCLUSIONS

In a rapidly urbanizing world, urban green spaces are critical for the provision of multiple ecosystem services on a global scale (Green et al., 2016). The provision of CES plays an especially important role in the promotion of community cohesion, health and well-being. Yet, CES are often overlooked in landscape management assessments due to their perceived intangibility (Scholte et al., 2015). Through this study, we used a variety of participatory, inductive, spatial and statistical methods to provide guidance as to the best course of action for future development of an important urban green space in Southampton, UK. Analysis of CES provision in the park's current state provided a critical baseline, outlining the present value of specific areas of the park in terms of CES and disclosed personal perceptions of key, local stakeholders. Comparison with results regarding the proposed, alternative state revealed spatially specific insights into areas of the park where conflict between multiple users with competing demand for non-substitutable services reside. In this case, cultural benefits that are inevitably affected by the development could potentially be recreated in areas that are considered as cultural 'coldspots'. However, in the wider context, this study provides further evidence that the combined use of participatory methods and spatial mapping of CES can provide land managers and decision-makers with the information required to find an optimal compromise between stakeholder groups, so as to maximize CES, health and well-being benefits for the local community. The future use of the CES assessment methods outlined in this study, in conjunction with the assessment of other types of ecosystem services can encompass multiple biocentric and economic aspects of ecosystem service assessment, providing an effective and holistic approach to landscape management.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHORS' CONTRIBUTIONS

K.S.-H.P., J.L.S. and L.J. conceived the research. All authors designed the study. L.J. collected the data and completed the analysis, L.J. wrote the paper. All authors commented on the analysis and presentation of data, and revised the earlier drafts.

DATA AVAILABILITY STATEMENT

Due to the personal nature of the demographic information and free-listing statements collected for this study are fully anonymized. Data are available from the Dryad Digital Repository https://doi.org/10.5061/dryad.427c0pr (Jones et al., 2019).

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.