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A comparison of cultural ecosystem service survey methods within South England

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ABSTRACT

Across all societies, humans depend on goods received from nature, termed ecosystem services. However, cultural ecosystem services (CES), the non-material benefits people obtain from ecosystems, are often overlooked in land-use decision making due to their intangible nature. This study aimed to evaluate three possible survey methods for site-based CES data collection; language-based supervised surveys (in which interviewers conduct surveys in real-time, recording verbal responses), language-based unsupervised surveys (respondents complete written surveys without an interviewer), and image-based unsupervised surveys (respondents complete surveys via image selection without an interviewer). Language-based supervised surveys were found to be more efficient in collecting CES data than language-/image-based unsupervised surveys, with a mean completion rate over 1.5-fold greater than either unsupervised survey; furthermore, survey completion was over twice as fast, and less than a sixth of the monetary cost per respondent compared to unsupervised surveys. The site-based assessment developed in this study provides robust data, and is shown to provide rapid and useful feedback to land-use decision makers. We recommend that rapid, site-based assessment methods are utilised to collect the information required to support CES-related decision making.

1. Introduction

All life on earth depends on support from ecosystems, however changes in land use across the globe are having a generally negative effect on ecosystem service (ES) supply (Church et al., 2011; MA, 2005). Both scientific and public awareness has increased over the past decade (Jax et al., 2013), but despite this, a robust methodology for measuring and monitoring ES has not been developed nor widely adopted (Verburg et al., 2016), although research into this has begun (Peh et al., 2013). Standardised methodologies are particularly hard to develop for cultural ecosystem services (CES; the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences'; MA, 2005) as CES are spatially and temporally distinct, intangible, subtle, mutable and intuitive in nature, based on ethical and philosophical perceptions; thus largely unique to the individual (Church et al., 2014). Culture-nature interactions are a relatively new concept (Darvill and Lindo, 2016), thus many social/economic data collection methods are not designed to examine key CES aspects. It is therefore apparent a multidisciplinary approach is required to improve understanding of CES, taking into account the dynamic nature of interactions between humans and the environment (Carvalho-Ribeiro et al., 2016).

There are many survey-based methods of collecting CES data (e.g. Anthem et al., 2015; Bark et al., 2016). Survey questionnaires are highly useful as they collect structured data about the same variables (and so are readily comparable) directly from the user and thus provide a promising approach for CES data collection (Raymond et al., 2014). They are often the only financially viable option for collecting information across a large spatial scale. However, surveys come in a variety of forms and their response rate (the proportion of individuals in a sample population that successfully completes a survey) and efficacy (see Pedersen and Nielsen, 2016) in the context of collecting CES information is not well studied, despite high stakeholder demand for such

Abbreviations: CES, Cultural Ecosystem Service; CI, Confidence Interval; ES, Ecosystem Service; GBP, Great British Pound; GLM, General Linear Model; MA, Millennium Ecosystem Assessment; SS, Supervised Survey; URL, Universal Resource Locator; US, Unsupervised Survey

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information (Willcock et al., 2016). Language-based surveys – defined here as surveys in which answers are provided in written or spoken word, e.g. text or oral surveys – are useful as language is able to clearly convey ideas thus leaves little ambiguity in meaning (Can and Walker, 2014). However, communication by language can be time consuming. Image-based surveys – defined here as surveys in which answers are given as an image, selected or created by the respondent – are useful as images engage the senses and emotions in a powerful way (Pink, 2011) and are able to rapidly communicate a variety of factors (Watson and Lom, 2008). However, there may be differences between individuals in ideas of what an image represents and the associated connotations (Watson and Lom, 2008). Thus, success of image-based surveys may be largely dependent on the quality of images used.

Surveys can be conducted in a supervised (defined here as surveys in which the respondent is guided by an interviewer in real time, e.g. in-person, via telephone or instant online communication) or unsupervised manner (defined here as surveys in which the respondent completes the survey independent of real time guidance; e.g. online). Sinclair et al. (2012) describe several advantages and disadvantages of unsupervised surveys (US) compared to supervised surveys (SS). US are useful as they can easily be distributed globally and are convenient for respondents to complete; additionally, the cost of running an US is commonly low (Casler et al., 2013; Weinberg et al., 2014). However, some US (e.g. online surveys) can only be completed by computer-literate individuals with online access, or may be perceived as junk mail resulting a low response rate (Sinclair et al., 2012). Despite a low response rate, US can still quickly collect a large sample size of completed surveys due to ease of distribution. SS can be completed without the use of technological aid and by individuals with no literary skills, as the interviewer is able to complete the survey on behalf of the respondent. SS generally provide clearer data as respondent queries can be addressed before survey submission (Szolnoki and Hoffmann, 2013). Furthermore, the response rate of SS is commonly higher than that of US as they seem more personal (Ansolabehere and Schaffner, 2014; Sinclair et al., 2012). However, SS are commonly more costly than US and may be subject to interviewer bias (Sinclair et al., 2012). Whilst each method has merit, there is debate over which method of data collection is the most effective (Casler et al., 2013).

This study quantifies the number and value of CES at 11 ecosystems within south England (Brownsea Island, the Cerne Abbas Giant, Durdle Dor, Figsbury Ring, Lyme Regis, the New Forest National Park, Richmond Park, Runnymede, the South Downs National Park, Stonehenge, and the Uffington White Horse; Fig. 1; Table 1; Table S1). We investigate which survey methodologies are best suited to CES measurement at these sites. We perform and critique language-based SS, language-based US and image-based US; hypothesising that SS would record more respondents per survey invitation than US and US would record more respondents per unit time than SS.

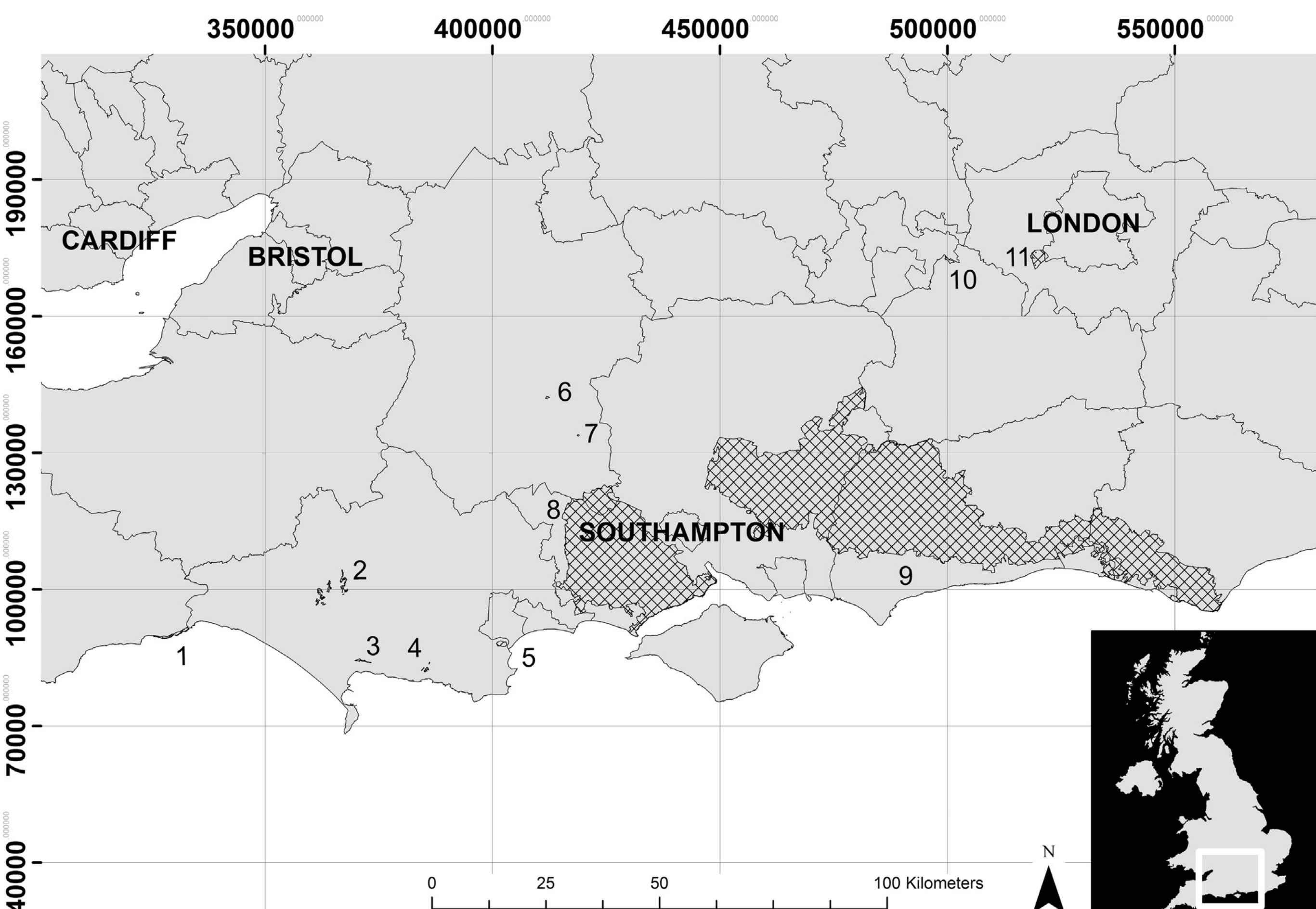

Fig. 1. The geographic location of our study sites within the United Kingdom (inset) and South England (1. Lyme Regis; 2. the Cerne Abbas Giant; 3. Uffington White Horse; 4. Durdle Dor; 5. Brownsea Island; 6. Stonehenge; 7. Figsbury Ring; 8. the New Forest National Park; 9. the South Downs National Park; 10. Runnymede; 11. Richmond Park).

Table 1
A site summary, including: Shannon and Simpson Diversity Indices for CES heterogeneity; and estimated annual site value (based on mean expenditure per person and the number of annual visitors to the site) for sites with readily available data (Brownsea Island, The New Forest National Park, Richmond Park and Stonehenge). 95% CI are provided where available.

Site	Number of responses	CES heterogeneity		Mean travel expenditure to access site (GBP£ person^{-1}) (±95% CI)	Annual visitor number (millions)	Estimated annual value of site (GBP£ million yr^{-1}) (±95% CI)
		Shannon diversity index	Simpson diversity index			
Brownsea Island	49	2.41	10.40	28.68 (±4.96)	0.13[a]	3.71 (±0.63)
The Cerne Abbas Giant	100	2.19	7.70	0.75 (±0.12)	–	–
Durdle Dor	150	2.21	8.18	163.74 (±22.25)	–	–
Figsbury Ring	100	2.24	8.49	2.11 (±0.16)	–	–
Lyme Regis	150	2.08	6.79	51.18 (±2.39)	–	–
The New Forest National Park	151	2.24	8.66	159.71 (±22.54)	14.50[b]	2315.80 (±326.89)
Richmond Park	107	1.93	6.09	1.57 (±0.24)	2.28[c]	3.57 (±0.54)
Runnymede	87	2.09	6.95	1.81 (±0.33)	–	–
The South Downs National Park	150	2.20	8.06	98.24 (±27.66)	–	–
Stonehenge	151	2.30	8.95	30.42 (±3.38)	1.00	30.42 (±3.38)
The Uffington White Horse	150	2.28	9.00	5.85 (±0.66)	–	–

[a] South West Tourism Alliance (2009);
[b] New Forest District Council (2015);
[c] Hitchcock et al. (2008).

2. Method

At each site visitors were approached at random and asked to participate in an anonymous oral survey (Appendix 1). All surveys were conducted by a single interviewer (eliminating observer bias) who then recorded the respondents' postcode/town of origin, length of their overall journey, time spent at the site, number of individuals in the visiting party, and frequency of visitation. Furthermore, respondents indicated their reasons of visitation in terms of CES from 0 (low) to 5 (high). The list of possible CES used in this study were adapted from Alcamo (2003), adding mental health benefits and physical health benefits in accordance with Chiesura (2004) (Table S2). These CES categories were chosen because preliminary investigations identified that members of the public related better to these terms than those used by other studies (e.g. Church et al., 2011). In addition, the definitions used by Alcamo (2003) are compatible with the most recent unifying CES definitions (King, 2012). The heterogeneity of CES at each site was calculated from the survey data using Simpson and Shannon diversity indices (Shannon, 1948; Simpson, 1949).

Site value was indicated by mean expenditure per person to access the site and associated CES. Mean expenditure per person was calculated by summing a party's travel costs to and from the site, site entry fees and, when visitors indicated an overnight stay (an overall journey length of over 1 day), accommodation costs, and dividing by the number of people in the party. Return travel costs for mainland UK residents (defined as those whose journey originated from England, Scotland and Wales) were calculated by doubling the petrol cost estimated by Classic Google Maps for one standard petrol vehicle at fuel price £1.35/L for the journey between the site and respondent's postcode/town (Google Inc., 2014). Travel costs for non-UK residents (those whose journey originated from outside England, Scotland or Wales) were calculated as the cost of return flights per person (assuming all party members required adult tickets) using the cheapest flights available from the Expedia search engine (Expedia, 2014), departing from the airport nearest to their town of origin, arriving in London Heathrow; chosen as it is the busiest airport in England (Suau-Sanchez et al., 2016). For parties undertaking a journey of greater duration than can be booked using Expedia, the cost of a single ticket was doubled and multiplied by the number of individuals in the party. Flight costs were then summed with return fuel costs to the site, calculated using Classic Google Maps (Google Inc., 2014) as described above with London Heathrow as the point of origin. Accommodation costs were determined using the average cost per person per night reported by Expedia when the postcode at which data collection took place was entered into the online search engine (Expedia, 2014). This cost was multiplied by the number of individuals in the respondent's party and by the total number of days of the respondent's journey. Thus, the total travel expenditure was the sum of petrol costs and (where appropriate) costs of flights, accommodation, and entry fees.

The proportion of total travel expenditure allocated to the site was assumed equal to the proportion of the total journey time spent at the site. Therefore, for respondents only journeying to visit the site, 100% of the travel and accommodation costs were included; however, for respondents on a multi-site journey, the total travel and accommodation costs were multiplied by the percentage of time spent at the site. All accommodation price searches were performed in September 2014 for the equivalent dates of each respondents visit in 2015, assuming that at the time of survey completion parties were at the start of their total journey and that predicted expenditure in 2015 is representative of the respondent's expenditure in 2014. Similarly, all flight prices were performed in January 2015, with the same assumptions. Finally, the proportion of travel expenditure allocated to the site was then divided by the number of individuals in the party to obtain an estimate of the value of the site per person.

In addition to the SS (outlined above), US were created for Brownsea Island, the South Downs National Park and Stonehenge, using Fluid Surveys (Survey Monkey, 2014). For each site, two possible US were created: 1) a language-based version of the SS; 2) an image-based version of the same survey, whereby text responses were replaced with images selected to visually represent the same meaning (Appendix 2). The US were made available to members of organisations associated with each site. Specifically, the uniform resource locator (URL) for the South Downs National Park was distributed to members of the neighbourhood watch in Corhampton via email (M. Camp 2014, pers. comm., 3 Jul. 2014). The URL for the Stonehenge US was publicised on the Stonehenge Druids website (Stonehenge Druids, 2014). Furthermore, the URLs of all three sites were distributed to staff of the Centre for

Biological Sciences and members of the Centre for Environmental Sciences, both at the University of Southampton, via email (K.R. Lipscombe 2014, pers. comm., 7 Aug 2014). On accessing the survey, the respondents were randomly allocated to one of the possible two US types.

The number of respondents and the researcher time invested for each survey type (language-based SS, language-based US and image-based US) were recorded. For SS, researcher time invested is the sum of the time spent travelling to and from the site, and the time spent surveying at the site. However, for US researcher time invested is the sum of the time spent converting the survey to an online format and the time spent distributing the survey URL as described above. Data were also collected on the number of respondents that terminated the survey before completion. The effect of survey type (language-based SS, language-based US and image-based US) on acceptance rates (the proportion of people invited to partake in the survey that agreed to do so) and completion rates (the portion of respondents that completed the survey to the end) was tested via separate general linear models (GLM). The difference in time taken to complete the survey for language-based SS, language-based US and image-based US was also investigated via 95% confidence interval (CI) comparison. The time and monetary cost of conducting each survey type was also noted, enabling the identification of which survey type was most cost effective per respondent. All statistical analyses were performed using Minitab software (Minitab 17 Statistical Software, 2010).

3. Results

Overall, a total of 1423 SS were completed across 11 sites; thus, whilst we have a limited sample size between sites, our sample of respondents is large. Of the sites tested, Durdle Dor scored the highest mean expenditure per person (£163.74), over 200-fold greater than the lowest scoring site, the Cerne Abbas Giant (£0.75; Table 1). Brownsea Island has the highest CES heterogeneity (Shannon: 2.41; Simpson: 10.40), while Richmond park has the lowest CES heterogeneity (Shannon: 1.93; Simpson: 6.95; Table 1).

The three different survey methods used (language-based SS, language-based US and image-based US) were explored by comparing acceptance rate, completion rate, time spent by the respondent completing the survey, and time and money costs to the researcher (Table 2). There were significant differences between the acceptance rates of the different survey types (SS or US), noted by the non-overlapping 95% CI. SS achieved over 7 times as many acceptances per invite as US, SS averaging 99% and US averaging 13% (Table 2). A significant difference was also identified in the effect of survey type (SS or US) on survey completion rates ($F_{1,13}=33.26$; $p<0.001$; $R^2(\text{adj})=80.31$). SS showed a mean completion rate over 1.5-fold greater than that of US, 99% and 61% respectively (Table 2). However, there was no significant difference between language-based US and image-based US ($F_{1,13}=0.51$; $p>0.400$; $R^2(\text{adj})=80.31$). There was no significant difference in the effect of US type (language-/image-based) on the time taken for completion. However, SS took less time for respondents to complete than either US; requiring approximately 2 min compared to US language-based (4 min 23 s) and US image-based (5 min 44 s; Table 2). Finally, whilst there was little difference between the researcher time invested per respondent across all three survey types, the cost per respondent was over 6 times greater for US than SS. SS methods are substantially more cost-effective for collecting CES information than US methods.

4. Discussion

The SS conducted in our study were able to rapidly provide a large amount of information to decision makers, enabling immediate impact. For example, preliminary reports for each site were sent to the specific decision makers within 48 h of survey completion (Appendix 3). Decision makers were interested in the rapid feedback provided by the preliminary reports, often implying the information provided would shape the future of the site in order to maximise public enjoyment. For example, upon sending the preliminary report to the Head Ranger of Figsbury Ring, we received a response of "Many thanks for sharing this info[rmation] ……. We are planning potential new interpretation for the site [and will consider this information]" (Head Ranger 2014, pers. comm., 18 Jul. 2014). This can be contrasted with landcover and substitutability proxy-based methods, which do not provide useful CES information at our sites (see Appendix 4 and 5).

To aid the rapid nature of our survey, we used expenditure to indicate site value. Expenditure is a useful method as it is a standardised unit easy for decision makers to understand (Tourkolias et al., 2015). However, whilst the survey methods used here provide useful information on the present use and values of sites, values may be highly uncertain when used to predict future trends (see Appendix 5). The mean expenditure per person to access a site is likely to be a conservative calculation of CES value as other important factors, such as time and planning, are not accounted for as valuing these factors is beyond the scope of our study (Tourkolias et al., 2015). However, underestimating the mean expenditure per person allows respondents to retain full anonymity and does not artificially inflate CES values, which could lead to poorly informed decisions.

Despite the associated uncertainties, by combining our results with the number of annual visitors to a site, the annual value of CES at each site can be calculated (Table 1). This may provide a clear way to compare the value of the CES provided by multiple sites. For example, the mean expenditure per person to access Brownsea Island is similar to the mean expenditure to access Stonehenge, but inclusion of annual visitor numbers to each site results in the annual CES value of Stonehenge being over 8 times greater than that of Brownsea Island (Table 1). Similarly, the mean expenditure per person to access The New Forest National Park is approximately 5 times greater than that of Stonehenge, but the annual value of CES in The New Forest National Park accounting for visitor numbers is over 70 times greater than Stonehenge (Table 1). We estimate The New Forest National Park CES are worth

Table 2
Comparison of language-based SS, language-based US and image-based US (with 95% CI, where available).

Methodology	Number of responses	Mean Acceptance Rate (%) (±95% CI)	Mean Completion Rate (%) (±95% CI)	Mean time for respondent to complete (minutes: seconds) (±95% CI)	Researcher cost per respondent (£)	Researcher time per respondent (hours)
Language-based SS	1423	98.85 (±0.54)	98.85 (±0.54)	~02:00	0.37	0.18
Language-based US	39	13.08 (±4.68)	64.14 (±7.54)	04:23 (±1:19)	2.37	0.15
Image-based US	43	13.08 (±0.57)	58.81 (±10.94)	05:44 (±0:25)	2.15	0.14

over £2300 million per year; highlighting the cultural value of natural landscapes. Estimates of the annual value of CES at specific sites may encourage decision makers to invest more heavily in the maintenance of these sites; for example, the 2013–2014 expenditure budget for The New Forest National Park was £5.44 million (New Forest National Park Authority, 2014), over 400-fold less than the value received from CES.

Of the three methodologies investigated (language-based SS, language-based US and image-based US), we recommend the use of language-based SS over both image- and language-based US. The acceptance rate of SS is over 7 times higher than that of US, the completion rate of SS is also higher than US (Sinclair et al., 2012). Sauermann and Roach (2013) suggest the higher acceptance and completion rates of SS may be due to the personal feel of SS compared to the impersonal invitations of US. The SS we conducted were completed outdoors, thus acceptance and completion rates were subject to uncontrollable factors such as weather conditions. Ad hoc observations suggest in both rain and strong sunshine the acceptance rate of SS was lower than in more mild conditions. The acceptance rate of SS is therefore likely to be highly changeable throughout the year. Furthermore, we found SS to be cheaper per respondent and thus more cost-effective than US methods. This finding is in contrast to that of other studies (Casler et al., 2013; Weinberg et al., 2014), perhaps as researcher wages were not considered in our study; considering wages may be unnecessary as volunteers are often happy to support such studies by collecting data. Additionally, the mean time for SS completion was less than that of US (Ansolabehere and Schaffner, 2014). This may be due to distractions in an unsupervised environment, or confusion with no means to clarify queries. US were conducted remotely in the respondents own time, whereas SS were conducted during real time at the site; SS respondents may have been eager to complete the survey in order to maximise time for enjoyment at the site. Under supervised conditions respondents could clarify queries before answering, thus give a more informed response and produce higher quality of data. For different survey topics US may be equally, or more, appropriate than SS, however with regards to CES, a concept poorly understood and defined by scientists, let alone the layman, SS are likely to be more useful than US.

5. Conclusions

Surveys can be used to rapidly obtain robust data on cultural ecosystem services via site-based assessment and thus support decision-making. For our study sites, supervised surveys had mean completion rates over 1.5-fold greater than unsupervised surveys, as well as being substantially cheaper and faster per respondent. Thus, whilst unsupervised surveys have their merit and may be appropriate for analysis of other factors, supervised surveys are most efficient in assessing cultural ecosystem services at a site-scale.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.ecoser.2016.06.012.

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