An empirical review of cultural ecosystem services indicators[a]

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An empirical review of cultural ecosystem services indicators

Abstract

Over millennia human well-being has benefited from ecosystems, not only through tangible goods, but also through intangible assets known as cultural ecosystem services. Despite growing research over the last decade, cultural services assessment still remains arbitrary and is largely limited to marketable services such as tourism. Evident difficulties in standardizing definitions and measurements have challenged cultural services accounting in decision making processes. However, the imminent formation of the Intergovernmental Platform on Biodiversity and Ecosystem Services offers an opportunity to counterbalance this misrepresentation by establishing a scientific basis for consistently assessing cultural services. In that regard, the current review intends to facilitate discussion investigating the current state of cultural services accounting by offering an appraisal of existing evidence regarding cultural services indicator quality. The current review builds on scientifically recognized frameworks to develop a holistic understanding of how cultural services indicators are conceived within ecosystem services research. Among the measures found, benefit indicators were most frequently used for assessing inspirational, educational and recreational services. A broad variety of methods for accounting cultural services was found, mainly due to the varied aims of the studies. Most of the cultural services indicators were deficient concerning their clarity of definitions, purposes and understanding of the processes to be measured and referring only marginally to tradeoffs and bundles with other services. Only 17% performed multitemporal assessments and 23% used spatially explicit information. It seems that cultural services indicators quality could be greatly enhanced by investing more effort towards involving relevant stakeholders in conceptualization and communication phases, using participatory mapping tools to enhance visibility.

Keywords

Millennium Ecosystem Assessment, Cultural ecosystem services, Accounting, Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), Non-material values

1. Introduction

Cultural ecosystem services (CES) are the 'the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences' (MA, 2005). There are many environmental settings where culture interacts with nature, from domestic gardens to national landscapes, making significant contributions towards attainment of key individual and social needs (Plieninger and Bieling, 2012; UK NEA, 2011). Provisioning and regulating ecosystem services are largely regarded as having stronger linkages to human well-being than cultural services, particularly with regard to obtaining or maintaining security, basic materials for a good life, and health (MA, 2005). Yet, CES are those services with the least potential for mediation by socioeconomic factors. This means that, once degraded, cultural services are unlikely to be replaced by technical or other means (MA, 2005). In this vein, a recent global-level study has provided empirical evidence that human dependence on CES increases in the course of a country's economic development, while dependence on substitutable provisioning ecosystem services decreases (Guo et al., 2010). Recognition and observation of CES dynamics is, therefore, vital for assessing the impacts of ecosystem degradation on human well-being.

As CES present some of the most compelling reasons for ecosystem conservation, they are considered a fundamental component of all current ecosystem services frameworks (Chan et al., 2011). Worldwide, CES are influential motivators for owning and managing land, often more important than traditional commodity production (e.g. Bieling, 2004; Plieninger et al., 2012). But compared to other categories of ecosystem services, there have been very few assessments of CES (Feld et al., 2009; Seppelt et al., 2011), and the study of CES has been considered one of the most difficult and least accomplished tasks in ecosystem services research (Schaich et al., 2010). This lack of empirical evidence concerning the value of CES not only has consequences for ecosystem services research, but may also put the ideas at the core of the green economy discourse at large into question: valuing natural assets correctly, investing in natural assets, and seeking out actions that can deliver economic, social and environmental benef ts simultaneously (Le Blanc, 2011) all depend on effective assessment of the cultural services of ecosystems (Daniel et al., 2012).

This underrepresentation of CES data can result in biased ecosystem assessments and landscape planning, hampering their integration into conservation policies and threatening the creation of meaningful links between society and nature (Chan et al., 2012). It also overlooks that peoples' differing preferences regarding CES find their way into socio-political discourses around important issues such as rural development, natural resource management and nature conservation (Soliva et al., 2008).

This study aims to review the state of the art and the quality of CES indicators that have been commonly used in empirical studies. In order to reduce the variability of understandings and terms related to CES prevalent in the literature, we have based our study on the cultural services categories of the Millennium Ecosystem Assessment (MA, 2005), which provides the most comprehensive overview and categorization to date. We raise the following questions:

- What indicators for cultural ecosystem services have been used in empirical studies worldwide over a 20 year period?
- How can the informational quality (in terms of relevance and reliability) of cultural ecosystem services indicators be assessed?

To answer these questions, we systematically analyze three facets of the CES literature: firstly, the dimensions of cultural services are identified and categorized; secondly, a classification of the indicators found in the literature is performed, linked with an ecosystem indicators framework; and, finally, a quality appraisal of the CES indicators is carried out, examining their conception, calculation and communication.

2. Cultural ecosystem services and their indicators

2.1 Concept and challenges

Early references to the idea of ecosystem services go back to the mid-1960s and early 1970s (de Groot et al., 2002), with a parallel emergence of the notion of CES. Since that time, the CES concept has been used for reference to nonmaterial benefits people obtain from ecosystems.

The categories of cultural services have evolved significantly from the original classifications: at first recognizing merely recreation and culture (Costanza et al., 1997), but now broadened in the consolidated framework developed by the MA in 2005. The following categories and definitions were established by the MA (2005) and are used in the present study:

- **Spiritual and religious:** Many societies attach spiritual and religious values to ecosystems or their components.
- **Recreation and ecotourism:** People often choose where to spend their leisure time based in part on the characteristics of the natural or cultivated landscapes in a particular area.
- **Aesthetic:** Individuals find aesthetic value in various aspects of ecosystems, as reflected in support for parks, scenic drives, and selection of housing locations.
- **Inspirational:** Ecosystems provide a rich source of inspiration for art, folklore, national symbols, architecture, and advertising.
- **Sense of place:** Ecosystems as a central pillar of ‘‘sense of place’’, a concept often used in relation to those characteristics that make a place special or unique as well as to those that foster a sense of authentic human attachment and belonging.
- **Cultural heritage:** Many societies place high value on the maintenance of either historically important landscapes (‘‘cultural landscapes’’) or culturally significant species. The diversity of ecosystems is one factor contributing to the diversity of cultures.
- **Educational:** Ecosystems and their components and processes provide the basis for both formal and informal education in many societies. In addition, ecosystems may influence the types of knowledge systems developed by different cultures.

Despite the intuitive logic of the above CES categories, working with the concept of cultural services brings forth a number of challenges to ecosystem services accounting (Norton et al., 2012). One is the inherent difficulty of establishing a clear relationship between possible CES that might be assigned to certain elements of the ecosystem and its functions (Vejre et al., 2010); for example, a panoramic site could be a recreational attraction while also serving as an information function about the area for students. Additionally, a CES assessment requires identifying distinct 'operational units', to which functions, benefits and values can be assigned (Haines-Young and Potschin, 2007).

Therefore, prior to making CES assessments, agreement upon precise definitions of each category for the respective operational units is needed, to avoid double counting or misleading interpretations. For example, when landscape elements such as the number of spiritually related sites (churches, hermitages, altars and/or sanctuaries) are defined as proxies for spiritual services, these should not also be included in the category of touristic places.

Another problem is that, even if distinct biophysical carriers of CES can be identified, value is not often a calculable outcome. Although valuation techniques (e.g. choice experiments, willingness-to-pay) are available for services such as tourism or landscape aesthetics, many CES (in particular religious and spiritual services and sense of place) have proven resistant to monetary valuation, as they do not conform well to economic assumptions, and their assessment is complicated by the properties of intangibility and incommensurability (Chan et al., 2011). Therefore, economists have been challenged to recognize the inadequacy of valuation techniques to capture people's perceptions of CES (Kumar and Kumar, 2008).

Researchers working with CES must not only consider the services generated by the ecosystem, but also the relationship between the observer and the environment, including personal and social driving forces that influence the demand side in all ecosystem services (Gee and Burkhard, 2010). Consideration of the demand side is crucial for provisioning and regulating services as well, but most current ecosystem services assessments are focused on the supply side only (Plieninger et al., 2013). Factors related to the observer, such as social and cultural background, habits and belief systems, traditions of behavior and judgment, and styles of living also come into play – factors, in other words, that are related to the observer and indirectly at best to the ecosystem (Kumar and Kumar, 2008; Martín-López et al., 2012). Therefore, in most of the cases CES are built on individual perceptions using qualitative information what makes their verification difficult (Fagerholm and Käyhkö, 2009). However, CES indicators do not have to be built on individual evaluations only. For instance, percentage of land dedicated to protected areas could be understood as a societal expression of appreciation of ecosystems and therefore serve as a proxy for ecosystem services values. In any case, the consideration of preferences both at the individual and the societal level displays a form of democratic validation.

In the face of such challenges, there are only a few, if any, suitable measures to monitor the actual delivery of most CES (Feld et al., 2007; Layke, 2009). In the MA, only 38 indicators out of a total of 344 ecosystem services indicators corresponded to cultural services, and most of them are merely focused on recreation and tourism (32 indicators) at the national level

(UNEP-WCMC 2009). This kind of deficiency in CES accounting appears not only in the MA, but throughout the literature on ecosystem services worldwide. For example, Rey Benayas et al. (2009) performed a meta-analysis on 524 quantitative indicators of biodiversity and ecosystem services from 89 restoration assessments, but did not find a single study that measured cultural services explicitly.

2.2 Indicator quality

An indicator can be defined as a measure based on verifiable data that conveys information about more than itself (BIP, 2011). Assessments are being increasingly called upon to account for ecosystem services in terms of concrete results. In order to make this possible, indicators are expected to be 'SMART' (Specific, Measurable, Achievable, Relevant and Time-bound) (UNDP, 2009). SMART objectives and/or indicators play an important role in results-based management and in discussions on accountability. Indicators also need to be objectively verifiable, meaning that different researchers should be able come up with similar information when using a given indicator.

As for any evaluation, when assessing CES, minimum conditions should be met to guarantee indicator quality. For example, the UK National Ecosystem Assessment argued that cultural services measures should be context specific, fluid and mutable, as meanings, values and people's behaviors change over time and space in response to economic, technological, social, political and cultural drivers (UK NEA, 2011). Accordingly, the process of creation seems almost more important than the resulting measure itself when designing effective cultural services indicators. Development of such measures requires specific stages, from conceptualization to communication that may not be needed for other ecosystem services measures.

Therefore, the SPICED indicators framework (Table 1), which was developed for impact assessment of development programmes, may be particularly useful in the context of CES. Roche (1999) claims that when indicators use subjective information the SPICED framework becomes suitable. Consequently, during the literature review for this study, we compared the cultural services indicators found across studies to the model quality assessment (Fig. 1) that we explain below. The entire process for developing responsive SPICED cultural services indicators is defined as follows:

Conceptualization phase: This is the initial stage, when the aim and questions that need to be answered by the CES indicator are defined. Due to the subjectivity inherent in measuring intangible assets, clear definitions and the development of a conceptual framework involving relevant stakeholders will be crucial for defining how the measure relates to its purpose. Normally, an isolated indicator will not effectively measure a CES and will likely need to be combined with others.

Calculation phase: Once the stakeholders define indicator rationale, the next step is to identify the operational units to which the CES indicators will be assigned, which should represent the most suitable spatial and temporal context, according to data availability and indicator requirements. Establishing a base line is important, so that indicators can be

responsive to contextual changes. During this phase, searching for primary and/or secondary source information takes place. The data should be easily accessible at the level of the operational units, so that it can be used in future assessments, and data validity needs to be cross-checked, even when using purely qualitative information. This can be done by comparing different indicators from different informants, methods and researchers or, if available, with an accepted theory of the relationship between the indicator and its purpose. Specifying reasons for heterogeneity on the indicators may be useful for explaining uncertainties and assessing the accuracy of the outcome.

Communication phase: Interpretation of indicators is a significant process that should once again involve local stakeholders so as to build a coherent storyline. CES indicators should be easily understandable for the target audience by carefully selecting adequate language, graphics and media for presenting the findings. Finally, an attempt should be made to ensure that indicators are relevant to user's needs and capacities for measuring progress, early-warning of problems, understanding issues, reporting or raising awareness. Due to lack of information related to the dissemination of the indicators in some studies, this phase was included in the quality assessment, but only tentatively.

3. Methods

We used the ISI Web of Science (http://www.isiknowledge.com) to search for peer-reviewed journal papers that studied CES (search term: cultural ecosystem services). We did not limit the review to studies published during a fixed period or in a specific journal or performed in a specific country. The search was performed in July 2011 and resulted in a total of 200 studies, with the original sets of papers, being derived from 32 different journals. There has been a significant increase of published literature on this topic in the last 20 years, appearing to grow exponentially beginning in 2005 when the MA was released and reaching a peak in 2010. From the 200 studies found, we selected a subset of 70 papers that reported empirical ecosystem assessments. Out of these, 42 papers became the subject of our analysis, because they included explicit qualitative or quantitative measurement of any cultural ecosystem service dimension mentioned in section 2.1, at any spatial or temporal scale. The remaining papers were either conceptual, with no relevant empirical component, or were unrelated to CES assessment. The papers finally considered were published between 1999 and 2010.

The selected studies were initially classified by geographic location and scale. Then, in an attempt to maintain consistency across the uneven CES measurements, the indicators found in the empirical studies were sorted out. The indicators were first classified using the MA categories and then by following an ecosystem indicators framework that runs from ecosystem conditions to impacts on human well-being indicators. This framework borrows from a number of sources incorporating elements from the Driving force-Pressure-State-Impact-Response (DPSIR) framework and was useful for organizing the indicators for the Ecosystem Service Indicators Database (ESID, 2012). The resulting indicator classification was eventually reviewed during an experts' workshop session on ecosystem services indicators (UNEP-WCMC, 2010), which led to the establishment of the final set of categories (Table 2). In the following, an in-depth analysis of the selected papers was carried out. This covered the geographic location and scale of study, the CES indicator classification systems

and types considered and an analysis of a broad range of variable in the methods applied (e.g., quantitative or qualitative approaches, use of scenario techniques, spatial scale of indicators' representation). Lastly, the indicators were submitted to a quality assessment based on the fulfillment of the different steps within the phases (conceptualization, calculation and communication) defined in the SPICED conceptual model (Fig. 1).

When the indicator accomplished one SPICED step they received one point so the highest quality indicators accumulated a total of nine points when they fulfilled the entire SPICED process. As a result of the preceding analyses, we filtered the top ten quality CES indicators which are most effective within their context of use.

4. Results

4.1. The geographic location and scale of the studies

The size of the study (Table 3) areas ranged from a few studies performed at a very local scale (< 10 km²) to more than 35 % of the studies being carried out at large scales (> 100,000 km²).

Within the 42 selected documents, two global assessments (Everard et al., 2010; Guo et al., 2010) and two regional studies in Europe and South Africa (van Jaarsveld et al., 2005; Vila et al., 2010) were found (see Table 4). At country level, the highest number of empirical studies was performed in China (14%), half of them located in urban green systems (Jim, 2006; Jim and Chen, 2006; Jim and Chen, 2009). In the USA, a large number of empirical studies addressing CES was performed as well (12%), focused on agroecological and multifunctional landscape frameworks (Lovell et al., 2010a, b). Some of these studies tried to expand the limited Western view of cultural services towards a more holistic definition of ecocultural attributes as understood by some Native American tribes (Burger et al., 2008; Burger, 2010). Australia ranked third in number of studies and was the country with the largest study areas. Africa and Latin America had a low representation in the published literature (7%).

4.2 Cultural services indicators classification

The MA framework for cultural ecosystem services was explicitly used in only five studies, although the majority of the studies mentioned and recognized the MA categories as valid. A total of 70 cultural services indicators were found in the literature and classified using the MA terminology. Some difficulties appeared during the sorting process, due to the intricate array of meanings used by the authors. Recreational services were easily identifiable and classifiable, but cultural heritage and knowledge system services were more ambiguous to assess.

For example, 'traditional ecological knowledge (TEK)' indicators were classified as education, despite their also being potentially understood as part of cultural heritage service.Manifold studies assessed other ecosystem services and, in some cases, tradeoffs and bundles were even recognized, although exhaustive analyses were not performed therein. Recreation and ecotourism were the most accounted for services, with 54% of the indicators, followed by aesthetic (14%) and educational services (9%). Inspirational indicators were least developed (3%) (Fig.2).

From the final set, a total of 29 studies measured other ecosystem services beyond cultural services, and only six considered tradeoffs of these services with cultural services. Burger et al. (2008) highlighted the holistic tribal understanding of nature, where dysfunctional regulating and supporting services could affect delivery of other benefits. Additionally, Raudsepp-Hearne et al. (2009) propose a method to quantify the provision and interactions among multiple ecosystem services across differently characterized landscapes. They found that municipalities with high ecosystem service diversity values or high multifunctionality were those with high values for CES, moderate values for crop production, and moderate values for forest recreation.

Figure 3 shows how the measurements, assembled under MA categories, were classified according to the cultural services framework (presented in Table 2). The cultural ecosystems benefit indicators, which measure the products from an ecosystem that humans consume directly, were most frequently used for measuring overall inspirational, educational and recreational services, such as the amount of poems, art, or folklore produced in an area (Everard et al., 2010), the number of educational programmes (Rönnbäck et al., 2007) or tourists' willingness to pay (Petrosillo et al., 2007). In addition, function indicators were used only in spiritual, recreation and aesthetic categories (Barthelet al., 2005; Ingold and Zimmermann, 2010; Raudsepp-Hearne et al., 2009; Seidl and Moraes, 2000; Teh and Cabanban, 2007; Vejre et al., 2010), while intermediate services were found across all categories except inspirational. Measures of CES impacts on human well-being were only found in three studies (Bolund and Hunhammar, 1999, Everard et al. 2010, Petrosillo et al. 2007). A selection of the relevant indicators in accord with the ecosystem services classification framework is given in Table 5.

4.3 Analysis of the methods applied

A broad variety of methods for CES accounting was found, mainly due to the wide spectrum of aims the studies expressed. Some empirical studies targeted identifying impacts on CES derived from a particular intervention, for example the consequences of offshore wind farming in the North Sea on perceptions of cultural services (Gee and Burkhard, 2010) or the loss of traditional ecological knowledge in consequence of the transition to a market economy in rural Southern Spain (Gomez-Baggethun et al., 2009). Other, more policy-oriented studies joined quantitative measures of the environment with stakeholder appreciation of CES to derive most sustainable landscape management strategies (Burger et al. 2008).

An equal use of quantitative and qualitative measurements was observed (see Fig. 4), with a slight predominance of combined data (38%). Most of the quantitative methods to measure CES consisted of contingent valuation and secondary market data, mainly for accounting of recreational and ecotourism benefits (Beaumont et al., 2008; Bolund and Hunhammar, 1999; Ingold and Zimmermann, 2010; Jim and Chen, 2006; Jim and Chen, 2009; Martin-Lopez et al., 2009; Rodriguez et al., 2006; Seidl and Moraes, 2000; Vejre et al., 2010; Wang et al., 2006; Wang et al., 2010; Zander et al., 2010; Zander and Straton 2010). More than 50% of the studies derived their information from primary sources via direct observations, fieldwork and

interviews involving stakeholders in almost two-thirds of the cases. Stakeholder involvement at more than one stage of assessment was used in 68% of the studies.

Projections regarding a future state of CES under different scenarios were assessed in only five studies. Guo et al. (2010) performed projections to 2020 in a business-as-usual scenario to evaluate the evolution of human dependency on ecosystem services and biodiversity. In contrast, Quetier et al. (2007) created a model to predict community dynamics under different land-use change scenarios. Monetary value was not assigned in any study to sense of place, cultural heritage or spiritual services, likely due to a fundamental lack of conceptual understanding and required information available on these topics.

As a result of deficient availability of data over time, mainly punctual studies were found, with merely 17% performing multitemporal assessments. Different approaches were used to evaluate the CES trends, from analyzing existing data series on tourism investment (Guo et al*.,* 2010), performing landscape evaluations retrospectively to identify the evolution of landscape perceptions (Barthel et al., 2005; Vejre et al., 2010) or using historical trend lines as a tool in rapid rural appraisals (Pereira et al., 2005; van Jaarsveld et al., 2005).

Only 23% of the studies were explicitly represented spatially on a map. Among them, a variety of approaches were found to spatially represent cultural services across different biomes, using mainly discrete landscape units as system boundaries (Barthel et al., 2005; Ceperley et al., 2010; Petrosillo et al., 2007; Rönnbäck et al., 2007; Wang et al., 2006;Wigand et al., 2001; Willemen et al., 2009; Zander et al., 2010) and, in few cases, using farms as a common land unit (‘‘the smallest unit of land that has a permanent, contiguous boundary, a common land cover and land management, a common owner and a common producer”, Lovell et al., 2010b) or municipalities as administrative limits (Raudsepp-Hearne et al., 2009).

Different spatial scales of representation were found ranging from local to global mapping. In most of the spatially explicit studies, biophysical variables from the landscapes were overlaid with stakeholders’ perceptions of cultural services within the landscape (Barthel et al., 2005; Ceperley et al., 2010; Lovell et al., 2010b; Tzoulas and James, 2010). Recreation and ecotourism was the cultural service most commonly presented in a spatially explicit way by, for example, plotting condition indicators such as number of green spaces to be enjoyed by the public (Barthel et al., 2005), mapping recreational facilities like trails for hiking, biking or skiing (Lovell et al., 2010b) or enumerating touristic attractions per km² (Raudsepp-Hearne et al., 2009). Benefit indicators were also mapped, for instance using the zonal travel cost method at various spatial scales (Martin-Lopez *et al.,* 2009).

In the studies analyzed, no overall methodological consistency was found. Every assessment is based on a specific problem and therefore needs its specific classifications, definitions, and methods. But if scaling up is the target, a consistent method may be needed with a minimal agreement on the CES definitions and procedures for creating CES indicators.

4.4 Quality assessment of the cultural services indicators

Based on the conceptual model (Fig. 1) for developing CES indicators, a quality assessment was performed across the 70 indicators identified. Regarding the conceptualization of the indicators, the majority responded to a specific target identified within the study (57%). However, clear definitions as well as the development of conceptual frameworks to define rationales for the indicators was lacking in most of the cases. In most of the studies, the conceptualization phase was not fully developed; especially lacking was the participatory process with local stakeholder involvement.

Therefore, most of the indicators were deficient in terms of clarity of definitions, purposes and understanding of the processes to be measured. In the calculation phase, few indicators (11%) included a baseline to assess changes over time, as was done in the case of the 'traditional ecological knowledge' indicator presented by Gomez-Baggethun et al, (2009) or in the analysis of nature trails and recreation facilities in Swiss forest enterprises (Ingold and Zimmermann, 2010). Furthermore, only 60% of the indicators clearly identified the spatial operational units where the cultural service took place.

The majority of the cultural services indicators performed well during the communication phase, sufficiently adapting the findings to the context of the study area. However, assessing the suitability of communication strategies in terms of using appropriate graphs, language and channels (scientific articles, policy reports, web pages, and public presentations) appears to have been challenging. For some studies it was not feasible to completely assess the success of the communication phase since it was finally performed using other media like local radio or magazines, which were not specified in the article (Bolund and Hunhammar, 1999; Jim and Chen, 2006). The greater part of the CES indicators were utilized by users to achieve their purposes. Although, it is important to state that the creators, the users and managers of CES indicators are often different people An example for the latter is the case of Burger (2010) in which he valued the eco-cultural attributes such as participation in nature-related religious rituals in Northwestern Idaho for Native Americans and Caucasians. Here, the resulting indicators were used not by the users of the CES but by the local politicians to better design the eco-cultural events in the area.

In the following, we selected the top ten indicators which obtained the best ratings in the quality assessment (Table 6). It is important to highlight that the quality of the indicators is attached to their context of creation; therefore, the same indicator would not necessarily perform successfully in other circumstances.

5. Discussion

Cultural ecosystem services (CES) are strongly correlated with the perceived well-being of people in developing countries who are directly occupied with land use and resulting commodity products as well as those in developed countries, where economic growth has made humans more dependent upon other types of ecosystem services than supporting ones (Guo et al., 2010). However, up to now specific definitions and robust measurements of the importance of cultural services for people have been elusive. Better understanding of this importance could offer a feedback mechanism concerning changes in ecosystem service delivery as perceived by those who are directly affected to the establishment of public policies

that, in turn, can contribute towards driving improved land management (Selby et al., 2007). Assessing the strength and scope of such feedback mechanisms is a key priority in ecosystem services research (Carpenter et al., 2009).

The analysis presented here has revealed that recreation and ecotourism are the most accounted for CES categories, while inspiration was the least investigated dimension. Although many studies included other ecosystem services measurements, only marginal references to tradeoffs and bundles were found. This fact can be seen as being problematic, since competitive forces have driven many societies to consistently sacrifice their CES for more prosaic needs (Butler and Oluoch-Kosura 2006).

Regarding the indicator types found in the review, benefit indicators were the most frequently used for measuring inspirational, educational and overall recreational services, probably as methods for their economic valuation are well-developed. Yet indicators measuring impacts on human well-being were only marginally represented, despite existing research connecting recreational activities and health benefits (Dasgupta, 2001; MA, 2005). Therefore, it would be a relatively straightforward task to find solid measures for this domain. Regarding the quality assessment conducted, it is evident that the reviewed cultural services indicators are generally lacking in terms of conscious conceptualization of the subject to be measured, which may lead to confounding outcomes. Investing more effort towards involving relevant stakeholders in the definition and conceptualization of measurements would likely improve their quality. Communication strategies to disseminate indicators were barely apparent in the literature, although the indicators assessed seemed to sufficiently reach their target audiences by using suitable communication means.

Finally, it was shown that spatially explicit measures contributed to improve the quality of the CES indicators. Participatory mapping tools can greatly enhance the visibility of intangible ecosystem services, improve understanding of spatial and temporal dynamics and enable their ranking in order of relative importance (Brown, 2005; Fagerholm et al., 2012; van Berkel and Verburg, 2012). Moreover, spatial inventories of cultural services via mapping approaches can enable identification of possible trade-offs with other local- to regional-scale ecosystem services and may help inform decision making in regional landscape planning (Bieling and Plieninger, 2012; Schaich et al., 2010).

6. Conclusions

The present review leads to conclusions which are relevant for future CES assessments. Their consideration may be particularly fruitful for the current process of establishing a Intergovernmental Platform of Biodiversity and Ecosystem Services (IPBES):

- CES assessments should draw on recognized frameworks such as the MA (2005) and the ESID (2012). Most importantly, they should be combined with the SPICED indicator framework (Roche, 1999) as this has proven highly useful for understanding, categorizing and contextually assessing the quality of CES indicators. This would be especially useful to approach a consistent method that enable the scaling up of the EU

Biodiversity Strategy toward 2020, which requires all member states to map and assess cultural services at national scales (European Commission, 2011).

- CES assessments could be greatly enhanced by using a combination of different indicators, ranging from the condition of an ecosystem to the potential and actual benefits for its users. Triangulation of different indicators would be particularly helpful for assertively classifying and reaching a holistic understanding of the CES indicators within the multifaceted processes occurring in ecosystems.

- Stakeholder involvement does notably improve the quality of CES indicators. During the conceptualization phase, the relevant stakeholders may ensure a common understanding of cultural services which improves the collection of data for the calculation phase. Finally, a participatory communication process results in a more successful CES assessment outreach. Participatory mapping tools are particularly useful for enhancing the visibility of intangible ecosystem services. The IPBES has the potential to establish a model of a systematic and effective process of stakeholder engagement by determining aspects such as: Who are the relevant stakeholders in the different phases of the CES evaluation (conceptualization, calculation and communication)? How could a balanced participatory process of the relevant scientist versus non scientist stakeholders be ensured? How could we organize stakeholder involvement for global vs. local CES assessments? Who can stakeholders be integrated in cross-scale CES studies?

- Since the existing studies on CES have been pursued for different purposes and within different disciplines, the resulting attempts at assessing and valuing cultural services are highly heterogeneous in their definitions, frameworks and approaches. To overcome the shortcomings of assessing CES, fostering collaboration among landscape ecologists, social scientists and environmental planners is essential for overcoming disciplinary language barriers and creating common ground for understanding. This could bring us a large step forward towards achieving truly equilibrated ecosystem assessments, where cultural services have the same visibility as provisioning or regulating services.

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Tables

Table 1
Definitions of SPICED indicators (Source: Roche, 1999).

Properties	Definition
Subjective	Informants have a special position or experience that gives them unique insights which may yield a very high return on the investigator's time.
Participatory	Indicators should be developed together with those best placed to assess them. This means involving a project's ultimate beneficiaries, but it can also mean involving local staff and other stakeholders.
Interpreted and communicable	Locally defined indicators may not mean much to other stakeholders, so they often need to be explained.
Cross-checked and compared	The validity of assessment needs to be cross-checked by comparing different indicators and their progress and by using different informants, methods, and researchers.
Empowering	The process of setting and assessing indicators should be empowering in itself and allow groups and individuals to reflect critically on their changing situation.
Diverse and disaggregated	There should be a deliberate effort to seek out different indicators from a range of groups, especially men and women. This information needs to be recorded in such a way that these differences can be assessed over time.

Table 2
Ecosystem services indicators classification framework adapted to cultural ecosystem services (Source: adapted from UNEP-WCMC, 2010).

Indicator type	Definition
Cultural ecosystem condition indicators	Indicators related to the physical, chemical and biological properties of an area, measuring the ability of ecosystems to support ecosystem processes and deliver cultural ecosystem services.
	Example: Number of endemic plants per km²
Cultural ecosystem function indicators	Indicators for the processes by which ecosystems deliver cultural services, based on known links between ecosystem conditions and the ability of ecosystem functions to deliver services. Most regulating and supporting services within the MA framework are ecosystem functions.
	Example: Capacity of an area to provide natural touristic attractions
Cultural ecosystem intermediate service indicators	Indicators, both quantitative and qualitative, of ecosystem products that are important for supporting human well-being, but not directly consumed by people.
	Example: Number of scenic roads in a natural area
Cultural ecosystem benefit indicators	Indicators of tangible products, which may or may not have monetary value, from ecosystems that humans directly consume. Much data of this sort is tracked as part of national accounts.
	Example: Visitors payments to a touristic area
Cultural ecosystem impact indicators	Indicators of the state of people's physical, economic, social, and spiritual well-being of an area and how they are provided for by CES there.
	Example: Levels of stress among frequent visitors of a natural area

Table 3
Distribution of the studies according to extent of study area.

<10 km²
10-99 km²
100-999 km²
1,000-9,999 km²
10,000-999,999 km²
>1,000,000 km²

Table 4
Geographical distribution of the studies ([a] More than one country included in the study).

Country	**Number of studies**
Australia	4
Benin	1
Brazil	2
Canada	1
China	6
Denmark	1
England	2
France	2
Germany	1
India	1
Italy	1
Malaysia	1
Peru	1
Portugal	1
Spain	2
Sweden	3
Switzerland	1
The Netherlands	1
United States	5
Regional [a]	3
Global	2
Total	42

Table 5
Examples of cultural services indicators found across the literature review.

	Religious and Spiritual	**Aesthetic**	**Inspirational**	**Sense of place, cultural heritage and diversity**	**Education and knowledge systems**	**Recreation and ecotourism**
Condition-property	Riparian forest composition in sacred sites (Ceperley et al., 2010)	"Visual Quality"; combination of diverse habitat types (Lovell et al., 2010b)		Tangible objects in sea contributing to sense of place (Gee and Burkhard, 2010)		
Function	No. of intact ecosystems providing sacred grounds (Burger et al., 2008)	Impacts of alien species on aesthetic perception of landscape (Vila et al., 2009)		% of authentic land use/cover in cultural heritage landscape (Willemen et al., 2009)		Quality of river for fishing (Zander et al., 2010)
Inter-mediate services	No. of people participating in sacred activities (Burger, 2010)	No. of scenic roads, views used for photos (Everard et al., 2010)		Use of marine biodiversity (Beaumont et al., 2008)	Local ecological knowledge (Silvano et al., 2008)	Bird watching (Tzoulas and James, 2010)
Benefits		Property and house prices (Ronnback et al., 2007)	Benefits in production of folklore (Everard et al., 2010)	No. of lyrics purporting sustainable use of Opuntia scrub (Rodriguez et al., 2006)	No. of educational programs (Lovell et al., 2010b)	Revenue from tourism (Everard and Kataria, 2010)
Impacts on human well-being				Impacts of sand blowing on people (Everard et al., 2010)		Stress level reduced by green environment (Bolund and Hunhammar, 1999)

Table 6
Top ten CES indicators according to the quality assessment

Top ten CES indicators
1. Sacred sites to determine beneficial differences in different riparian forests (Ceperley et al., 2010)
2. Travel costs to the tourist spot near a hydropower facility (Wang et al., 2010)
3. Intrinsic tree attributes and related tree-condition, location and outstanding features (Jim, 2006)
4. Funding for scientif c research and education facilities within the ecosystem (Wang et al., 2010)
5. Number of recreation facilities (Ingold and Zimmermann, 2010)
6. Number of people performing outdoor activities in a park (Tzoulas and James, 2010)
7. Formal revenue through hunting licenses (Everard and Kataria, 2010)
8. Formal and informal revenue from camp support (Everard and Kataria, 2010)
9. Housing prices as aesthetic value proxies (Jim and Chen, 2009)
10. Zonal and individual travel costs (Martin-Lopez et al., 2009)

Figures

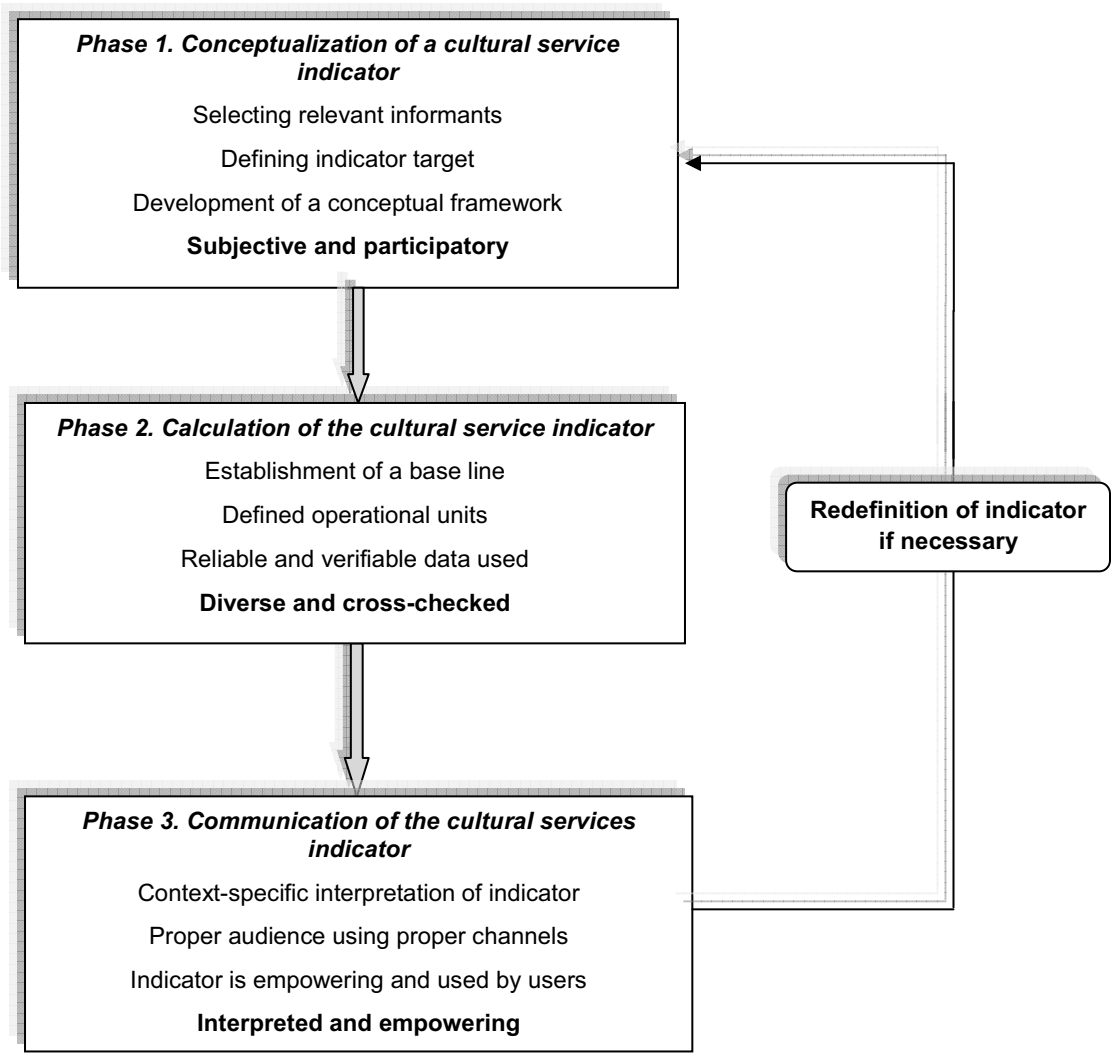

Fig. 1. Conceptual model to develop SPICED cultural services indicators (Source: adapted from BIP, 2010).

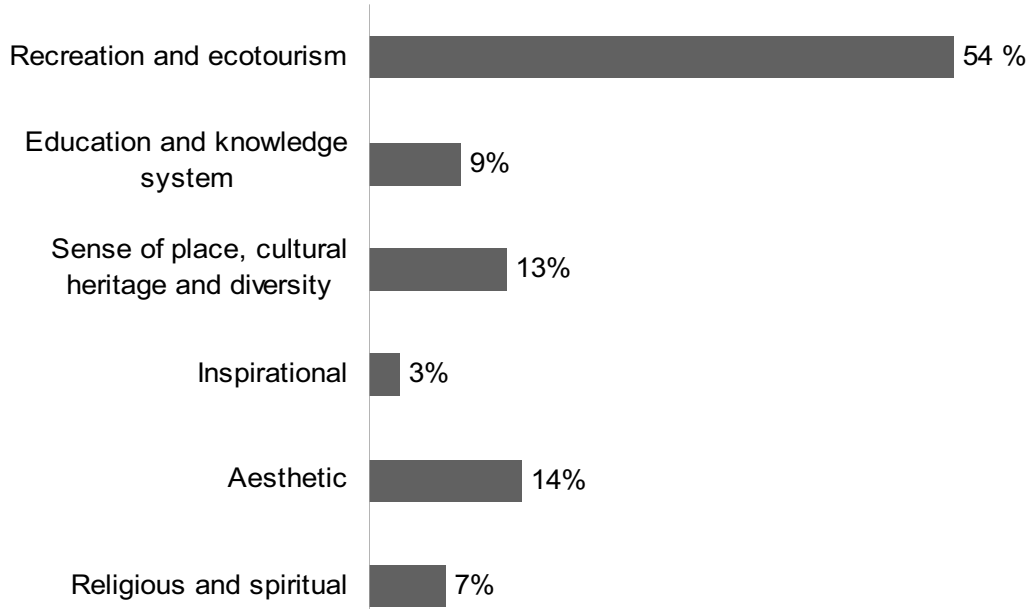

Fig. 2. Percentage of cultural services indicator categories.

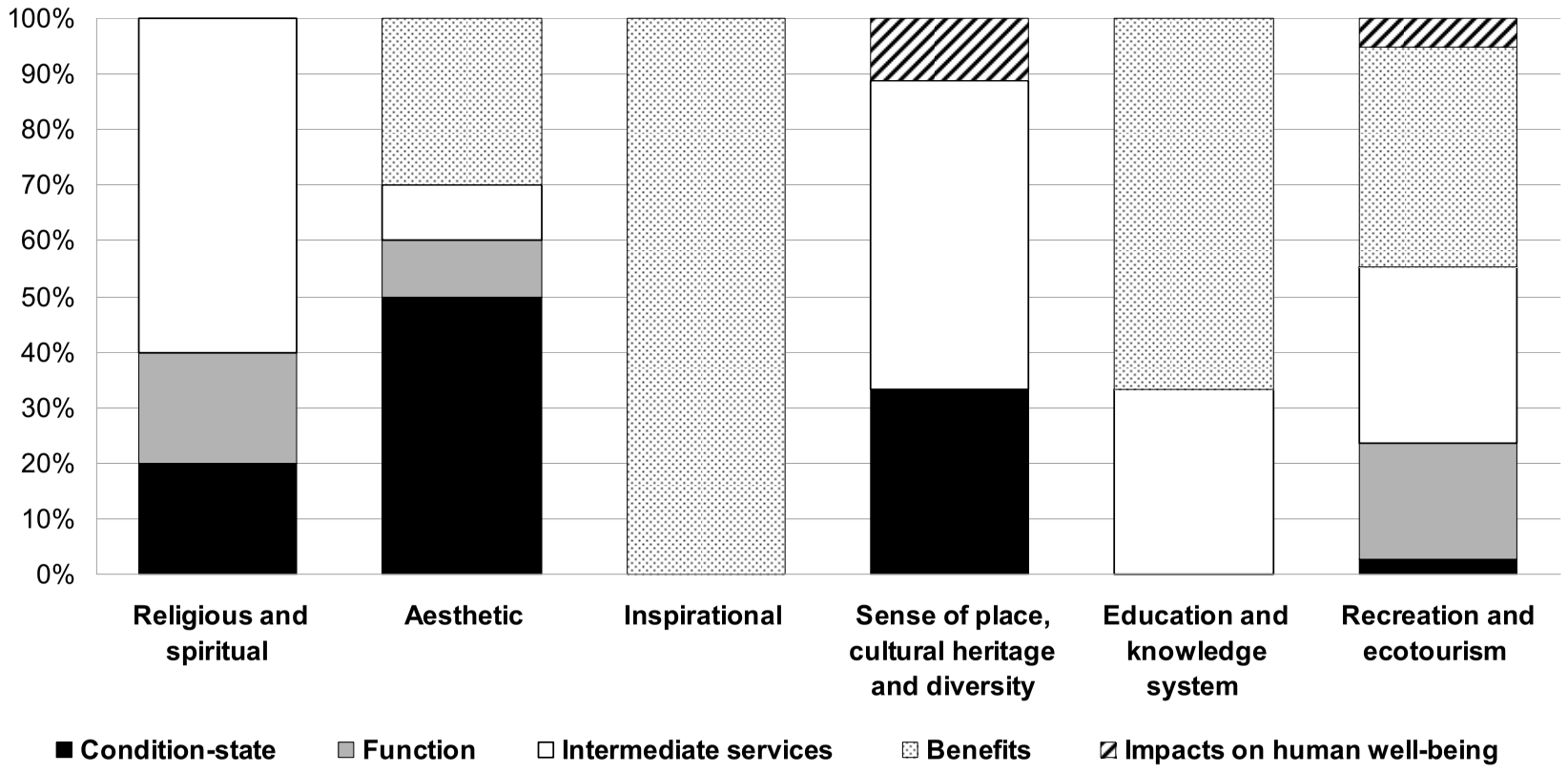

Fig. 3. Percentage of cultural ecosystem services indicators according to indicator type and category.

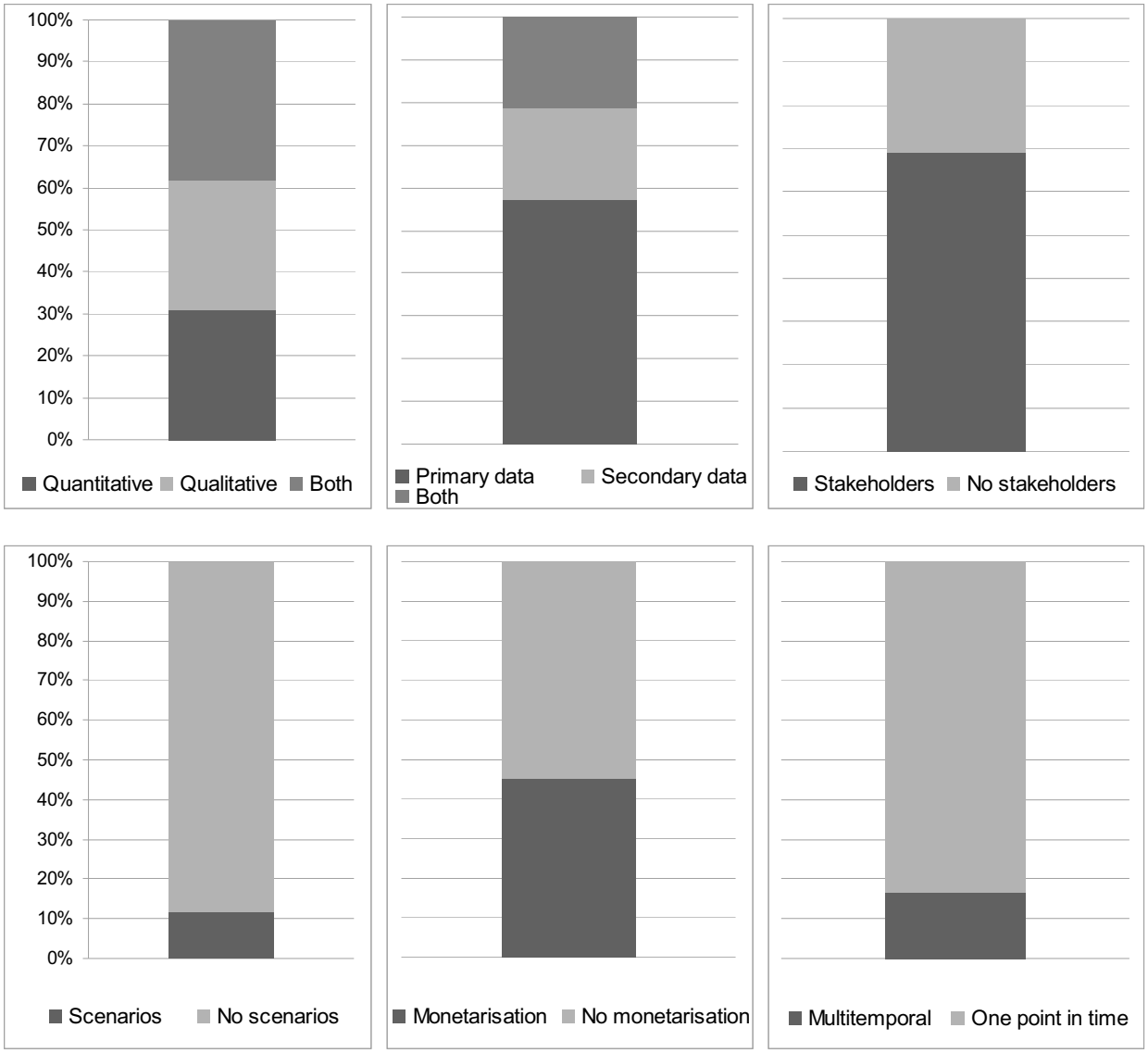

Fig. 4. Percentage of cultural services assessments that used various method (from top left to bottom right: a. use of qualitative or quantitative data; b. use of primary or secondary information; c. involvement of stakeholders; d. use of scenarios; e. monetary non-monetary valuation; and f. multitemporal vs. one point in time analysis).