INSIGHT INTO CULTURAL ECOSYSTEM SERVICES: COMPREHENSIVE REVIEW THROUGH CLUSTER ANALYSIS

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Abstract

The nature of an ecosystem shapes human culture, heritage, values, social interactions and knowledge systems as well as amenity services (i.e. aesthetic, tourism and recreation, artistic, spiritual and intellectual development) considerably; thus, any changes in an ecosystem can have significant impacts on cultural services for societies. In light of this, this paper presents the outcome of a comprehensive review of literature focusing on the current status of cultural ecosystem services (CES) and the various conceptual, ideological and methodological approaches developed and used in this context. The literature on CES covering the 2009-2016 period was screened with the aid of a structured questionnaire which was developed, pre-tested and modified to fit the purpose. An Agglomerative Hierarchical Cluster Analysis characterised by Binary Squared Euclidian distance with Centroid Clustering method was employed to analyse the responses to the questionnaire, and the result was further supported and interpreted by way of qualitative discussion. The review, as a whole, identified the importance of CES and acknowledged its contribution to wellbeing as peripherals to a bundle of services. It recognised that most studies on this phenomenon were not limited to a specific region and/or on a specific system and were rarely quantified. Further, it was remarked that those studies did not value the ecosystems very often in monetary terms, but tended towards areas like mapping and cultural landscape.

Key Words: *Cultural Ecosystem Services, Literature Review, Cluster Analysis*

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INTRODUCTION

Cultural ecosystem services (CES) have been included in many studies and frequently defined in the manner proposed by Millennium Ecosystem Assessment: i.e., the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation as well as aesthetic experience (Milcu, et al., 2013; Tenerelli, et al., 2016; Schaich, et al., 2010; Daniel, et al., 2012; Bieling & Plieninger, 2013; Lopez, et al., 2009; Chan, et al., 2012a; Chan, et al., 2012b; Morcillo, et al., 2013; Satz, et al., 2013). Based on this definition, the Millennium Ecosystem Assessment included seven subcategories of cultural services: i.e., (i) cultural diversity; (ii) spiritual and religious values; (iii) knowledge systems; (iv) educational values; (v) inspiration; (vi) aesthetic values; (vii) social relations; (viii) sense of place; (ix) cultural heritage values; and (x) recreation and ecotourism.

CES have been similarly defined as contributions to the nonmaterial benefits that arise from human ecosystem relationships (Chan, et al., 2012a) as well as the services that contribute to human wellbeing because of the existence of a particular interpretive ‘lens’ that has its roots in cultural background (Baulcomb, et al., 2015). These services demonstrate a significant relationship between ecosystem structures and functions specified in the biophysical domain and the satisfaction of human needs and wants (Daniel, et al., 2012). As an approach to define the ‘culture in ecosystems, cultural heritage refers to complex activities of life, including those beliefs, values, customs and traditions that are embodied in folklore and ethnography or communal creations such as dances, songs, myths and designs (Tolentino, 2007). Furthermore, cultural services are recognised as the strongest incentives for developed communities to become involved in environmental conservation (Schaich, et al., 2010; Morcillo, et al., 2013; Chan, et al., 2012a).

Alternatively CES were addressed in the concept of natural capital as a metaphor to elicit values of nature which are not directly quantifiable in monetary terms i.e. amenity, health, education, symbolic meanings (Chiesura & Groot, 2003). These belong to the ethical, spiritual and affective realm of human beings, which reflect the intangible dimensions of their relation with nature. The importance of cultural services has consistently been recognised, but infrequently assessed due to its inherent characteristics. Those are intangible, subjective, invisible and nonmarket goods, which are difficult to quantify in biophysical or monetary terms. (Daniel, et al., 2012; Lopez, et al., 2009; Baulcomb, et al., 2015; Pleasant, et al., 2014).

The analysis of global values of ecosystems (Groot, et al., 2012) gives an overview of the value of ecosystem services of 10 main biomes (or subsystems). The study (Groot, et al., 2012) provides the values in monetary units. There are 665 value estimates on

provisioning, regulating, habitat and cultural services (145 estimates) described as follows (Table 1).

Table 1: The Number of Value Estimates per Valuation Method and Ecosystem Service

Cultural Services	No. of Est.	Market Values						Revealed Preference		Stated Preference		Other
		Direct Market Values			Cost based Methods							
		DMP	PES	FI/P	AC	M/R	RC	HP	TC	CV	GV	
Aesthetics Information	12	2						3				1
Recreation	122	40	1	8	0	0	0		23	6		7
Inspiration	2	1								43	1	
Spiritual Experience	1									1		
Cognitive Development	8	5							1	1		1
Total	145	48	1	8	0	0	0	3	24	51	1	9

Source: (Groot, et al., 2012).

Among the 145 estimates, the majority found were for recreation (84%). The estimates were derived through contingent valuation (35%), direct market (33%), travel cost (16%), other (6%), Hedonic (2%) and group valuation (0.6%) methods. Table 2 shows a summary of the monetary values for each sub cultural service per biome which are presented as ‘averages’. The highest economic values were recorded in coastal reefs, inland wetlands, coastal wetland and fresh water systems.

Thus the cultural service has a substantial contribution in total value of a particular ecosystem. But the intangible nature of cultural services hinders its value from the total ecosystem value. Therefore it is worthwhile to review, the literature on CES, rather than a general review of ecosystem services. Therefore this review explores the current status of CES in terms of conceptual frameworks and methodologies in literature, which allow to identify the conceptual, ideological and methodological approaches that has not been explored yet.

Table 2: Summary of Monetary Values for each Service per Biome (\$/ha/year), 2007

Cultural Services	Marine	Coral Reefs	Coastal Systems	Coastal Wetland	Inland Wetland	Fresh Water	Tropical Forest	Temperate Forest	Woodland	Grasslands
Aesthetics		11,390			1,292					167
Information										
Recreation	319	96,302	256	2,193	2,211	2,166	867	989	7	26
Inspiration					700					
Spiritual Experience			21							
Cognitive Development		1145	22					1		
Total	319	108,837	300	2,193	4,203	2,166	867	990	7	193

Source: (Groot, et al., 2012).

METHODOLOGY

This study is a primary review of the publications which explicitly deal with CES. A comprehensive search was performed using Google Scholar to search peer-reviewed journal papers and publications that studied CES (search term: cultural ecosystem services). We confined the study to items published between January 2009 and January 2016, irrelevant to a particular journal or region. Further the study was limited to the articles that contained ‘CES’ in its title or among their keywords. The recreation and ecotourism service is often considered, but classified as a provisioning service rather than a cultural service. Therefore the articles that describe some of the subcategories of CES (i.e. tourism, recreation and landscape) but do not recognise them as cultural services, or studies that do not use cultural services in their terminology are excluded from the study. As the final point, 45 papers were subject to in-depth analysis. Those publications that explicitly deal with CES were taken as the study sample, and the contents of each were perused in line with a questionnaire designed to gather structured information on the literature reviewed. The questionnaire classified cultural services under ten categories as established in the Millennium Ecosystem Assessment. To gain a deeper understanding, the questions were developed to identify ecosystem services

bundling, mapping, subcategories of CES, and subsystems in ecosystems, conceptual frameworks and different valuation approaches. It was difficult to individually contemplate all 45 articles. Therefore seven characteristic questions were used in an agglomerative hierarchical cluster analysis through Binary, Squared Euclidian distance with Centroid clustering method. Those seven characteristic questions that were best addressed to identify the ideology and methodology of the publication were accounted for as the variables of the study. The measures of the characteristics were taken as Binary solutions (if present 1; if absent 0). Best fit cutting points of the clusters were designated to minimise the variance within a group and to maximise the variance between groups. Similar groups that were identified through cluster analysis were interpreted and supported by qualitative discussions.

RESULTS AND DISCUSSIONS

Elementary Analysis of Profile

The sample had 43 articles and two reports published between 2009 and 2016 (Figure 1). In some publications (n=22), CES was discussed in general while others regarded it (n=23) as a specific type of ecosystem included in the classification of Millennium Ecosystem Assessment (Figure 2). There were seven studies on coastal ecosystems (Fagerholm & Käyhkö, 2009; Gee & Burkhard, 2010; Lopez, et al., 2009; Baulcomb, et al., 2015; Morcillo, et al., 2013; Pleasant, et al., 2014; Ghermandi, et al., 2009) and two on urban systems (Andersson, et al., 2015; Sander & Haight, 2012). No studies on polar or island systems were found.

Figure 1: Number of Publications in Yearly Basis

Figure 2: Cultural Service Studies on Ecosystems

Figure 3: CES Studies on Regional Basis

Approximately half of the studies discuss cultural services in general, although these services should be articulated according to the specific type of ecosystems. There are systems (coastal, urban, forest) with significant levels of cultural diversity that are under threat from humans: a situation which should be addressed with vigour.

According to the review more than one fourth of the studies were not based in a specific region, while a majority of the studies ($n=19$) was based in Europe (Figure 3). There is a lack of attention towards regions with significant levels of cultural diversity (Asia and Africa) that are at present under threat from humans and that need to be treated separately.

Twenty six publications discussed specific drivers promoting change of CES, either directly or indirectly. Seventeen publications presented ways to map CES (Tenerelli, et al., 2016; Bieling & Plieninger, 2013; Berkel & Verburg, 2014; Giannecchini, et al., 2009; Plieninger, et al., 2013a; Groot, et al., 2010) and 22 acknowledged the contribution of CES to wellbeing. One third of publications ($n=30$) were assessed by accounting CES as a sole category and only 15 publications have made an attempt to figure out subservices as a discrete service bundle of CES (Figure 4). Thus in literature, CES and their drivers of change have been sufficiently acknowledged, but its sub services have not been critically assessed. Further there are only a few studies with methods to map CES, which result in a huge gap in identifying those services.

Figure 4: Number of Publications in Different Subcategories of CES

Recreation and ecotourism subcategories together with aesthetic were investigated more frequently in literature. The subservices, namely knowledge systems, education, sense of place, social relation, cultural and heritage values were not found in any article. Fourteen studies had no empirical method in either qualitative or quantitative form. There were qualitative (n=15), quantitative (n=14) as well as mixed (n=2) methodologies used across the sample.

There were seven publications that have derived an economic value for cultural services in relation to the recreation and ecotourism values that were derived through the revealed preference methods. The cultural landscape seems to be an area of research which is rapidly growing, with more than half of all studies surveyed dealing with the concept (Tenerelli, et al., 2016; Schaich, et al., 2010; Tengberg, et al., 2012; Hartel, et al., 2014; Berkel & Verburg, 2014; López-Santiago, et al., 2014; Plieninger, et al., 2014; Groot, et al., 2010; Pleasant, et al., 2014; Turner, et al., 2014). There were only five tradeoff analyses with in-depth discussions, often in relation to the tradeoffs among the ecosystem services but with very rare incidents of tradeoff among cultural services or stakeholders.

Cluster Analysis

Six meaningful clusters were developed to minimise the variance within the cluster and to maximise the variance between clusters (Figure 5). The clusters are as follows: (a) Meta studies; (b) Conceptual studies; (c) Descriptive studies; (d) Qualitative studies; (e) Noneconomic studies and; (f) Economic studies. They will each be described in order.

a. Meta Studies

Meta studies are those with no conceptual framework or model which describe the large number of studies in literature using either qualitative, quantitative or semi-quantitative methods. These studies are a comprehensive review of literature and the smallest cluster consists of only three publications (Milcu, et al., 2013; Morcillo, et al., 2013; Schaich, et al., 2010).

Milcu et al. (2013) is a comprehensive review of literature of CES studies. The study included service providers, geographical distribution, CES subcategories, methods, and drivers of change. The numbers of publications in each category are relatively higher in comparison with the numbers that we derived in our study. This is due to the fact that our search term is restricted only to the CES (the study was limited to articles that contained 'CES' in its title or among its keywords).

Figure 5: Dendrogram of the Hierarchical Cluster Analysis

Morcillo et al. (2013) is an empirical meta-study of cultural ecosystem service indicators that intends to investigate the current state of cultural services by accounting and appraising existing indicators. The review builds on scientifically recognised frameworks (Roche, 1999) to develop a holistic understanding of how cultural services indicators are conceived within ecosystem services research. The selected relevant indicators in accordance with the ecosystem services classification framework are summarised in Table 3. Further the study contains the 10 indicators which obtained the best ratings in quality assessment (Table 4).

Schaich et al. (2010) is a qualitative empirical meta-study of cultural landscape, which is a top indicator and a growing research area in CES. The study includes a broad discussion and a comparison of the objectives, approaches, and methodologies adopted by ecosystem services research and cultural landscape research. The term 'cultural landscape' is defined and supported through many references as the interface between nature and culture, tangible and intangible heritage, biological and cultural diversity that can be understood as a social-ecological system, where the social, economic, and environmental components are closely interlinked. The study compares two types of categories: (a) publications that contain ecosystem services as a keyword; and (b) publications that contains cultural landscape as the keyword. Cultural landscape was found to be documented 50 years before ecosystem services was documented, but was still behind in terms of the total number of publications as well as the mean number of citations per paper.

b. Conceptual Studies

There were two conceptual studies that outlines a framework to address cultural services within the ecosystem framework (Daniel, et al., 2012; Chan, et al., 2012a). Daniel et al. (2012) provide a foundation for merging ecological and social science epistemologies to define and integrate cultural services better within the broader ES framework (Figure 6). This presents the cultural service categories in terms of the relevance of ecological structures and functions for their formation. There were three assessment methods i.e. (a) monetary assessments (b) quantitative (nonmonetary) assessments, and (c) comprehensive studies of the human nature interaction that was based on scope and may extend beyond the other classes.

Table 3: Examples of Cultural Service Indicators Found across the Literature Review

Cultural Services	Classification of Indicators				
	Condition-property	Function	Immediate Services	Benefits	Impact on Human Wellbeing
Religious and Spiritual	Forest composition	No. of sacred grounds	No. of people participating in sacred activities		
Aesthetic	Visual quality	Alien species on aesthetic perception of landscape	No. of scenic roads, views used for photos	Property and house prices	
Inspirational				Benefits in production of folklore	
Sense of Place, Cultural Heritage and Diversity	Sense of place	Cultural heritage landscape	Use of marine biodiversity	No. of lyrics	Impacts of people
Education and Knowledge Systems			Local ecological knowledge	No. of educational programs	
Recreation and Ecotourism		Quality of river for fishing	Bird watching	Revenue from tourism	Reduced stress level

Source: Adopted from (Morcillo, et al., 2013).

Table 4: The Best 10 CES Indicators according to the Quality Assessment

Publication	Cultural Service	Descriptor
a. (Ceperley, et al., 2010)	Cultural landscape	Sacred sites
b. (Wang, et al., 2010)	Recreation and ecotourism	Travel costs
c. (Jim, 2006)	Landscape	Intrinsic tree attributes and related tree-condition
d. (Ingold & Zimmermann, 2010)	Recreation and ecotourism	Infrastructure facilities
e. (Wang, et al., 2010)	Education and knowledge systems	Funding for scientific research
f. (Tzoulas & James, 2010)	Recreation and ecotourism	Number of people performing outdoor activities in a park
g. (Everard & Kataria, 2010)	Recreation and ecotourism	Formal revenue through hunting licenses
h. (Jim & Chen, 2009)	Aesthetic value	Housing prices
i. (Lopez, et al., 2009)	Recreation and ecotourism	Zonal and individual travel costs

Source: Adopted from (Morcillo, et al., 2013)

Chan et al. (2012a) have developed a three step framework (Figure 7) to avoid double counting as well as to ensure appropriate representation of the full range of relevant values i.e. (a) identification of broad ecosystem typologies and categories; (b) identification of the benefits and services derived through the relevant ecosystem categories; and (c) connecting the benefits to kinds of values and using those values to inform choice and application of valuation and decision-making methods.

Chan et al. (2012b) provide a framework for general ES research and practice to facilitate the characterisation of the diverse values associated with ecological and socio ecological change through a series of steps, but with a specific focus towards cultural benefits and values (Figure 8).

Figure 6: Ecological and Social Science Epistemologies in CES

Source: (Daniel, et al., 2012).

Fish et al. (2016) specifically discuss a conceptual framework for understanding CES and related benefits in terms of the environmental spaces and cultural practices that arise from interactions between humans and ecosystems (Figure 9). The overall argument is that environmental spaces and cultural practices should be considered as mutually reinforcing CES through which cultural benefits to wellbeing accrue. Those elements (culture, spaces, practices, benefits, cultural values) shape and reflect CES, and provide researchers and decision makers with a framework by which to understand the cultural significance of ecosystems.

Two studies outline the relationship between the cultural services and landscape planning (Tengberg, et al., 2012; Groot, et al., 2012). Tengberg et al. (2012) aim to provide a conceptual analysis of CES and how they are linked to the concepts of landscape, heritage and identity (Figure 10). De Groot et al. (2010) provide a framework for integrated ecosystem services and values in landscape planning, management and decision making (Figure 11).

Figure 7: Conceptual Framework to derive Values of CES

Source: (Chan, et al., 2012a).

Christopher et al. (2014) evaluate two contrasting paradigms for the assessment of social values: (a) instrumental paradigm - an objective assessment of the distribution, type or intensity of values that individuals assign; and (b) deliberative paradigm - the exploration of desired end states through group discussion (Raymond, et al., 2014).

Figure 8: Ecological and Socio Ecological Change

Source: (Chan, et al., 2012b).

Figure 9: CES, Environmental Spaces and Cultural Practices

Source: (Fish, et al., 2016).

Figure 10: CES vs. Landscape, Heritage and Identity

Source: (Tengberg, et al., 2012)

Figure 11: Integrate Ecosystem Services and Values in Landscape Planning

Source: (Groot, et al., 2010).

c. Descriptive Studies

Descriptive studies (n=7) contained neither quantitative nor qualitative methods in the form of empirical study. The studies in this group explain some of the phenomena in CES and are frequently backed by many references. They often include discussions on challenges in incorporating cultural services in ecosystem and environmental assessments and ways of doing so (Satz, et al., 2013), limitations in such incorporation (H.Winthrop, 2014) and CES as an approach to sustainable planning as well as development (Andersson, et al., 2015; Plieninger, et al., 2015; Ghermandi, et al., 2009).

There were studies that specifically accounted the theoretical, empirical and practical concepts in specific CES categories i.e. recreation, cultural, aesthetic (Ghermandi, et al., 2009) and cultural landscapes (Plieninger, et al., 2014; Plieninger, et al., 2015). At the same time there were studies that documented specific ecosystems i.e. coastal (Ghermandi, et al., 2009) or urban systems (Andersson, et al., 2015).

d. Qualitative Studies

This is the largest cluster of publications (n=12), and in these, the empirical studies dealt with localised outcomes of advanced qualitative arguments documented on CES. Majority of the studies were on specific types of ecosystem i.e. coastal systems (Fagerholm & Käyhkö, 2009; Gee & Burkhard, 2010; Pleasant, et al., 2014), dry land systems (Pastur, et al., 2016; Sagie, et al., 2013), cultivated systems (Norton, et al., 2012; Bieling & Plieninger, 2013) and mountain systems (Plieninger, et al., 2013b). Seventy five percent of these publications were on cultural landscape (Fagerholm & Käyhkö, 2009; Pastur, et al., 2016; Plieninger, et al., 2013b; Bieling & Plieninger, 2013; Norton, et al., 2012).

e. Non-economic Studies

These were quantitative studies (n=8) without an economic approach. There were studies that were documented on general (Paracchini, et al., 2014; Oteros-Rozas, et al., 2014) as well as on specific ecosystems i.e. forest systems (Nahuelhual, et al., 2013; Chiabai, et al., 2011) and mountains (Tenerelli, et al., 2016).

f. Economic Studies

These are quantitative studies (n=7) with an economic approach. All the studies were on a specific type of ecosystem i.e. coastal (Lopez, et al., 2009; Baulcomb, et al., 2015; Ruiz-Frau, et al., 2013), urban (Sander & Haight, 2012), forest (Uddin, et al., 2013), inland water system (Bullock & Collier, 2011), and cultivated system (Berkel & Verburg, 2014). Recreation and tourism was the only service valued in monetary terms

(Lopez, et al., 2009; Berkel & Verburg, 2014; Ruiz-Frau, et al., 2013; Uddin, et al., 2013). Revealed preference method was used often by way of travel cost method.

CONCLUSIONS

In literature, ecosystem services have often been examined and the pluralities of those values have been tiered in recognising, demonstrating, and capturing the ecosystem services in policy making. CES as an ecosystem service is a relatively new field that has not been specifically acknowledged in literature and has mostly been treated in general. The objective of this study was to examine literature to identify the current status of CES in terms of conceptual frameworks and methodologies which allow us to identify the conceptual, ideological and methodological approaches that have not been explored in literature.

According to the review most studies were not specific to a region or system, although there were some regions (Asia and Africa) and systems (urban, coastal, forest) with significant levels of cultural diversity that were under threat from humans and which therefore needed to be treated separately. CES were searched as peripherals in bundle of services and most of the methodologically and theoretically important facets has not been explored yet. CES cannot be split into discrete units for marginal valuation and is difficult to measure. Therefore most of the studies are qualitative studies which acknowledged a contribution to wellbeing but rarely quantified it. Further the most frequently quantified subcultural services were the most easily quantifiable (recreation, tourism and aesthetic), but not those which matter to people. There is an occasional incidence of economic valuation, often in relation to recreation and tourism services. Cultural landscape seems to be an increasing research area that can be incorporated into the field of CES research. Review provides many principles that can be used in developing an economic valuation framework for CES.

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Appendix: Reference of Publications Denoted by the Case Number

ID	Reference	ID	Reference
1	(Milcu, et al., 2013)	24	(Paracchini, et al., 2014)
2	(Tenerelli, et al., 2016)	25	(H.Winthrop, 2014)
3	(Fish, et al., 2016)	26	(Oteros-Rozas, et al., 2014)
4	(Ghermandi, et al., 2009)	27	(Raymond, et al., 2014)
5	(Fagerholm & Käyhkö, 2009)	28	(Ruiz-Frau, et al., 2013)
6	(Daniel, et al., 2012)	29	(Sander & Haight, 2012)
7	(Bieling & Plieninger, 2013)	30	(Andersson, et al., 2015)
8	(Gee & Burkhard, 2010)	31	(Plieninger, et al., 2013b)
9	(Lopez, et al., 2009)	32	(Groot, et al., 2010)
10	(Giannecchini, et al., 2009)	33	(Uddin, et al., 2013)
11	(Baulcomb, et al., 2015)	34	(Turner, et al., 2014)
12	(Chan, et al., 2012a)	35	(Brancalion, et al., 2014)
13	(Plieninger, et al., 2013a)	36	(Bullock & Collier, 2011)
14	(Chan, et al., 2012b)	37	(Chiabai, et al., 2011)
15	(Tengberg, et al., 2012)	38	(Van Eetvelde & Antrop, 2009)
16	(Morcillo, et al., 2013)	39	(Gregory & Trousdale, 2009)
17	(Hartel, et al., 2014)	40	(Haaland, et al., 2011)
18	(Berkel & Verburg, 2014)	41	(Pastur, et al., 2016)
19	(López-Santiago, et al., 2014)	42	(Pleasant, et al., 2014)
20	(Nahuelhual, et al., 2013)	43	(Sagie, et al., 2013)
21	(Plieninger, et al., 2014)	44	(Schaich, et al., 2010)
22	(Satz, et al., 2013)	45	(Plieninger, et al., 2015)
23	(Norton, et al., 2012)		