

Review

Ecosystem Services for Scenic Quality Landscape Management: A Review

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Abstract: Since the Millennium Ecosystem Assessment Project proposed the valuation of ecosystem services—defined as regulatory, provisional, ecosystem and cultural—the question arises as to the utility of such assessments for scenic landscape management. This author as well as others has looked at the issue of integrating ecological concerns with landscape planning. This article will be a comprehensive literature review and analysis of issues involved with utilizing ecosystem services of assessment of scenic/visual landscape quality as well as management implications. Special emphasis will be placed on the role of cultural ecosystem services.

Keywords: cultural ecosystem services; scenic quality; aesthetics; landscape management



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1. Introduction

Cultural ecosystem services received international recognition as part of the Millennium Ecosystem Assessment Project [1–3]. Ecosystems services are regulatory, provisioning cultural and ecosystem support services. For this paper, the author is particularly concerned with cultural services, which include recreation, science and education, spiritual/historic as well as aesthetic resources as they relate to landscape. De Groot [4] and Faber et al. [5] offer descriptions of cultural ecosystem services in Table 1 below.

Note that in all three descriptions of cultural ecosystem services, there are four categories but also great potential for overall assessment and difficulty with quantification. Interestingly, this author [6–9] first addressed the visual/cultural values of wetlands with a rating system for freshwater wetlands in the Northeastern US that included the use and value of wetlands for *aesthetic*, *recreational* and *educational* purposes and also noted the interconnection and overlap of these landscape-related ecosystem services.

Recently, there have been efforts to develop standardized indicators or units of measurement for ecosystem service accounting purposes [10,11]. Scientists at the US Environmental Protection Agency (USEPA) have been working on a classification system for landscape ecosystem services plus accounting for beneficiaries of such services [11,12]. The USEPA has been particularly focused on water-based ecosystems including oceans, estuaries, freshwater wetlands, rivers/streams and lakes in this regard.

Measurement of ecosystem services by traditional economic means is sometimes problematic—especially for cultural ecosystem services. Particular challenges from the ecological economics literature include:

1. Unquantifiable values [10,13–15];
2. Double counting and overlap of services [16,17];
3. Addressing trade-offs between ecosystem services for land management decision making [5,18–20];
4. Lack of engagement of stakeholders [20,21];
5. Lack of consideration of ethical issues [22,23];
6. The need to address the spatial scale relationship to ecosystem service beneficiaries [20,24].

Table 1. Cultural ecosystem service classification and description.

Services	Comments and Examples	
Aesthetic	Finding beauty or aesthetic value	
Recreational	Opportunities for recreational activities	
Educational	Opportunities for formal and informal education and training	
Spiritual and inspirational	Source of inspiration, religious attachment	
Functions	Ecosystem Processes	Goods and Services
<i>Information functions</i>	<i>Opportunities for cognitive development</i>	
Aesthetic information	Attractive landscape	Enjoyment of scenery
Recreation	Variety for recreation use	Travel for ecotourism
Cultural/artistic information	Natural feature variety with cultural artistic value	Outdoor sports
Spiritual and historic information	Natural feature variety with spiritual and historic purposes	Use of nature in books, film, painting, folklore, symbols
Science and Education	Natural variety with scientific and education value	Use of nature for religious and heritage value
		Use of natural systems for school exercises and scientific research
Functions and Services	Description	Examples
<i>Cultural Services</i>	<i>Enhancing emotional, psychological and cognitive well being</i>	
Aesthetic	Sensory enjoyment of functioning ecological system	Proximity to scenery and open space
Recreation	Opportunities for rest, refreshment and recreation	Ecotourism, bird watching, outdoor sports
Science and education	Use of areas for natural field lab and natural reference areas	Scientific and educational activities
Spiritual and historic	Spiritual or historical information	Use of nature as symbol or natural landscape with significant religious value

Adapted from the Millennium Ecosystems in Wetlands Report [1]; De Groot et al. [4] (p. 397); Faber et al. [5] (p. 123).

Despite these challenges, there have been some interesting works carried out by ecological economists and social scientists to assess cultural ecosystem values. Traditional econometric methods such as hedonic analysis, travel cost, and contingent valuation have been used for valuing ecosystem services for coastal recreation [25,26] as well as landscape-related cultural ecosystem services [15,27–29].

However, this paper will specifically focus on aesthetic resource assessment as part of cultural ecosystem services. As stated above, there may be an overlap of aesthetics with recreational, educational and inspirational aspects of cultural ecosystem services. Many authors have argued the underpinnings of an “ecologic aesthetic” of landscape appreciation that can be informed by ecological knowledge [30–36]. Unfortunately, such ecological underpinnings of landscape appreciation are not shared by many members of the public in their perception of landscape aesthetics.

The rest of this article will include a brief history of aesthetic or scenic resource assessment and management in the US and Europe. This will be followed by a literature review of established cultural ecosystem protocols that include aesthetic resource assessment. Finally, the last part of the review will be a summary of cultural ecosystem service studies applications that include aesthetic resources by both landscape settings and methods used.

2. Materials and Methods

This review process incorporated Google and other search engines to surface key research articles, reviews and other studies that specifically addressed cultural ecosystem

service assessment related to landscape quality and usage. Key search words included: cultural ecosystem services, scenic landscape assessment, and aesthetic resources. Other key ecosystem services' search reviews were also utilized. This was not an exhaustive literature search but the author proposes that it did capture the most pertinent literature in terms of key concepts as they relate to cultural ecosystem services and landscape-based aesthetic and scenic resources.

3. Landscape Resource Policy Context

The overarching landscape policy for protecting landscape character is the European Landscape Convention (ELC) or what is termed the "Florence convention" [37], which is one of the first documents in Europe to focus on landscape character definition, assessment and protection. It has a broad definition, which connects landscape perception with human rights, social equity and democratic participation [38] (pp. 3–20). The implementation of the Landscape Convention in regard to landscape characterization and implementation is covered by Fairclough et al.'s 2018 book *Routledge Handbook of Landscape Character Assessment* [38] (pp. 3–20).

For the American landscape assessment context, it is quite fragmented and diverse with different approaches among individual US states and Federal Agencies. The mandate for addressing aesthetic, visual or scenic landscape resources as part of any Federal agency action is the National Environmental Policy Act of 1969 [39]. The most extensive work has been carried out by the US Forest Service, USDI Bureau of Land Management for scenic resource inventory for land management since the late 1970s. The Federal Highway administration has had visual impact assessment criteria and methods since 1980 and, recently, the USDI National Park Service and Bureau of Ocean and Energy Management have developed visual resource assessment protocols for addressing large-scale renewable energy projects. The US treatment of scenic and visual resources is summarized by Palmer and Smardon [38] (pp. 131–142) and early federal agency scenic landscape resource assessment development is summarized by the author [40].

For a history and summary of Australian aesthetic landscape constructs, please see the summary by Lennon [38] (pp. 203–216) and Lothian [41]; other countries' landscape character assessment approaches are covered in Fairclough et al.'s (2018) book *Routledge Handbook of Landscape Character Assessment* [38].

Thus, the concept of landscape character in Europe as opposed to scenic or visual quality in North America is quite different, which argues for a contextual definition of landscape-related aesthetic resources.

4. Aesthetic Value Assessment Theory

There are methods for assessment for some cultural ecosystem services. The next section of this paper will drill down to aesthetic assessment value theory, again focusing on landscapes. From Zube et al. [42], there are four major paradigms: the expert paradigm, the psychophysical paradigm, the cognitive paradigm, and the experiential paradigm.

(1) The expert paradigm. This involves evaluation of landscape quality by skilled and trained observers. Skills evolve from training in art and design, ecology or in resource management fields where wise resource movement techniques may be assumed to have intrinsic aesthetic effects.

(2) The psychophysical paradigm. This involves assessment through testing general public or selected populations' evaluations of landscape aesthetic qualities or of specific landscape properties. The external landscape properties are assumed to bear a correlation or stimulus-response relationship to observer evaluations and behavior.

(3) The cognitive paradigm. This involves a search for human meaning associated with landscapes or landscape properties. Information is received by the human observer and, in conjunction with past experience, future expectation, and socio-cultural conditioning, lends meaning to landscape.

(4) The experiential, paradigm. This considers landscape values to be based on the experience of the human-landscape interaction, whereby both are shaping and being shaped in an interactive process.” [42] (p. 8).

4.1. The Expert Paradigm

Each of these paradigms will be examined in their relationship to aesthetic cultural ecosystem services within wetland landscapes. The expert paradigm is illustrated by the visual-cultural model of Smardon [6] and Smardon and Fábos [43] where aesthetic, recreational and educational values of freshwater wetlands can be assessed using the factors of landform contrast, surrounding landform diversity, associated water body size, associated water body diversity, wetland edge complexity, surrounding land use contrast, land use diversity, internal wetland diversity, internal wetland contrast and wetland size. These variables are augmented by educational proximity, physical accessibility and ambient (water, air and solid waste) quality.

Recreation-related activities plus use of settings and benefits from the landscape setting can be assessed by use of the US Department of Interior Bureau of Reclamation *Water and Land Recreation Opportunity Spectrum (WALROS)* system [44]. This system can assess the kinds of activities that benefit from either direct water presence or visual proximity to water bodies. This is also an expert system.

4.2. The Psychophysical Paradigm

There have been a number of studies using psychophysical methods and two examples will be reviewed here. Cottet et al. [45] utilized a photo questionnaire with a sample of riverine wetland photos along the Ain River (France), which was administered to 403 laypeople and self-identified experts in order to identify the different parameters (visual or ecological) influencing perceptions of value of the ecosystems; and compare the perceptions of value of the experts versus laypeople. The criteria that strongly influenced people’s perceptions of ecological and aesthetic values included water transparency and color, the presence and appearance of aquatic vegetation, and the presence of sediments and trophic status (oligotrophic to eutrophic).

In another example of this approach, Dobbie [46] conducted a psychometric study, which involved Likert scale ratings of photo preferences of wetlands in Victoria, Australia. Some 241 participants rated 70 images. His statistical analysis related preference to sociodemographic variables and familiarity with wetlands. The major preference categories from least to most are brown grasslands to wetlands with emergent vegetation to wetlands with open water to wetlands with trees. Wetland preference attributes include the presence of trees, amount of water and perceived wetland health. Wetland health was related to water quality, vegetation lushness and proportion of land to water. Overall predictors of preference were perceived wetland health, complexity, orderliness and perceived naturalness.

4.3. The Cognitive Paradigm

There are also more cognitive studies of aesthetic cultural attributes. Manuel [47] surveyed residents in three urban communities in the Halifax Regional Municipality in Nova Scotia, Canada. He found that the residents were generally aware of the urban wetlands and identified them as assets as natural features in the landscape as well as habitat for urban wildlife. Nassauer [48] compared restored and more natural reference wetlands with several measures including land use context, cultural perceptions and management practices for six metropolitan wetlands in Minnesota. Cultural measures were drawn from surveys of visitors, neighbors, planners and managers of these areas. Sites that were perceived as well cared for plus a good place to enjoy nature were perceived as more attractive. Additionally, cultural cues and natural landscape context were related to perceived attractiveness as well as bird species richness.

There have been two studies of cognitive attributes of riverine landscapes drawing from the work of Kaplan and Kaplan [49] in assessing the *coherence, complexity, mystery* and *legibility* of landscapes. Ellsworth examined the landscape units, setting units, and waterscape units of the Cutler Reservoir and tributaries in Cache County, Utah. He utilized color slides to elicit preference on a five-point scale of rivers and marshes in regard to *coherence, complexity, mystery* and *legibility*. He found that subjects found *coherence* when there was similar vegetation with strong horizontal edges in marsh scenes and *edge definition* in rivers. Subjects found *mystery* with river beds and bends in river corridors, *complexity* for rivers and marshes when there was diversity in vegetation and visual depth, *legibility* with straight river corridors and simple spaces, and *legibility* with fine textured marsh vegetation and *spatial definition*. Similarly, Lee [50,51] carried out a study of Louisiana River landscapes and found strong interdependence, in that the preference value of river scenes often included one or two characteristics (legibility, complexity, spatial definition, mystery, distinction or disturbance), but could not conclude the significance of one factor versus others.

Additionally, under the cognitive paradigm, Lee [52] has proposed that there is cognitive aesthetic appreciation of ecological functions of the landscape setting, which include the natural arousal of emotions. Others have supported this thesis [36,45,46,53,54] as well as determining landscape preference [55,56].

4.4. The Experiential, Paradigm

Experiential assessment relates to the actual landscape perception in situ. It also relates to the specific recreational and other activities in the landscape. Such assessment could be carried out on site with interviews, questionnaires, observation as well as user photography and video to capture the experiential qualities of the recreational, aesthetic and educational experience.

So, whether one is utilizing an expert, psychophysical, cognitive or experiential paradigm or methodology, the question is how stable or accurate is such an assessment over time? James Palmer [57] investigated the perception of scenic quality of the Cape Cod community of Dennis, Massachusetts from the 1970s to the 1990s. The original views in his 1975 study [58] were re-photographed and another sample of Dennis residents was surveyed. Results indicated that the variation in scenic perception was explained by the spatial landscape metrics (views blocked or change in land use area). So, the model retains its predictive efficacy after 20 years [57,58].

The next section describes how we can utilize the landscape assessment paradigms above as part of cultural ecosystem service assessment.

5. New Cultural Ecosystem Valuation Methods

Some newer approaches have been used specifically for assessing cultural ecosystem services. Milcu et al. [59] reviewed 107 publications to extract 20 key attributes describing the types, context, methods, scales, drivers and tradeoffs between cultural ecosystem services. The authors' stress that cultural services can link gaps between researchers and disciplines. Chan et al. [16] warns us about conflation of services values and benefits as well as failure to address diverse values. The authors go on to demonstrate the interconnected nature of benefits and services as well as the ubiquity of intangible values by reviewing the methodological challenges and new methods used for assessing cultural ecosystem services in the following section.

Given these challenges, Brown et al. [60] and Raymond et al. [61] both utilized participatory community mapping to identify community values for ecosystems services. Brown et al. [60] utilized Internet-based public participation GIS or PPGIS to identify ecosystem services in Grand County, Colorado. Their findings included that cultural ecosystem service opportunities were the easiest to identify, while supporting and regulatory services were most challenging. Most participants were highly educated about nature and science. They found that some geographic locations were strongly spatially associated with specific

ecosystem services. Finally, this method (PPGIS) proved to have high potential for identifying ecosystem services in general by engaging people to identify areas providing these ecosystem services.

Raymond et al. [61] utilized in-depth interviews and mapping to quantify and map values and threats to natural capital assets and ecosystem services in the South Australian Murray Darling Basin region. The most highly valued ecosystem services were recreation and tourism, bequest, intrinsic and existence, freshwater provision, water regulation and forest provision, in that order.

Palmer and Smardon [62–64] utilized group meetings and fieldwork followed by a random mail questionnaire to assess aesthetic (visual) and recreational uses and values of wetlands in Juneau Alaska. This work was part of a regional Wetland Management Plan for the City/Borough of Juneau. The cultural ecosystem service component was one of the most consistent value assessments after public scrutiny as compared to the biological and hydrological assessments. This was demonstrated by Juneau residents identifying and reinforcing the existence of cultural ecosystem services displayed on maps of specific wetland areas with aesthetic and recreational use attributes.

5.1. Recent Standardized Protocols for Cultural Ecosystem Services including Aesthetic Landscape Attributes

Ruskule et al. [65] from the University of Latvia have developed an Ecosystem Service Framework for integrated planning. This framework includes mapping and assessment of ecosystem sociocultural services. Specifically for aesthetic resources, participatory GIS is used to identify selected landscape features such as openness of the landscape, relief undulation, vicinity to water bodies and streams, character of land use and character of surrounding land use [65] (p. 58).

The US Geological Survey has developed a computerized system to assess social values of ecosystem services [66] This is a GIS application to identify social values through public preference surveys to yield social value maps for aesthetics, biodiversity and recreation with a 10-point value index. A combination of spatial and non-spatial responses to surveys is used plus average distances to land cover and water features. All of this is used to build maximum entropy models to calculate ecosystem service values.

Finally, the author was involved as one of the participants in the US Environmental Protection Agencies development of a “Final Goods and Services Classification system” [11]. The USEPA used expert panels to develop a classification system for land and water landscape types with matrices for beginning, intermediate and final ecosystem services for each landscape type. So, each matrix, say for a freshwater wetland, could be used as a master checklist to assess cultural ecosystem services, including aesthetics such as wetland views and nature appreciation. The matrix for the example of the freshwater wetlands would have indicators for both intermediate and final ecosystem services that could exist for that landscape type.

5.2. Specific Landscape Aesthetic Ecosystem Service Assessment Application Types

Aesthetic landscape resources as part of cultural ecosystem assessment were utilized as part of large-scale heritage assessments in the English countryside [67], Sweden [68] and Zanzibar Island, Tanzania [69]. Often, aesthetics as part of cultural ecosystem services (CES) is used for assessing recreational and nature-based tourism in Central Spain [70], Toyota City, Japan [71] and for the Silk Road corridor in Zhangye, China [72].

Coastal landscapes have been assessed for CES including aesthetics in Latvia [73], for the influence of human interventions on the Huiwen wetland in southern China [74], for coastal areas caught between sea level rise and urban expansion on Johns Island, South Carolina [75] and Georgia [76] and for assessing public reaction to wetland restoration in Costa Brava, Spain [77]. These studies identified the key natural and cultural landscape features that were associated with cultural ecosystem service benefits.

Cultural ecosystem services (CES) including landscape aesthetics have been utilized as part of river environmental quality assessment [78], urban riverfront restoration [79,80]

and for freshwater lake benefits to the surrounding community in Cazenovia, NY [2]. In all three cases, aesthetic, recreational, educational and inspirational cultural ecosystem services were identified and assessed.

CES with aesthetic resources have been used to understand residents' sense of place at the rural–urban interface in the Helsinki Metropolitan area [81] and the peri-urban landscape near Copenhagen [82]. Aesthetics within CES has been used to manage residential landscape priorities, value dimensions and cross regional patterns in a study of several US cities including Minneapolis–St. Paul, Boston, Baltimore, Los Angeles, Miami and Phoenix [83]. Other urban-related CES with aesthetics studies have been carried out to assess the quality of UK urban green spaces [84] and the use motivation of parks in the three European cities of Leipzig, Coimbra and Vilnius [85].

Many of the CES assessments that include the aesthetic landscape resources above utilize some sort of citizen surveys plus participatory mapping to gather data regarding aesthetic CES as well as educational, recreational and inspirational CES. There are CES methods that are beginning to use scenarios or decision choice models to gauge societal groups' reaction to landscape change such as the Hunziker et al. [86] study of future landscape change in the Switzerland Alps. There is also Palmer's (1983, 2004) study of landscape change in the coastal community of Dennis, Massachusetts over a 20-year time span. We are also seeing increased use of social media such as the perception study of coastal Georgia to place attachment and coastal storm risk [76].

6. Summary and Conclusions

CES assessment involving aesthetic landscape resources has overlapping issues with recreational, educational and inspirational benefits. Additionally, CES often have not been given the same consideration as other ecosystem services according to some reviewers [16–18,87]. Aesthetic landscape resources should be addressed on an equal footing and this article illustrates the various CES landscape applications that have already been applied. Incorporating CES in landscape planning applications has great utility for identifying and incorporating key geographic elements and benefits that would otherwise be missed. It should be stressed that aesthetic landscape CES are indeed contextual and one formula does not fit all, but there are methods and assessment tools that can be used to assess CES landscape aesthetic and scenic resources. As stated by Hermann et al. [87] in a comprehensive review of ecosystem services and landscape research “There are still a lot of challenges that have to be faced regarding quantifying, visualizing as well as valuing ecosystem services” [1,87]. This is especially important given the development and climate change impacts on the world's landscapes [88].

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