VISUAL IMPACT ASSESSMENT OF A GOLF COURSE IN A MEDITERRANEAN FOREST LANDSCAPE

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ABSTRACT

Increased demand for diverse and quality recreation opportunities has placed pressure on the natural resource and its management. Landscape managers, environmental specialists, governmental agencies and citizens are interested in scientifically based tools to assist in the study of the environment. In the present research it was used a quantitative landscape assessment method to estimate visual impact, landscape quality, landscape fragility and visual absorption capability of a planned golf course in a forest landscape. The study area was an enclosed, meadow, riverside landscape in Loule, Portugal. Numerical values were used to assign factors such as slope, vegetation, observation distance, visual magnitude and human activities in order to analyze, evaluate and characterize the landscape. A geographic information system was to understand and manage the visual resources and a decision support system was developed to predict and to help mitigate the visual impacts of the proposed development.

Keywords: landscape quality assessment, aesthetic, ecosystem management, recreation, geographic information system.

INTRODUCTION

Landscape managers, environmental specialists, governmental agencies, non-profit environmental organizations and citizens are interested in scientifically based tools to assist in the study of the environment. Visual quality assessment was firstly predicted by Shafers equations (Shafer et at., 1969). They employed social science research methods to statistically obtain a perception based evaluation of black and white rural landscape photographs. Shafers work was examined in a forest management setting to illustrate the utility of the research (Brush and Shafer, 1975), but was heavily criticized and not accepted (Weinstein, 1976; Carlson, 1977). In the 1990a and early 2000s, visual quality research often focused upon spatial modeling tools and techniques to simulate the three-dimensional qualities of the environment (Crawford, D., 1994; Orland, B., 1994; Bishop and Husle, 1994; Panagopoulos and Hatzistathis, 1995; Buckley et al., 1998; Panagopoulos, 2001; Ramos and Panagopoulos, 2006[a]).

The aesthetics, a western concept, is a matter largely discussed. It has been a subject of debate for philosophers, artists, since at least the time of Socrates and more recently, for environmental managers/policy makers (Lothian, 1999). Aesthetic expectations ought to be considered in a thoughtful design. To achieve this, is needed a careful understanding of visual and non-visual environmental aesthetics, knowing that color, form, line and texture are characteristics that define visual and aesthetic any object or landscape (García et. al, 2005).

Besides of the vast amount of research in this field, there is not yet, a broad and comprehensive theory of landscape aesthetics. The term "aesthetics" is commonly divided in the following contrasting and immiscible categories or ideals: the "ecological aesthetic", based in biological principles of ecosystem management, the "scenic aesthetic" (Parsons and Daniel, 2002) or even the "tended aesthetic" (Hull et al., 2000).

Visual impact assessment is often regarded as a subjective process (Arthur et al., 1977; Ramos and Panagopoulos, 2006[b]). Some authors tend to associate aesthetic experience with a purely sensuous, non-cognitive response to visual stimuli (Costello, 2004) and others believe that some aesthetic properties may not be perceptual (Carrol, 2004).

However, techniques which ensure that investigations can be undertaken in a systematic, consistent mode, were developed in the present study making the assessment as objective as possible. The approach used in the present study for landscape quality assessment defined as the expert/design approach by Daniel (2001) and has been dominant in environmental management practice (Canter, 1996; Burley, 2001). In this approach, landscape evaluated and inspected with respect to a combination of abstract design parameters deemed relevant to landscape aesthetics. Increased demand for diverse and quality recreation opportunities has placed great pressure on the natural resource and its management. Lack of understanding of interactions between people and forest recreation environments result in wide variations in perceptions, expectations, and patterns of choice and use.

Golf course development is one of the fastest growing tourist activities, changing significantly the Mediterranean landscape. Actually, 31 golf courses exist in South Portugal and other 25 are under construction or planned. Golf courses are often located in forest areas of high scenic value. It is inevitable, that the visual impact of those projects receives considerable attention - particularly in view of the long duration and often permanent re-profiling of the landform and habitat modification. However, in golf course design little research devoted to examine how visual impact assessment may improve their public acceptance. In the present research it was used a quantitative landscape assessment method to estimate visual impact, landscape quality, landscape fragility and visual absorption capacity of a planned golf course in a forest landscape.

METHODOLOGY

The study area of the project is an enclosed, meadow, riverside landscape in the mountainous area of Loule, Portugal (Figure 1). The valley has 110m altitude close to the river and 270m at the highest point. The climate of the area is sub-humid Mediterranean with a relatively short dry period at summer. Average annual precipitation is 657mm (Loule meteorological station, 30 years of record) with a maximum monthly average in January (107 mm).

The average annual air temperature is 15^{o}C. The main forest species of the study area were *Quercus suber*, *Quercus ilex*, *Quercus rotundifolia*, and *Pinus pinea* and livestock forage, olive, orange and carob trees are grown by farmers. The main vegetation associations were *Thero-Brachypodietea* and *Festuco-Brometalia* in meadows, *Nerio-Tamaricetea* and *Securinegion tinctoriae* in riverside and *Cisto-Ulicetum argentei* on slopes. The main soil types were “red mediterranean calcarius soils” with pH 7, “aluvissols” and “basaltic lithossols” with pH 6. The primary tasks of the visual impact assessment were to identify landscape units, key viewpoints from which the golf course will be visible; to evaluate the quality and visual absorption capacity of those critical viewpoints; to assess the impact of visibility; and to modify the golf course design in such a way as to reduce potential impact to a minimum. Landscape units were identified according to criteria of relative homogeneity, biodiversity, identity and sensation (Abreu, 1989). The landscape quality survey embraces the study of both biophysical interacting components: features of the environment and human perception/experience (Daniel, 2001).

As a result, numerical values were used to assign factors such as slope, vegetation, observation distance, fragmentation, visual magnitude and human activities in order to analyze, evaluate and characterize the landscape (Canter, 1996; Burley 2001). A numerical rating assigned indicating low (1), moderate (2), high (3), or very high (4) visual sensitivity and quality and as a result, digital maps of the above were elaborated.

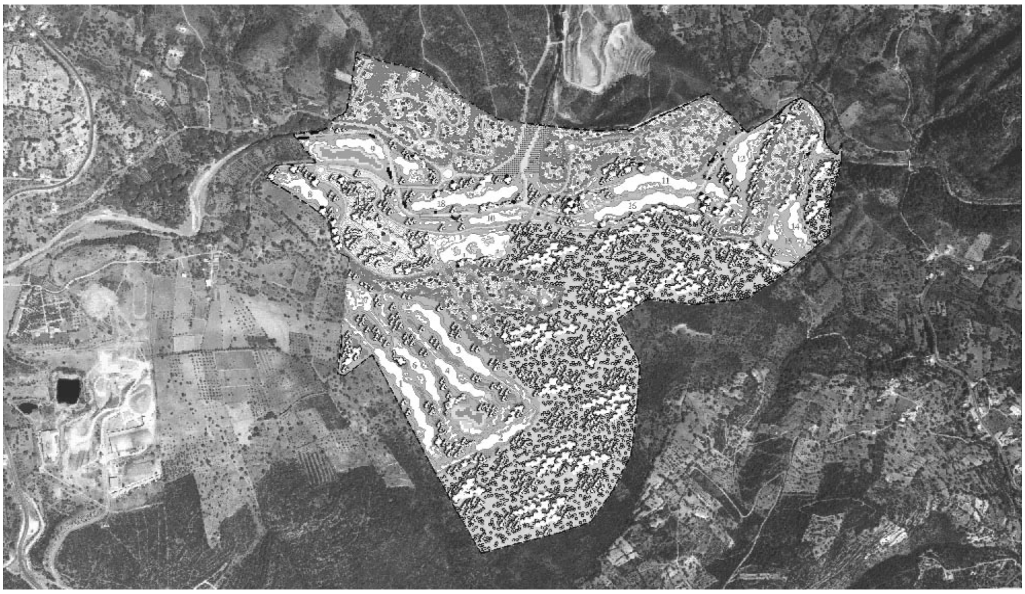

Figure 1. The golf course superimposed on the study area

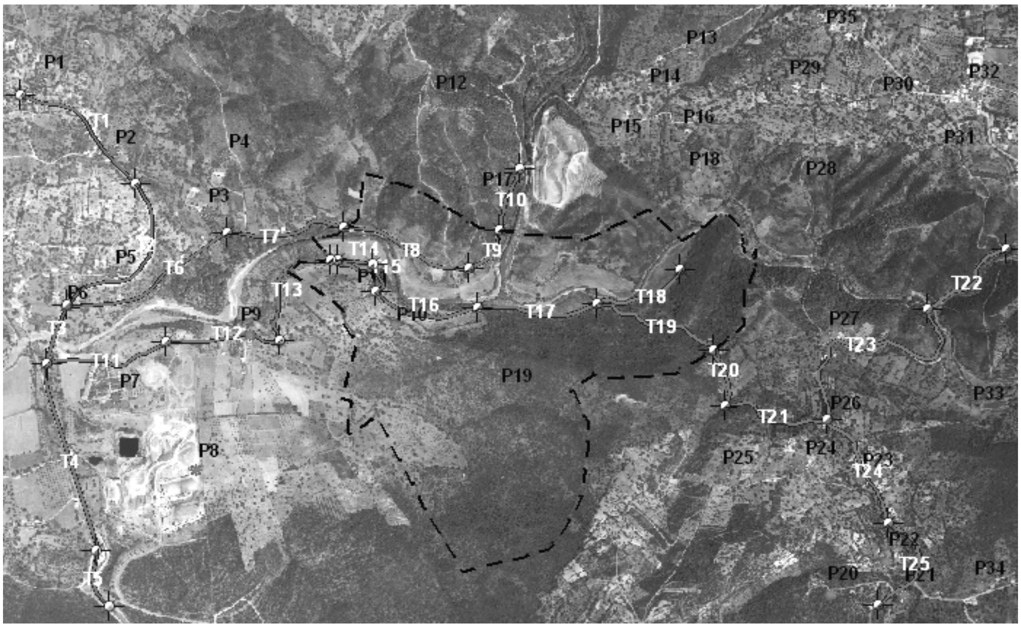

Figure 2. Residential key view points (P1-35) and tracks (T1-25) that used for the visual impact study

The most frequently used residential areas and golf surrounding roads and trails were selected as “key viewpoints” (Figure 2).
A Digital Terrain Model (DTM) generated with ArcGIS 8.3 from digitized contour maps. From the final DTM was studied the potential intervisibility of the area and the two-dimensional maps (viewsheds) of all areas visible from the viewpoints at a given height.
Visual simulation in three dimensions was elaborated and fly-over digital video was made to visualize the development projects on the study area.

RESULTS AND DISCUSSION

Using aerial photos and in situ observations the landscape of the golf surrounding area was divided into five units: A) agriculture; B) forest; C) meadow D) riparian; E) quarry industrial area and other landscape elements (road network and residential).
Visual quality for each landscape unit is shown in Table 1. According to the criteria used, visual quality is the capacity of a landscape to not change and to maintain its structure, while fragility is the degree of susceptibility in transformation.
The quarry and other industrial and residential area present low quality according to the used parameters. Agricultural, meadow and riparian landscape units present medium quality and forest high. Landscape sensitivity or fragility for each of the landscape units is shown in Table 1. The most fragile landscape unit was quarry and Quercinea areas while the others present medium sensitivity and residential low sensitivity.

Table 1: Visual quality and sensitivity of landscape units at the golf study area

Landscape units		Area (ha)	%	Quality	Class	Fragility	Class
Agriculture	Extensive	270	34.44	1.82	Moderate	2.48	Moderate
	Intensive	50	6.37	2.04	Moderate	2.41	Moderate
Forest	Low density	290	36.98	2.94	High	2.78	High
	Quercinea	22	2.81	3.63	Very High	2.49	Moderate
Meadow	Xerophilic	32	4.08	1.86	Moderate	2.19	Moderate
	Hydrophilic	10	1.27	1.95	Moderate	1.93	Moderate
Riparian		38	4.84	2.42	Moderate	2.45	Moderate
Mineral extraction		40	5.10	1.40	Low	3.05	High
Residential and road network		32	4.08	1.45	Low	1.05	Low

Sixty viewsheds of the planed golf course were calculated at the selected key viewpoints. Most of the 143ha of the area affected by the golf course was estimated as a high quality, average fragility and low visual absorption capability (VAC). Forest landscape affected from golf course had very low VAC, mainly the Quercinea area. Garrigue and riverside areas had low VAC while meadow and agricultural areas presented high VAC. A landscape with high VAC rating can absorb a lot of change without losing its quality (Ramos and Panagopoulos, 2004).
According to the above, any change in the forest area will be immediately visible and determinant, so visual mitigation measures ought to accompany the development of golf course.
The VAC of the most significant five points and five tracks are shown in Table 2.
There were two primary populations of viewers: viewers from households and travelers of the nearby national roads. Only 12% of the quarry will be visible from the nearby village (key point P28). The most affected households were P2 and P17 with 74 and 36% of visibility, meanwhile the house at P17 had visibility mostly at the Quercinea site that will not be altered from the golf project. Visibility from the mineral extraction site P7 was 77%. Travelers will also view the

quarry as they drive through the mountains. From field survey was recorded that 4650 meters of roads are visible from the golf course.
With a traveling speed of 80km/h the golf will be visible for relatively short period. Forty seconds was the longest viewing time at close range. Visual simulations were elaborated and fly-over digital video, similar to that found in a flight simulator, was made to visualize the future development projects on the study area. Subsequently, various solutions of vegetation screening were adopted, and several profiles of landform made, using Autocad software and photomontages. Visual barriers on specific locations at the national roads 523 (track T3), 524 (tracks T6, T8) and 525 (track T23) with fast growing trees were suggested.

Table 2. Visual absorption capability measured at the most important points and tracks of the study area

			Key viewpoints					Key tracks				
Factors	Variable	Mark	P2	P7	P10	P17	P28	T3	T6	T8	T13	T23
Observer position (degrees)	+5 till +10	1			x							
	+2 till +5	2	x			x	x					x
	±2	3						x			x	
	-2 till -5	4		x					x			
	-5 till -10	5								x		
Observer distance (meters)	0-400	1									x	
	400-800	2				x				x		
	800-1600	3		x	x							x
	1600-3200	4	x				x					
	+3200	5						x	x			
Visualization time (sec)	>30	1	x	x	x	x	x			x	x	
	10-30	2							x			
	5-10	3										
	3-5	4						x				x
	0-3	5										
Landscape type	Characteristic	1										
	Focal	2				x			x			
	Enclosed	3								x		x
	Panoramic	4	x	x	x		x	x			x	
	Other	5										
Gradient (%)	>45	1										
	30-45	2										
	20-30	3										x
	10-20	4	x						x	x		
	0-10	5		x	x	x	x	x			x	
		Total	15	17	14	12	16	21	17	15	14	15
		VAC	mid	high	mid	low	mid	high	high	mid	mid	Mid

CONCLUSIONS

The aesthetic study helped to assess visual adverse impacts of golf course and to suggest mitigation measures and rehabilitation design alternatives. The golf project could be used to reclaim the nearby abandoned mineral extraction sites. Computer simulations such as photomontages and digital fly-over videos helped in three-dimensional imaging and characterization of the landscape.
The presented landscape evaluation method could help planners, and other professionals involved in the design of sustainable landscapes with aesthetic and social value. It also could enrich the decision-making process and help governmental officials to take the appropriate decision: accept, reject or suggest aesthetical modifications in any proposed golf course project.

The incorporation of aesthetic concepts may help to minimize visual impact of golf courses or other development projects in Mediterranean forest landscapes, mainly now when government has an important role to play in the matters of providing aesthetic welfare and avoiding conflicts between public and golf courses.

Future evolution of the present study is to integrate the expert/design approach with the perception-based assessment methods.

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