

Landscape and sustainability in golf courses in the Algarve region, Portugal.

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Abstract

The main goal of the present study is to contribute for the improvement of landscape sustainability of the golf activity, focusing on the Algarve region, Portugal. Although the economical dimension of sustainability is arguably assured its landscape, ecological and territorial dimensions are not entirely. In Portugal, and particularly in the Algarve, tourism plays a key role for its economy. Golf is one of the touristic activities by excellence in the region of Algarve. Golf players have increasing demands on the quality of their experience, including environmental and landscape dimensions.

This study provides a brief theoretical introduction focusing on the role of golf courses in landscape sustainability from both a landscape ecological and cultural viewpoints. A practical application study was developed approaching from a broad perspective the 39 golf courses existent in the Algarve. From these a sample of 13 courses was selected based on several criteria, in order to estimate their performance focusing on its biophysical, ecological, cultural and scenic components, both within the courses and its relationships with the surrounding landscape. The courses were also selected according to the construction date (1966-2009) in order to assess if its performance would improve with different designs throughout these past 43 years. Finally it was also surveyed which courses have implemented an environmental management program.

The main issue identified occurs in the biophysical/ecological dimension. Golf course's performance show that some criteria did not change across time, but others evolved positively. As far as the application of environmental management programs, there is no apparent distinction between golf courses that have this kind of system and those who don't. This study allowed providing a set of recommendations and contributions for the improvement of golf courses, namely its landscape ecological and cultural sustainability.

Key-words: golf course; sustainability; landscape evaluation; landscape integration; landscape ecology; land use; scenic value; Algarve region.

1 Introduction

The region of Algarve is a privileged golf touristic destination in the Europe. Golf is considered one of the ten strategic tourism products in the Algarve region [1-4]. The success of golf in the Algarve results, besides the excellent climatic conditions for this activity, from the high quality standards of most of its golf courses. Golf players have increasing demands on the quality of their experience,

including environmental and landscape dimensions.

The golf business is responsible for a significant proportion of tourist income in the region, about 8.5%. In addition to its economic importance it is also important to consider its low seasonality, showing an opposite pattern of the dominant tourism product in the region – the so-called "Sun and Sea", which is concentrated mainly in the summer season. Golf contributes to counteract the extreme seasonality of tourism in

the Algarve, by increasing tourist occupancy rates throughout the year [5].

Sustainability is considered an essential goal in the development of human activities. Its various goals are only possible to achieve if it is assured a balance between its various dimensions, economic, social and ecological [6]. Golf courses use landscape resources, *e.g.* water, soil, and scenic vistas, thus causing some pressure on natural resources. However there are some studies focusing on golf courses which indicate that with proper management there is a high potential to maintain and or create habitats, improve ecological conditions for indigenous flora and wildlife, and consequently increase and diversify the number of species, compared to the surrounding areas [7, 8].

The main goal of the present study is to contribute for the improvement of the landscape sustainability of the golf activity in the Algarve region. It provides a brief theoretical introduction focusing on the role of golf courses in sustainability from both a landscape ecological and cultural viewpoints.

A practical application study was developed studying from a broad perspective the 39 golf courses existent in the Algarve. From these a sample of 13 courses was selected based on several criteria, in order to estimate their performance focusing on its biophysical, ecological, cultural and scenic components, both within the courses and its relationships with the surrounding landscape [9]. It was also surveyed which golf courses have implemented an environmental management program.

The presented article is a synthesis of a masters dissertation in landscape architecture developed at the University of Algarve [9].

2 Materials and Methods

2.1 Materials

For the development of the present study were used the following information: satellite images (Google-Earth, 2010), topographical maps (the so-called “military maps”, scale 1:25.000), and the environmental impact assessment (EIA) studies that were available for some of the golf courses.

2.2 Methods

The study was initiated by a bibliographic review conducted on the topics analyzed, which allowed to define the study goals. Next a sample of golf

courses was defined to identify the case-studies, followed by the definition of the study limits for selected each course, the evaluation procedure, and finally the analysis and discussion of the results, that supported a set of recommendations.

2.2.1 Selection of the case studies

In order to simplify the approach, and avoid redundancy, a sample of 13 golf courses (out of 39) was selected. The criteria for selection of the case studies were: (i) starting date of operation (1966-‘90, ‘90-‘95, and ‘95 to date), (ii) location, covering the major landscape units in the Algarve [10] where golf courses occur, and (iii) total area of the golf course. The location of the selected golf courses in the Algarve region is shown in Figure 1.

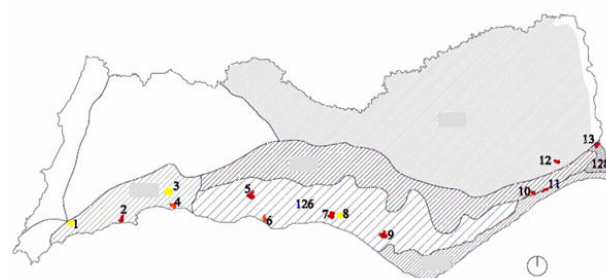


Fig. 1. Location of the 13 golf courses selected for the study in the Algarve region.

In a first phase satellite imagery and digital topographical maps were useful to analyze the golf courses and its surroundings, followed by a series of preliminary field visits. At the same time it was prepared a sheet to evaluate the performance of the golf courses based on the pre-defined criteria.

2.2.2 Definition of a visual basin

The definition of the limits to study each golf course was developed in two steps: (i) a visual basin was defined using a reference value of 700 m. This value corresponds to the limit that human vision can still distinguish some details and the landscape is perceptible. It is also an average value from those used in several studies [11]; (ii) then observation points were defined within the visual basins. These were located in higher areas (ridge lines) and preferably in locations potentially most visited (roads/paths and urban/residential areas), recognizing that the landscape is not frequented homogeneously and thus visual impacts of any activity are more

prone to be seen from highly frequented places than others that are not, *e.g.* sites that are inaccessible due both to topographic features *e.g.* steep slopes, peaks or lack of trails or roads [11].

2.2.3 Evaluation Procedure

For the characterization and analysis of golf courses it was considered that a field corresponds to a system essentially consisting of two units: the “Hole”, which is in turn composed by three components: i) Tee, ii) Fairway, iii) Green; Zone outside the hole, comprised by three components: i) the “Rough”, ii) housing units, excluding the Club House, and iii) lakes and streams.

To assess the performance of the golf courses, it was defined a set of evaluation criteria described below. Subsequently were made field visits to apply the evaluation procedure which was recorded in the evaluation sheets. For the evaluation it was adopted a qualitative scale of three classes: A (0-33%), B (33-66%), and C (> 66%). The goal was to make a relative comparison between golf courses, estimating the performance of each course against the established criteria. Additionally, was developed another evaluation sheet, which integrated the information gathered during the field work with the one produced in the office.

The performance evaluation criteria, described below, were grouped in four components: Biophysical\Ecological, Cultural, Scenic value, and Environmental Management:

(1) Biophysical\Ecological: The main impacts of a golf course considered were the changes in the existent topography, the changes, fragmentation, and or destruction of habitats or species, and the artificiality of the landscape, translated into the following criteria: 1.1 Topography / Hydrography; 1.2 Flora (Holes); 1.3 Roughs: 1.3.1 Flora and 1.3.2 Vegetation spatial structure; 1.4 Lakes and Streams: 1.4.1 Flora and 1.4.2 Vegetation spatial structure; 1.5 Flora - Urban green spaces; 1.6 Golf course outer landscape integration; 1.7 Isolation: 1.7.1 Roughs and 1.7.2 Lakes and Streams, where 1.7.2.1 Within the golf course and 1.7.2.2 With the outer landscape hydrological system.

(2) Cultural component: the criteria considered were based on the land use contrast between the golf courses and the surrounding landscape. The following classes of land uses were considered: agricultural (irrigated and non-irrigated), forestry and urban. The percentage (in

area) of each land use was assessed, both in the visual basin (excluding the golf course), and in the golf course. These two percentages were weighted for each land use (*e.g.* forest within the visual basin, and forest inside the course), then coming up to a value that reflects the difference in land use between the golf course and surrounding. This analysis allowed us to assess the contrasting land use and how the golf course has introduced changes in the landscape matrix

3. Scenic assessment: The main objective was to assess the scenic value of golf courses, and of its landscape context by estimating the visual impact of the golf course in the landscape in which is inserted. The contrast between the course and the environment were evaluated according to the following criteria: vegetation and scenic value.

4. Environmental management (EM): The main goal was to determine which of the golf courses that have implemented an EM program and/or monitoring, and which temporal relationships could be established between the fields that implemented it and those who did not. It also aims to assess whether the management systems have an effective impact in maintenance activities. The fields were evaluated on a binary scale: 0 - no EM system, 1 - with EM system implemented.

3. Results

The results of the evaluation on the biophysical/ecological component conducted for the selected 13 golf courses in the Algarve region are summarized in table 1. The other two components are described below.

Considering the flora present in the golf courses evaluated all present a good performance (A) in the lakes and streams (1.4), and more than slightly half of the courses in the holes (1.2).

Additionally, circa two thirds present a good connection between roughs (1.7.1), and slightly less than half are reasonably integrated with the surrounding landscape (1.6).

Golf courses performance is medium (B) when considering its integration in the local topography and stream systems (1.1) for more than two thirds of the courses. Course's performance is lower (C) in the vegetation spatial structure around lakes and along streams (1.4.2), the flora existent in the roughs (1.3) and in the urban green spaces (1.5).

The cultural component evaluation, based on the land use contrast between the golf courses

and the surrounding landscape, is low to medium, where half (6) have a low contrast (A) and the other half (7) a medium contrast (B).

The scenic component presented a medium performance (B) for almost all courses: 11 courses in both the vegetation density and vertical stratification (3.1); and 10 in the scenic

value (3.2), where the remaining 3 presented low impact (A).

Finally, concerning the EM component, half of the courses (6) did not present any plan, but the remaining 7 did.

Golf Course Performance										
Evaluation Criteria: \ Performance:		A		B		C		No info		
1. Biophysical / Ecological Components	1.1 Topography / Hydrography		2	15%	10	77%	1	8%	0	0%
	1.2 Flora (Holes)		7	54%	3	23%	0	0%	3	23%
	1.3 Roughs	1.3.1 Flora	1	8%	4	31%	8	62%	0	0%
		1.3.2 Vegetation spatial structure	4	31%	5	38%	4	31%	0	0%
	1.4 Lakes / Streams	1.4.1 Flora	13	100%	0	0%	0	0%	0	0%
		1.4.2 Vegetation spatial structure	0	0%	0	0%	13	100%	0	0%
	1.5 Flora - Urban green spaces		0	0%	0	0%	9	69%	4	31%
	1.6 Golf course outer landscape integration		6	46%	3	23%	4	31%	0	0%
	1.7 Isolation	1.7.1. Roughs	8	62%	3	23%	2	15%	0	0%
		1.7.2 Lakes / Streams	1.7.2.1 Within the golf course	4	31%	5	38%	3	23%	1
1.7.2.2 With the outer landscape hydrological system			2	15%	3	23%	8	62%	0	0%
Average Performance for Component 1			33%		25%		36%		6%	

Table 1. Performance evaluation of the 13 golf courses previously selected in the Algarve region based on biophysical \ ecological criteria.

4. Discussion and Conclusions

4.1 Biophysical / Ecological Component

All of the 13 golf courses have a very good performance when evaluating the vegetation planted around the lakes and along the streams margins. Only Algarve indigenous species are present, namely *Typha latifolia* L. (Bulrush), *Schoenoplectus lacustris* L. (Tule), among others. More than half of them present a good performance also when looking at the grass species used in the holes. Most of them (7) use species adapted to the Mediterranean climate of the Algarve, namely to the high temperatures in the summer, as *Cynodon dactylon* (L). Pers. (Bermuda var. Tifton 419), *Agrostis stolonifera* L. and *Zoysia* sp.. This is more common in the most recent courses.

Although most of the roughs are not composed by species belonging to the Algarve potential natural vegetation (PNV) [12], they do present species well adapted to the Algarve climate, such as the umbrella pine (*Pinus pinea* L.), which as a long tradition in the Algarve and

in Portugal at large (in sandy soils, near the coastline), the traditional Mediterranean dry orchards (mainly olive trees and carobs), and some shrubs from the local flora. In almost two thirds of the courses roughs are well connected with each other (1.7.1), favoring potentially the movement of faunal species within these golf courses. Additionally half of the courses (6) are well integrated in the surrounding landscape, and three more are fairly integrated (1.6). This can also favor the linkages between a golf course and the surrounding landscape, and thus the potential movement of individual species in and out of the courses, which is an important issue for wildlife management.

The evaluation procedure revealed a medium performance when considering the topographical / hydrography criteria due mainly to the construction of artificial lakes, which is most common in golf courses in the Algarve and elsewhere. Mostly (10) respected the natural topography of the small valleys and streams.

Notably the older courses were more respectful of the site topography.

On the other hand in all courses it was found a deficient vegetation spatial structure around the lakes and along the streams. There is a low diversity of species (1 or 2 herbaceous species), if any, planted in small clusters, with no vertical stratification (due to maintenance procedures). Unfortunately the survey registered no differences between the older courses and the most recent ones.

Roughs represent circa 50% of the golf course total area. Although the roughs' species composition sometimes can include adapted species (Umbrella pine) or traditional dry orchards, these do not belong to the PNV of the Algarve. Furthermore it is most common to plant palm trees, sometimes in large quantities, in most of the courses. Finally the species used in the green spaces of the urban / touristic complexes that are built associated with the golf courses are almost occupied with exotic species.

Noteworthy in the above context is that in the more mountainous part of the Algarve – the Serra, there are still large tracts of indigenous forest dominated by forests of cork oaks and strawberry trees in humid stations, or holm oaks (mostly in the calcareous soils of the Barrocal or in dryer stations), accompanied by a myriad of other Mediterranean trees, shrubs and herbaceous species. Most of these forests are classified sites under the European Ecological Network - NATURA2000. Also, in the Barrocal, the so-called “*garrigue*” dominate, *i.e.* Mediterranean low shrubs, *e.g.* *Lavandula* sp., *Cistus* sp., *Rosmarinus*, and *Cistus* sp.. These occur in large areas mostly in the hilliest parts of those karst landscapes. Unfortunately in the “Litoral”, where most of the golf courses are located, urban-touristic infrastructures, mainly nearby the coast, are contributing to the impoverishment of Algarve rich and diverse landscapes.

Although the linkage of the hydrological system within the courses is relatively good, the connection with the surrounding landscape is not. Therefore, hydrological linkages should be provided with the surrounding landscape, as with the roughs in most courses. In older courses isolation is higher due to the fact that there are, in average, fewer lakes, which make them more apart from each other. In these cases the stream system inside the course should be seen as a connector of the overall hydrological system.

4.2 Cultural and Environmental Management Components

The evaluation performed revealed that there is a tendency in newer courses to reduce land use contrast (2.1) with the surrounding landscape. Additionally golf courses' dimension has a positive relationship with contrast reduction, *i.e.* the larger golf courses presented a lesser contrast than smaller courses. This is due to the fact that larger courses have larger rough areas. Mind that the area occupied by the hole (roughly 30% of the total course area) does not change significantly between large and small courses. Thus larger courses have a potential of higher landscape integration than smaller ones.

Although there were two evaluation moments (summer and winter), the final one was during the winter, affecting the obtained results, *i.e.* the evaluation was underestimated. Furthermore a large number of the pre-defined observation points for conducting the scenic evaluation revealed as not being suitable due to the fact that golf courses are in rural areas where fruit and forest trees blocked the views towards the course. Therefore the definition of the observation points should ideally incorporate a 2.5 or 3-D model where vegetation and land use are superimposed to a digital terrain model, which was not the case. On the other hand, some courses were closely surrounded by small woodlands and orchards where the course is enclosed, not generating visual impacts.

Finally, concerning the environmental management (EM) component, there were no noticeable differences in landscape integration when comparing courses with and without an EM plan. A caveat is in order. The sample of the selected 13 courses is not representative of the total universe of the 39 existent courses in the region. Indeed only 11 (28%) out of 39 have an EM plan. However our sample included 7 with plan, which represents almost twice (54%) as much as compared to our sample. Nevertheless the survey revealed that more recent courses tend to adopt a EM plan, which is a positive trend.

5. Recommendations

A general but most important recommendation is that the landscape context (topographical, biophysical, ecological, and cultural) of the proposed site(s) to build a golf course should be acknowledged and integrated in the design process right from the start. Examples are

provided by the Nature Conservancy Council [13] and MAOTDR [14]. Note that existent landscape structures, processes and functions, and its dynamic relationships - abiotic, biotic and cultural should be considered as a pre-requisite when planning and designing any landscapes [15]. Site selection should be considered an iterative process according to site conditions and the client's preliminary program. Unfortunately in too many cases it is the economic dimension that dominates both the site selection and the actual design processes. Landscape context, including the relationships between site and the surrounding landscape should be reflected in the design of the overall spatial concept for the golf course. Note that course integration both in the site in itself and the landscape around it contributes noticeably to reduce building and maintenance costs [13].

Additionally, the re-naturalization of some components of the evaluated golf courses, including the use of indigenous vegetation, well adapted to the Mediterranean climate and soils, represents a major challenge to golf design in the Algarve. The overarching goals are to reduce golf courses' ecological impact, promoting nature conservation strategies, and to contribute to the preservation of the cultural identity of Algarve landscapes. Noteworthy is that the survey revealed that more recent courses tend to naturalize all the areas other than the hole, revealing a positive trend.

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Note: references in Portuguese: [1-6,9-12,14]; [9-12] with Abstract in English.