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SUMMARY

Lake Vela local inhabitants' and visitors' environmental attitudes and opinions about ecological conditions of the area and future management strategies to be implemented were investigated. The facilities required and the proposal to promote tourism activities, to enhance economic development, have revealed public illiteracy about ecosystems functioning and carrying capacity. This lack of scientific knowledge was recognized by a great percentage of individuals (61%, n=175), who mentioned environmental education programs as one of the main activities to be developed in the area. To spend some hours in a calm and healthy environment (67.6%, n=194), to share some moments with friends (58.2%, n=167), picnics (49.5, n=49.5%), and wildlife observation (46.7%, n=134) were the main motives cited by respondents to visit Lake Vela. These activities do not need to be restricted in the management of the area, but only directed for specific areas and carefully monitored, since they are passive activities that yield few significant impacts. The study also proposed some social benefits that could be integrated in the management of the area, in order to increase the quality of visitors` experiences and, hence, to get public compliance and involvement in the preservation of that natural resources.

KEYWORDS: freshwater lakes, management, facilities, public attitudes, questionnaires.

INTRODUCTION

Currently, it is largely recognized that patterns of natural resources use are unacceptable, and the principles of environmental sustainability need to be followed. Therefore, following the formulation of the Local Agenda 21 and national legislation in force (e.g. Portuguese National Strategy for Nature and Biodiversity Conservation) great efforts are being made by all the countries to promote public involvement in environmental resources management, mainly at the local and regional levels [1-4].

Many forms of public involvement are available for collecting information that could be used in the development of local conservation plans. These include local advisory committees, friends groups, questionnaire surveys and periodic information meetings, some of which have been successfully used in natural areas` planning [2, 5-10]. Oral questionnaires were considered to be one of the most cost-effective and efficient methods, since much information could be gathered with lower economical and temporal costs [11]. Local inhabitants are an important source of information about environmental conditions, the main anthropogenic activities developed, their own economic and social needs, and their expectations about local natural resources [5, 12, 13]. This information will be of extreme importance in the definition of management strategies that try to combine the restoration and management of local natural resources with the provision of economic, recreational and educational opportunities [5].

The present study was conducted as part of the formulation of a management plan for Lake Vela (Central Portugal), a freshwater body severely impacted by human activities [14]. The main purpose was to gather information about the types of activities carried out by local inhabitants and visitors and their socio-economic expectations as well as their opinions about the conditions of the lake and some of the restoration and preservation measures that were planned.

MATERIAL AND METHODS

Study site

Lake Vela, a coastal freshwater lake with a surface area of 70 ha and a maximum depth of 2 m, is located in Central Portugal, near Figueira da Foz. On its west is a *Pinus* sp.-wooded area, and on its east margin agricultural

fields are present. Corn and grazing fields also proliferate on its catchment area. This lake belongs to a system formed by three other small lakes, in which water levels fluctuate significantly with weather conditions and drainage for human and agricultural consumption [15].

Lake Vela is an important regional natural resource classified by the European Community program CORINE 85/338/CEE, 27 June, that attracts many tourists, especially those seeking an alternative to the beach and a refuge from nearby urban areas. This lake is also an important habitat for wildlife, especially migratory birds, which have been disturbed by the intense recreational pressure. More recently, in order to protect a valuable freshwater resource of European interest and its biodiversity, the lake was included within a national site from the Natura 2000 Network (PTCON0055) established by the Directive nº92/43/CEE of Council, of 21 of May [16].

Agricultural practices and cattle breeding on Lake Vela margins have been responsible for soil saturation with manure, fertilizers and other chemicals. The consequent leaching of high loads of nutrients and organic matter to the lake was responsible for the high concentrations of nitrogen and phosphorus compounds recorded in Lake Vela, mainly in autumn and winter months [17-19]. During the summer months the increase in temperature usually causes the reduction of dissolved oxygen concentrations, which, together with high levels of pH, may have been responsible for the release of phosphorus compounds from the sediments to the water column and the decrease in N:P ratio recorded in Lake Vela, which favoured the dominance of the phytoplankton community by cyanobacteria [20-23]. The blooms of cyanobacteria, mainly *Microcystis aeruginosa*, observed during the summer and autumn months, became increasingly frequent [18], and had a negative influence on the ecological, aesthetic and recreational values of the lake.

Another sign of the severe eutrophication process was the high macrophyte biomass productivity rate recorded in the east margin, mainly attributed to emergent species [24]. This observation has confirmed the nutrient inflows from surrounding agricultural fields. Machás [24] also found low frequencies and relative abundance for submerged macrophytes. Those species are an important component of a healthy shallow lake and their disappearance is a common occurrence during the eutrophication process [25-27]. In summary, Lake Vela is a turbid lake, threatened by eutrophication and is also facing the proliferation of exotic fish species [18].

Questionnaire design and implementation

The questionnaire covered four issues: i) personal data; ii) attitudes towards the environment; iii) knowledge of the area; and iv) attitudes towards new management strategies to be implemented. The first item, designed to obtain information about demographic variables like gender, age, residence, educational level and occupation, was followed by twelve questions. Four questions were enclosed, in which respondents could choose different options or include other aspects not taken under consideration during the questionnaire design. As for the other eight, six were in true-false format or were questions with a graduated scale, and two were open questions. Based on previous knowledge of the social and cultural level of the population, acquired during several years of scientific research in the area, the questionnaire was carefully designed according to survey research methodology [28-30]. The questionnaire was presented by direct interviews to the local population and Lake Vela visitors during the summer. This was considered to be the best method, since the interviewer could immediately clarify any question that might have been misunderstood [31]. The interviewers received precise information about their role and the main objectives of the questionnaire.

Statistical analysis

The questions were coded for statistical analysis, after the questionnaire's presentation. The category of "no answer/no opinion" was also defined in all the questions to include non-responded questions. Those cases may be important and should not be ignored in questionnaire analysis, because they do not necessarily mean that the individual has no opinion. By contrast, the question could focus on a sensitive issue and the inquired could have preferred to be neutral [30].

Contingency tables were constructed and multiple choice questions were analysed using Chi-square test to measure independence between groups, for each of the five pre-defined socio-economic variables. When groups were not independent, Cramers V was reported [32, 33].

Since data was not normally distributed, Mann Withney and Kruskall-Wallis analyses were performed for true-false format questions and questions with a graduated scale. Whenever significant differences were found, Dunn's multiple comparison test was performed [33].

RESULTS

A total of 287 interviews were carried out. The demographic results are presented in Table 1. The majority of respondents (78.7%, n=226) lived less than 10 km from the lake. Their educational level can be considered to be low and it differed significantly according to age (H=34.875, d.f.=5, p<0.001). The two younger groups were significantly different (p>0.05) from the two older ones, which had the same educational level. This is a consequence of the fact that a great percentage of the older individuals only attended the first level of basic school (Table 2).

TABLE 1 - Respondents distribution by sex, age, residence location, educational level and occupation (n=287).

	Total (n)	Percentages (%)
Sex		
Female	116	40.4
Male	171	59.6
Age		
Less or equal to18 years old	59	20.6
19-25	52	18.1
26-35	60	20.9
36-45	44	15.3
46-65	54	18.8
More than 65	18	6.3
Residence location		
Less or equal to 10 km	226	78.7
More than 10 km	61	21.3
Educational level		
1st level of basic school	74	25.8
2nd level of basic school	30	10.5
Secondary school	111	38.7
University	40	13.9
Didn't study/no answer	32	11.1
Occupation		
Student	79	27.5
Public functionary worker	29	10.1
Market/industry	77	26.8
Farmer	14	4.9
Housewife	22	7.7
Retired	10	3.5
Others	40	13.9
Unemployed/ Didn't answer	16	5.6

TABLE 2
Respondents distribution by age and educational level (n=287).

Educational level	≤ 18 N	≤ 18 %	19-25 N	19-25 %	26-35 N	26-35 %	36-45 N	36-45 %	46-65 N	46-65 %	> 65 N	> 65 %
1st level of basic school	2	3.4	4	7.7	8	13.3	18	40.9	27	50	15	83.3
2nd level of basic school	4	6.8	4	7.7	12	20	6	13.6	4	7.4	0	0
Secondary school	46	78	29	55.8	18	30	10	22.7	7	13	1	5.6
University	0	0	13	25	14	23.3	7	15.9	6	11.1	0	0
Didn't study/no answer	7	11.9	2	3.8	8	13.3	3	6.8	10	18.5	2	11.1

N = number

Attitudes towards the environment

When asked about environmental conservation importance and their contribution for it, 92.3% (n=265) of the respondents said they considered it to be a very important issue and 92% (n=264) stated that they contributed to a better environment. On the first question, differences in opinion were found among occupational groups (H= 24.331, d.f.=7, p<=0.001). Dunn's multiple comparison test could not distinguish which groups were different. Compared to the other groups, a greater percentage of farmers gave little or no importance to the maintenance of good environmental conditions. However, those results should be carefully interpreted, since this group was represented by only 4.9% (n=14) of the respondents and more research should focus on the attitudes of this group. Educational level groups also had significantly different answers (H=75.353, d.f.=4; p=<0.001). Respondents who had not attended school were significantly different (p<0.05) from the other groups, and they were represented by a higher percentage of individuals that did not

contribute, in any way, to a better environment. Somewhat surprising was the fact that no differences were found between individuals with basic school studies and those with university degrees (Q=7.845, p>0.05). Taking into consideration that 43.2% (n=42) of the respondents from the former group were more than 45 years old, two possibilities could explain those results: (1) older individuals are highly sensitized for local environmental problems, and direct their actions to minimize harmful impacts of their activities; (2) or, at least, they think they are doing that. Significantly different answers were also found among occupational groups (H=40.117, d.f.=7, p<0.001).

To pour the garbage out in appropriate facilities and to be careful when lighting a fire, as well as doing it in the proper place, were environmental practices of the great majority of the respondents (Table 3). Those actions were associated with gender (χ^2=15.585, d.f.=7, p=0.029, V=0.99) and educational level (χ^2=60.467, d.f.=28, p<0.001, V=0.61). Regarding gender, chi-square was recalculated after removing option A (see Table 3) from contingency table (χ^2=3.740, d.f.=6, p=0.712, V=0.516). Women seemed to be more concerned with the kind of chemical products they bought, and in using them as little as possible. A great percentage of women (37.9%, n=44) also separated litter and sent it for recycling.

It is interesting to note that respondents with university degrees were the main participants in ecological ac-tions that required specific information and a personal environmental ethic (Figure 1). Regarding the other groups, a great percentage of individuals that had attended university (62.5%) stated that they separated glass and paper for recycling. The actions cited in our study were also significantly related to residence location (χ^2=18.909, d.f.=7, p=0.008, V=1.0). A greater percentage of individuals, that resided more than 10 km from Lake Vela, stated that they separated trash for recycling (60.6%, n=37) and were concerned with buying only CFC-free sprays (49.2%, n=30).

TABLE 3 - Forms through which respondents use to contribute to preserve the environment (n=287).

	Total (n)	%
A. Pay attention to the kind of detergents used	89	31.0
B. Pour out the garbage in appropriate facilities	266	92.7
C. Send paper and glass bottles for recycling	91	31.7
D. Use only CFC free sprays	96	33.4
E. Teach the children to respect nature	125	43.6
F. Make fire only in appropriate places	196	68.3
G. Use the less quantity of chemical products as possible	133	46.3
H. Others	22	7.7

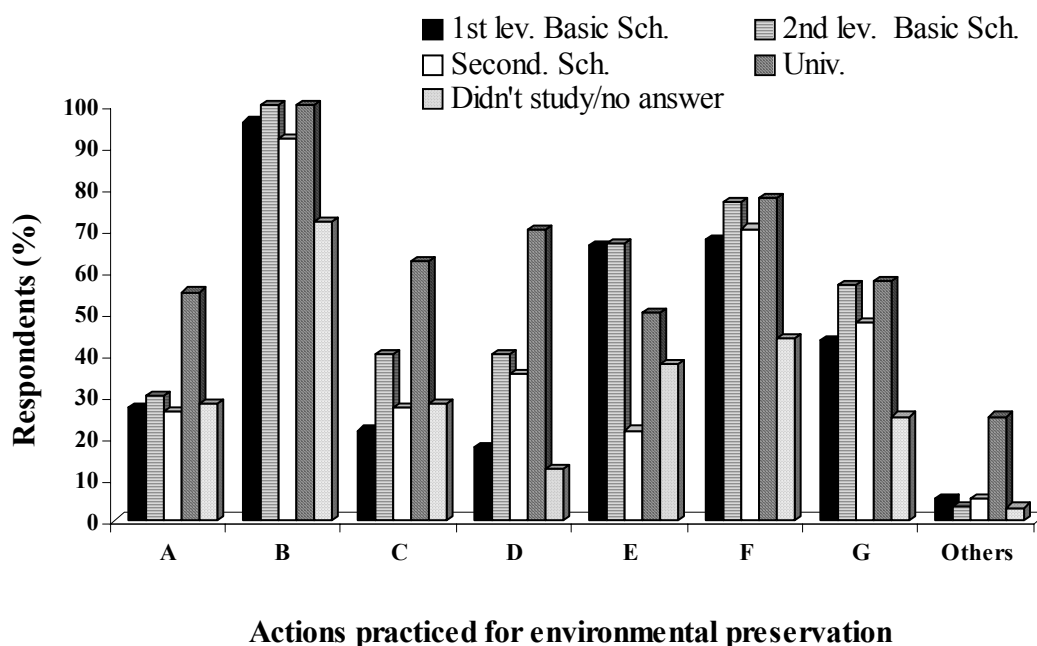**Actions practiced for environmental preservation**

FIGURE 1 - Percentage of ecological actions performed by respondents according to their educational level (A - Pay attention to the kind of detergents used; B - Pour out the garbage in appropriate facilities; C - Send paper and glass bottles for recycling; D - Use only CFC-free sprays; E - Teach the children to respect nature; F - Make fire only in appropriate places; G - Use the less quantity of chemical products as possible).

**Knowledge about the area and
attitudes towards its management**

The great majority of individuals (96.2%, n= 276) had previous knowledge about the area due to the proximity of their residences (78.7%, n=226), or because they had agricultural fields in Lake Vela catchment's area (9.6%, n=27). Only 3.1% (n=9) stated that it was their first time at Lake Vela.

The individuals were asked to specify (through multiple-choice answers) their motives to visit Lake Vela and its surrounding area. The need to spend some hours in a healthy and calm environment, to share some pleasant moments with friends, and picnics were the main motives that led respondents to visit the lake (Table 4). The motives cited were strongly related with gender (χ^2=25.876, d.f.=7, p<=0.001, V=1) and less with the educational level (χ^2=117.262, d.f.=32, p=<0.001, V=0.52). A higher percentage of men visited the lake to engage in recreational fishing (39.8%, n=68), while women were comparatively more interested in photographing the landscape and its wildlife (40.5%, n=47). Concerning educational level, individuals with university studies tended to visit the lake mainly to observe wildlife (85%, n=40) (Figure 2). Sport activities and walking or strolling were some of the additional activities mentioned by the people interviewed.

TABLE 4 - Motives to visit Lake Vela (n=287).

	Total (n)	%
A. Spend some hours in a calm and healthy environment	194	67.6
B. Enjoy some moments with friends	167	58.2
C. Picnics	142	49.5
D. Recreational fishing	82	28.6
E. Swimming	94	32.8
F. Wildlife observation	134	46.7
G. Photographing	97	33.8
H. Others	21	7.3

In the assessment of the degree of satisfaction, when considering the environmental conditions of the area, it was recorded that 39.0% (n=112) and 46% (n=132) of the respondents were little or not satisfied with the degree of deterioration of Lake Vela and its surrounding area. Significant differences were found between gender groups (U=4.023, d.f.=1, p=0.045). Regarding gender, a greater percentage of men stated not to be satisfied with the conditions of Lake Vela natural features. As well, a great majority of respondents (88.2%, n=253) agreed with the necessity to formulate, design and implement new management strategies in the area. No significant differences (p>0.05) were found among groups with respect to each of the five socio-economic variables.
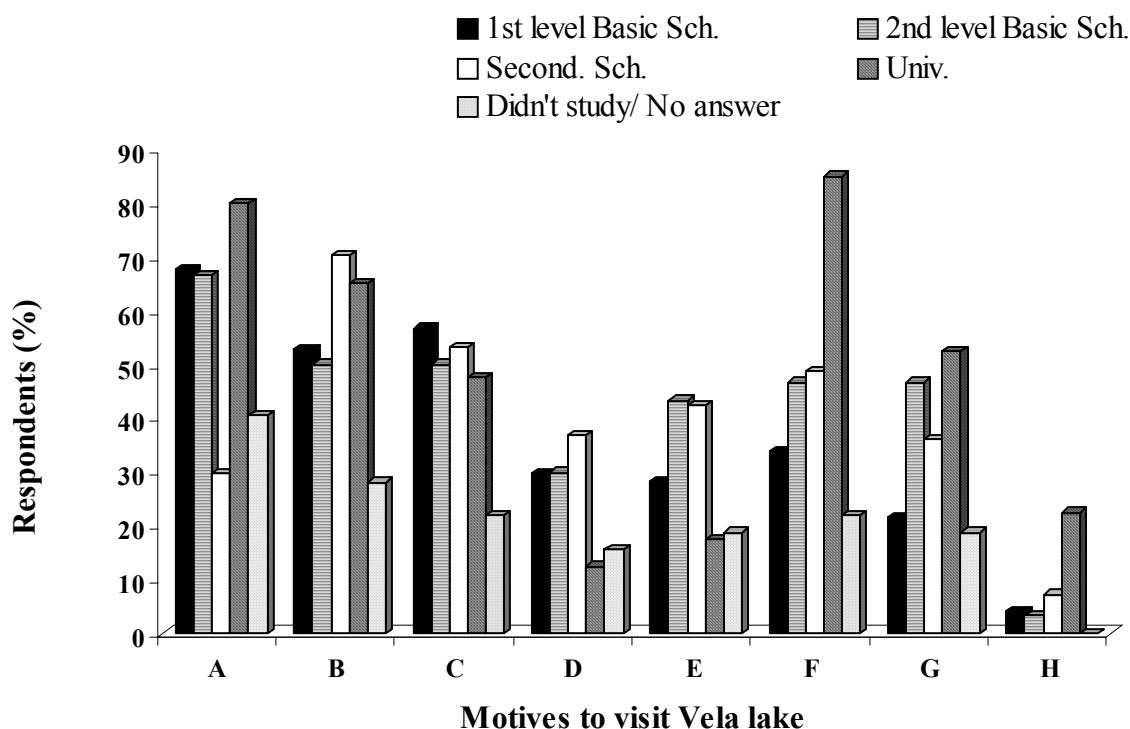

FIGURE 2 - Percentage of motives to visit Vela lake cited by respondents according their educational level (A - Spend some hours in a calm and healthy environment; B - Enjoy some moments with friends; C - Picnics; D - Recreational fishing; E - Swimming; F - Wildlife observation; G - Photographing; H -Others).
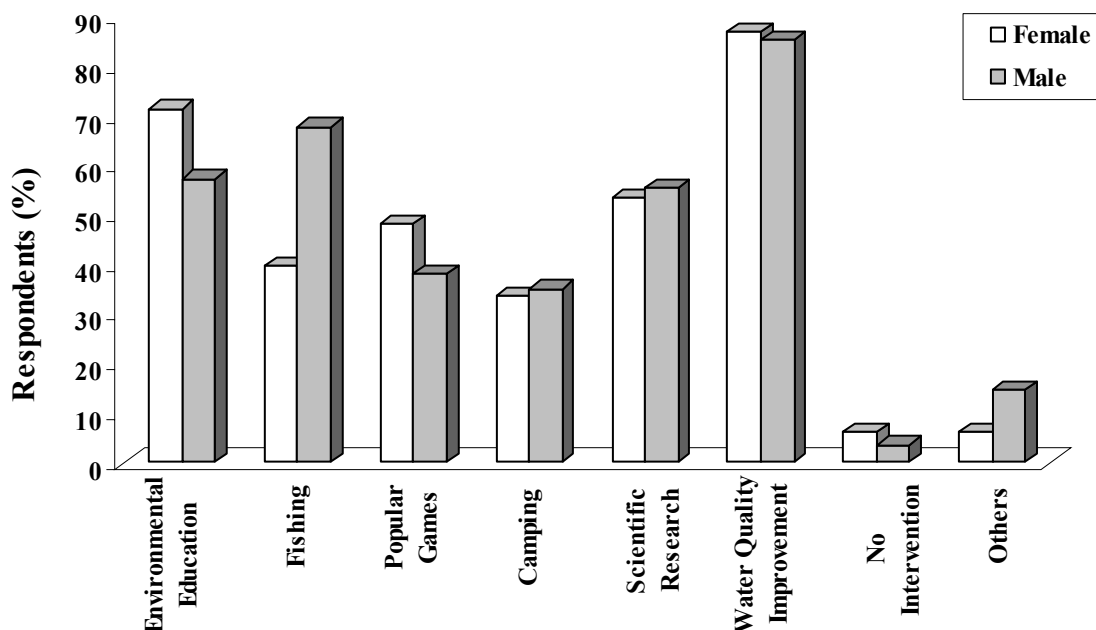
FIGURE 3 - Activities that the respondents would like to see developed in Vela lake according to gender.

A boat, a bar and a car parking area were the main facilities and services that respondents identified as lacking in the Lake Vela area, and mentioned them as a way to improve the quality of their visits (Table 5). The facilities cited were not related with gender, age, educational level, residence, or professional activity.

When asked about the main activities they would like to see developed in Lake Vela area, the rehabilitation of water quality, environmental education programs and recreational fishing (56.4%, n=162) were the most frequently mentioned by respondents. A significantly high percentage of men (67.8%, n=116) preferred the development of recreational fishing, while women preferred environmental education activities (71.6%, n=83) (χ^2=19.20, d.f.=7, p=0.008) (Figure 3).

The participants were also asked about closing the Lake Vela shores to car and motorcycle traffic. The majority (52.6%, n=151) agreed with this proposal. Statistically significant differences were found in the eight occupational groups (χ^2=14.937, d.f. =7; p=0.037). However, Dunn's multiple comparison test was not able to distinguish which groups were different. 48.1% (n=50 in 104) of the justifications given by respondents with a favourable opinion was that prohibiting traffic circulation in the area would be the best management practice to prevent pollution, whereas maintaining the right to drive cars and motorcycles up to the shores was the main justification presented by respondents with a non-favourable opinion (46.4%, n=26 in 56).

TABLE 5
Infrastructures and facilities that inquires considered to be necessary in Vela lake area to improve the quality of their visits (n=287).

	Total (n)	%
A. Bar	163	56.8
B. W. C.	225	78.4
C. Parking area	126	43.9
D. Boats	162	56.4
E. Nature guide	91	31.7
F. Tourism office	80	27.9
G. Bus	39	13.6
H. Bicycles	113	39.4
I. Others	54	18.8

According to the respondents, Lake Vela may be used to promote economic development in the local area, through the promotion and development of tourism activities (42%, n=103), and 20% (n=34) added that new infrastructure and facilities (e.g. hotels, camping, golf camp) should be created in the area. No statistically significant differences in opinion were found between the different groups defined for each of the variables.

DISCUSSION

Usually, the human society looks to ecosystems mainly as sources of economical and social benefits, without being concerned with potential harmful impacts that can result from the extraction of those benefits [34, 35]. Once more, this utilitarian point of view was observed in Lake Vela local inhabitants and visitors. Notwithstanding, the great

percentage of respondents considered the maintenance of environmental quality as a very important issue. The demand for facilities and infrastructure to promote tourism in the area has revealed the lack of awareness of relationship between human activities and environmental degradation. Consequently, we believe that the concern with the lake's environmental health, demonstrated by a great percentage of respondents who mentioned the improvement of water quality as a priority action, results only from the value of the lake as a potential economic and social resource. In fact, although Roe [36] argued that the public is really interested in ecosystems where they reside, Holl *et al.* [37] recorded that public with lower educational level was more concerned with the improvement of economic conditions than with environmental problems. Therefore, if public participation in the management of Lake Vela is to be profitable and long-term effectiveness of restoration strategies guaranteed, formal and non-formal education programs should be planned. According to Heinen [38], education programs without social and economic benefits are not likely to work, but they are of high importance as precursors of restoration efforts. In this study, 61% (n=175) of Lake Vela local inhabitants and visitors required educational programs, which was a good indication about the predictable effectiveness of these programs, because the public was the first to recognize their lack of knowledge about environmental issues. A great percentage of managers interviewed by Manning *et al.* [39] preferred visitors educational programs as a highly effective management strategy.

Non-formal environmental education programs could improve the understanding of the complexity of ecosystem functioning, the carrying capacity of resource systems, the impacts of human activities on ecosystem integrity and beauty, and the expected time lag between the implementation of management strategies and the occurrence of observable outcomes [40, 41]. And it could also demonstrate other possible benefits that conservation can bring to local communities. Previous studies carried out on Donãna National Park have demonstrated the importance of active local participation in environmental programs to improve landscape perception and appreciation [42]. In fact, people that interact directly with the landscape usually develop ecological aesthetics` sense and enhance understanding and appreciation of ecosystem management activities [43]. The existent Lake Vela environmental education centre could be used for temporary exhibitions and meetings (with resources managers) in order to provide information to the public, especially local inhabitants, about ongoing restoration activities. Additionally, informative signboards could be put in management areas, and interpretative nature trails could be used to explain management decisions implemented. According to Gobster [43], such facilities are useful tools to communicate with the public, which is of extreme importance in this area, since we believe that a misunderstanding about some actions and rules already defined by man-

agers may be the explanation for vandalism recorded in the area.

It is widely recognized that the public has increasing preferences for outdoor recreation activities in natural areas [31]. Outdoor recreation could produce impacts on biodiversity, as severe as that resultant from logging and livestock grazing [44]. However, the type of activities carried out in Lake Vela, namely wildlife observation and picnics, were passive ones. Those activities, in addition to recreational fishing, could be compatible with resources preservation, and with the maintenance of the quality of visitors' experiences, whether they were directed to specific areas or with simultaneous implementation of strategies to prevent crowding. The provision of a parking area in addition to prohibition of cars from that area and limiting the number of wood tables and benches could be some of those strategies. The recent findings of some authors [45, 46] note that crowding seemed to be an acceptable impact for different national park visitors, but it should be prevented in Lake Vela. Because of its small area, the ecological carrying capacity of the lake is likely to be quickly overcome.

According to Jussof and Majid [47], the offer of some social and economic benefits is a key factor in promoting public participation in the development of local conservation plans, and in complying with conservation actions. However, one of the main reasons for the failure of environmental restoration programs, results from the fact that benefits yielded are not received by those who incur the costs [48]. Therefore, the knowledge of socio-economic expectations of local inhabitants and Lake Vela visitors will allow the consideration of some of them in the management of the area, if they were compatible with the goals defined. Although, economic issues are frequently mentioned by neighbourhood inhabitants of natural areas [2], it is important to make people perceive that conservation programs also involve costs, such as restricted access to some areas, and the cessation of some activities. Moreover, it is important to acknowledge non-economic social benefits derived from the environment, such as aesthetics, spiritual benefits, education and recreation. The lack of environmental knowledge to take this reality seriously compromises the future of ecosystems.

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