A **new approach** to assess the **ecotourism** potential in protected areas: The case study of **Peneda-Gerês National Park**

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Abstract | Most of the ecotourism research focuses only on the ecotourism impacts on communities or environment, with few combining biological, ecological and cultural variables. Through the need to develop new approaches in this area to sustain the biodiversity conservation and rural communities' development, there was set forth a methodology to assess the ecotourism potential of five hiking trails, both spatially and temporally, in the Peneda-Gerês National Park. There were combined eight different criteria to achieve the ecotourism potential of these trails and they were evaluated through the annual seasons. Results illustrated that some trails have more potential for the development of recreational activities than the others. In a temporal scale analysis, all seasons have great potential for the development of such activities. These data allow managing efficiently tourists and their impacts on wildlife and may enhance the local economy. This novel approach can contribute to the main goal of ecotourism, the sustainable development.

Palavras-chave | Ecotourism, Peneda-Gerês National-Park, Sustainable development, Hiking trails.

Resumo | A maioria da investigação em ecoturismo tem-se focado apenas nos seus impactos nas comunidades rurais ou no ambiente, com muito poucos a combinar variáveis biológicas, ecológicas e culturais. Precisamente pela necessidade de desenvolver novas abordagens que compreendam tanto a conservação da biodiversidade como o desenvolvimento das comunidades rurais, foi aqui desenvolvida uma metodologia para avaliar o potencial ecoturístico de cinco trilhos pedestres, tanto espacial como temporalmente, no Parque Nacional Peneda-Gerês. Combinaram-se oito critérios diferentes para obter o potencial ecoturístico desses trilhos, que foram avaliados nas quatro estações anuais. Os resultados permitiram inferir que uns apresentam um potencial maior para o desenvolvimento de atividades de recreio do que outros. Numa análise temporal, todas as estações demonstraram um elevado potencial para o desenvolvimento de tais atividades. Estes dados permitem gerir eficientemente os turistas e os seus impactos na vida selvagem e melhorar a economia local. Esta nova metodologia contribuirá para o principal objetivo do ecoturismo, o desenvolvimento sustentável.

Keywords | Ecoturismo; Parque Nacional da Peneda-Gerês; Desenvolvimento Sustentável; Trilhos Pedestres.

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1. Introduction

Ecotourism as one of the fastest growing sectors of the tourism industry is bringing to the debate where to benefit the ecosystems preservation and the communities under Protected Areas (Stem, Lassoie, Lee & Deshler, 2003; Monteros, 2002; Schelhas, Sherman, Fahey & Lassoie, 2002). However, it is also considered as a new form of impacting negatively the ecosystems in many Protected Areas (PA's) (Barkin, 2003), notably mountain regions and islands (Zhou et al., 2013; Hall, 2010) through vegetation trampling, soil erosion, littering and wildlife disturbance (Li, Ge & Liu, 2005; Spanou, Tsegenidi & Georgiadis, 2012; Stem et al., 2003; Schelhas et al., 2002; Bouton & Frederick, 2003; McNamara & Prideaux, 2011). Although many ecotourism studies were made in the last years, most of them only try to assess the social benefits or the impacts on rural communities of ecotourism projects (Reimer & Walter, 2013) or the impacts those projects have in specific species (Bouton & Frederick, 2003; Nevin & Gilbert, 2005; Lindsey, Alexander, Toit & Mills, 2005). Very few combine biological, ecological and cultural data (Schelhas et al., 2002), and to achieve the sustainable tourism there is a need to integrate subjects of different disciplines, such as economy, environment and social area (Monteros, 2002; Spanou et al., 2012).

PA's offer great potential for the development of tourism related activities (Zhou et al., 2013; Spanou *et al.*, 2012; McNamara & Prideaux, 2011), though they are facing huge damages caused by human pressure (Bouton & Frederick, 2003), especially in the summer season. Thus, ecotourism research needs new approaches that combine variables from ecological and anthropogenic disciplines (Monteros, 2002) and evaluates them throughout the year, since biotic conditions are not static in time (Levin et al., 2013). Combining those variables, it is expected that the data collected help to manage the ecotourism activities, which in turn helps to safeguard the ecosystems and to generate socio-economic benefits for locals.

Also, the assessment of the ecotourism potential of an area needs to consider all the annual seasons. In what concerns to temporal scale the challenge is to undertake changes over time (Hall, 2010), whether they are of biological or landscaping nature (Levin et al., 2013). This may allow the spreading of tourists among the year (Barkin, 2003), since other seasons rather than summer can offer opportunities for the development of recreational activities (Loubser, Mouton & Nel, 2001). This way, it is expected to lessen the negative impacts caused by the recreational activities (Loubser et al., 2001). Yet, it is also necessary to know the conservation status of species affected by the recreational activities (Hall, 2010) in order to protect them efficiently.

In this study, it was developed a novel approach to study the ecotourism potential in PA's, by assessing eight different criteria (two biological, five ecological, and one cultural). Regarding this, a formula was designed to calculate the Ecotourism Potential Value (EPV) of hiking trails and tested it in Castro Laboreiro, Peneda-Gerês National Park (PNPG). Hiking trails allow the connection of tourists to ecosystems and landscapes (Xiang, 1996; Pena, Abreu, Teles & Espírito-Santo, 2010); and a close contact to natural and cultural heritage (Li et al., 2005; Hugo, 1999). Although they are often severely impacted by overuse, they help to raise environmental tourists' awareness (Hugo, 1999). To forecast biological differences, all seasons were covered.

The main goal of this study was to apply a novel approach that can be useful in management of recreational activities, especially in PA's. By providing and linking biological, ecological and cultural data as one, we also try to answer the following questions: (i) can other seasons rather than summer offer considerable ecotourism potential and enhance the visitation of our study area?; (ii) shall this work contribute to scatter ecotourists throughout the year, so that the negative impacts of the mass tourism can be avoided?; and (iii) can the assessment of the spatiotemporal biodiversity differences be useful to the ecotourism research?

2. Methodology

2.1. Study Area

Castro Laboreiro is a parish located in the northern Portuguese municipality of Melgaço with an area of 8.844 ha that belongs to the PGNP. It is a complex mountain with steep slopes to the south and slightly to the north where it culminates at a plateau (Município de Melgaço, 2006). Due to this relief it is mainly influenced by the Atlantic climate, although there is Semi-Mediterranean influence to the south (Honrado, 2003). It is characterized by an average temperature of 14.4º C and a total annual precipitation between 2.400 mm and 2.800 mm, which makes this one of the rainiest areas in Europe (Honrado, 2003).

This area has an ancient and rich historical and archaeological heritage, including the largest megalithic complex of the Iberian Peninsula at the plateau, the Castro Laboreiro Castle; medieval bridges; and elements with high representativeness in the local culture (Lima, 1996).

2.2. Criteria evaluation to assess EPV of hiking trails

EPV of five different trails was achieved to seek differences between trails and between seasons, based on eight different variables – Species Richness (S); Number of different Habitats (NH); Medium Value of the Habitats (MVH); number of Natural Marks (NM); number of Anthropogenic Marks (AM); Landscape Diversity (LD); Vertebrate Conservation Status-Plant Range Distribution (VCS-PRD) and Number of Endemisms (NE). The survey was conducted from September 2012 to August 2013.

S is achieved by counting the species seen in each trail once by season. NH represents the count of how many different habitats are present in a given trail. MVH is a measure of their rarity at a local level. The values range from one to five, being the lowest attributed to the more common habitats in the region and the highest to the rarest as follows: (i) dry heaths (4030pt2); (ii) Galician-Portuguese oak woods (9230pt1); Birch riparian galleries (91E0pt2) and Temperate Atlantic dry heaths (4020pt1); (iii) Northern Atlantic wet heaths (4010) and Alder riparian galleries (91E0pt1); (iv) Transition mires and quaking bogs (7140pt2); (v) Altitude meadows (6230). NH and MVH were accessed only once during this survey. To obtain a result that allows the comparison between trails, it needs to divide the sum of the weighs attributed to the different habitats by the number of habitats seen in each trail, as follows:

$$MVH = \frac{\sum Weighs\ of\ habitat\ types}{Number\ of\ different\ habitat\ types} \qquad (1)$$

The NM and AM represent, respectively, the total number of natural and anthropogenic elements present in each pedestrian trail with a measure of their relative importance. NM regards to watercourses (rivers, brooks, lakes); geological elements (stratigraphic folders or faults; very large stones; significant outcrops); and riparian galleries. AM regards to ancestral tumuli; ancestral bridges; old villages; churches; shepherd shelters; granaries; and other elements with high representativeness in local culture. All NM were assigned one point and AM were weighed according to date of construction, with values ranging from one – the most modern buildings – to five – the oldest buildings. The last accounts for the time of the Roman or the Neolithic period, and modern to the medieval time or the modern epoch. In this criterion it was considered the autochthonous animal breeds of this area, namely the Barrosão ox; Castro Laboreiro dog and Garrano horse, as an AM since they constitute part of the Minho cultural heritage. Both NM and AM are accessed by season. Physical structures were recorded only once during the survey as they are immutable and variable ones – like the autochthonous breeds – were counted once by season.

To achieve the LD spatially and temporally it was adopted the methodology proposed by Honrado and Alonso (2010) in the definition of Landscape Main Elements (LME). Their focus of LME comprises 'topography'; 'vegetation'; 'water'; and 'constructions'. These four elements plus the 'geology' were considered. Then, the LD consists on the identification of these five LME in each landscape unit. As trails have different lengths and there is a need of a relative value to compare them, the sum of all LME in a given trail was divided by its total length as follows:

$$\text{R}elative\ value\ of\ LD = \frac{\sum LME\ by\ trail}{Total\ Lenght\ of\ trail} \quad (2)$$

This criterion was evaluated only once during the survey.

VCS-PRD considers the conservation status of vertebrates (VCS) and the general range distribution of plants (PRD). Weighs vary between one and five, weighing more the animals that face a higher extinction risk or the plants that have a more restrict distribution. The weighs adopted were the follows: (i) Least Concern (LC) or Exotic Plant; (ii) Near Threatened (NT) or High Spread in the Country; (iii) Vulnerable (VU) or High Spread in the Study Area; (iv) Endangered (EN) or Iberian Peninsula Endemism; and (v) Critically Endangered (CR) or Portuguese Endemism, for the vertebrates or plants, respectively. Flowering and fruiting were considered by allocating more 0.5 points to the original value. For animals the VCS was accessed by the Red Book of Vertebrates of Portugal (Cabral et al., 2005) and the IUCN Red List of Threatened Species™ (see http://www.iucnredlist.org/), but between the two lists it was only considered the conservation status that protects more the species, i.e., the highest conservation status. Also, invertebrates, domestic animals and fungi which few are classified under the Red Lists, were weighed with 0.5 points. To obtain a value that allows the comparison between trails and seasons the sum of VCS-PRD values was divided by the S values of each trail (and each season) as follows:

$$VCS - PRD = \frac{\sum VCS/PRD}{S} \quad (3)$$

This criterion was accessed once by season.

NE consists on counting how many endemic species are present in a given trail by each season. In this survey it was considered both the Iberian and Portuguese endemisms.

After accessing the previous criteria EPV can be calculated. Here were adopted two different approaches to evaluate the EPV of each trail in each season. In the first, all criteria weighed the same and contributed equally to the calculation. In the second one each criterion contributed with different weighs, being the NH and MVH the least valued criteria; NM weighs twice more than the previous two criteria and S three times. NE and LD contributed four times more for the EPV than the first two criteria; and VCS-PRD and AM were the criteria considered to have more weigh in this analysis. The option to value more VCS-PRD and AM is due to the fact they are related to variables responsible to attract more the tourists, like threatened species and the cultural legacy of a region (Gössling, 1999; Álvares & Petrucci-Fonseca, 2002). To obtain easily interpretable results the final value was divided by the number of criteria considered as follows:

$$EPV = \frac{\sum values\ obtained\ for\ each\ criteria}{Number\ of\ Criteria\ analysed} \quad (4)$$

3. Results

Spring and summer were the seasons with more species recorded in all trails followed by autumn and winter with the lowest S values. Trail 1 recorded the highest S values recorded in all seasons, with a maximum of 179 species in summer. Trail 3 recorded less species in almost all seasons (102 species recorded in autumn and 132 in summer) – this is true except for winter, when Trail 5 recorded only 96 species (according to Table 1).

Trail 2 and Trail 5 showed more habitat diversity, with six and five different types of habitats, respectively. The poorest trails in terms of NH were the Trail 3 and the Trail 4 with only three different habitats (according to Table 2). The highest MVH was shown by Trail 5 with 3.0 points. It followed Trail 2 with 2.3 points; with Trail 3 and Trail 4 being the thirds, both with 2.0 points, and the Trail 3 with the lowest result of only 1.7 points (according to table 2).

In general, summer recorded less NM in all trails, whereas winter showed the highest values for all trails – this is true except for Trail 1, where the highest value was recorded in spring (24 NM) (Table 3). The highest value was recorded in spring for Trail 1 (24 NM) and the lowest in summer for Trail 4 (4 NM). Trail 3 was the poorest for almost all seasons, except the summer, when it recorded four more NM than Trail 4.

Trail 5 held the highest AM results in all seasons, with values ranging from 48 points in winter to 54 points in summer, whereas Trail 2 was the one with the lowest values, ranging from 3 points in summer to 5 points in other seasons. Trail 1 registered the second highest values, from 27 to 31 points, followed by Trail 4 and Trail 3 with values between 15 and 17 and between 8 and 10 points, respectively (Table 4).

Although Trail 5 showed almost as many LME as Trail 1, it was the least LD valued (Table 5). There was a hierarchy where Trail 1 recorded more LME (61), followed by Trail 5 (58), Trail 2 (42), Trail 4 (41) and Trail 3 (34). Notwithstanding, whereas the highest value of LD was recorded by Trail 1 with 11.05 points, Trail 3 followed it with 7.73 points, being the second highest valued. Yet, a hierarchy of the LD values could be made, where Trail 1 presented the highest LD value (11.05), followed by Trail 3 (7.73), Trail 2 (5.07), Trail 4 (4.81) and Trail 5 (3.77).

VCS-PRD values did not vary much from one season to another (Table 6). Trail 3 recorded the highest values of VCS-PRD in almost all seasons, ranging from 2.28 points in summer to 2.42 points in winter. The only exception falls on summer in Trail 1 with 2.31 points, being the highest value for this particular season. According to the results in table 6 the winter was the season with the highest values recorded for almost all trails except Trail 4. Controversially, Trail 4 registered the highest VCS-PRD value in the spring season, with 2.26 points.

Table 1 | Species richness by trail and by season.

S	Spring	Summer	Autumn	Winter
Trail 1	173	179	147	144
Trail 2	154	156	136	119
Trail 3	122	132	102	103
Trail 4	147	158	137	126
Trail 5	139	135	110	96

Source: Own construction.

Table 2 | Number of different habitats (NH), habitat types and their medium value by trail.

	NH	Habitat Types	MVH
Trail 1	4	4030pt2 *91E0pt1* 91E0pt2 *9230pt1*	2.0
Trail 2	6	*4010* 4020pt1 *4030pt2* 7140pt2 *91E0pt2* 9230pt1	2.3
Trail 3	3	*4030pt2* 91E0pt2 *9230pt2*	1.7
Trail 4	3	4010 *4030pt2* 9230pt1	2.0
Trail 5	5	*4010* 4020pt1 *4030pt2* 6230 *7140pt2*	3.0

Source: Own construction.

Table 3 | Natural marks by trail and by season.

NM	Spring	Summer	Autumn	Winter
Trail 1	24	20	23	23
Trail 2	18	12	21	21
Trail 3	12	8	11	12
Trail 4	13	4	14	15
Trail 5	13	11	14	14

Source: Own construction.

Table 4 | Anthropogenic marks by trail and by season.

AM	Spring	Summer	Autumn	Winter
Trail 1	31	31	27	29
Trail 2	5	3	5	5
Trail 3	10	10	10	8
Trail 4	15	17	15	17
Trail 5	52	54	52	48

Source: Own construction.

Table 5 | Landscape diversity by trail, with concerning to the number of points of scenery appreciation (PSA), the total length of the trails in mm and total number of LME in all PSA.

LD	Trail 1	Trail 2	Trail 3	Trail 4	Trail 5
PSA	23	14	10	12	18
Trail Total Length in Km	5.52	8.28	4.40	8.52	15.39
∑number of LME in all PSA	61	42	34	41	58
LD	11.05	5.07	7.73	4.81	3.77

Source: Own construction.

Table 6 | VCS-PRD by trail and by season.

VCS-PRD	Spring	Summer	Autumn	Winter
Trail 1	2.36	2.31	2.31	2.36
Trail 2	2.30	2.29	2.14	2.42
Trail 3	2.41	2.28	2.40	2.42
Trail 4	2.26	2.21	2.12	2.19
Trail 5	2.07	2.26	2.17	2.28

Source: Own construction.

Table 7 | Number of Endemisms by trail and by season.

NE	Spring	Summer	Autumn	Winter
Trail 1	16	15	12	13
Trail 2	19	17	15	15
Trail 3	11	10	9	9
Trail 4	13	12	9	8
Trail 5	10	8	9	6

Source: Own construction.

Spring recorded more endemisms than any other season in all trails, with 16, 19, 11, 13 and 10 endemic species recorded in Trail 1, Trail 2, Trail 3, Trail 4 and Trail 5, respectively (according to table 7). Summer showed the second NE highest values for almost all trails, with 15, 17, 10 and 12 endemisms in Trail 1, Trail 2, Trail 3 and Trail 4, respectively. Instead, Trail 5 registered the second highest results in autumn with 9 endemisms.

Table 8 | EPV by trail and by season: Results of EPV considering the first approach are at the top of each cell; results of EPV considering the second approach are at the bottom of each cell.

EPV 1st App. / EPV 2nd App.	Trail 1	Trail 2	Trail 3	Trail 4	Trail 5
Spring	32.93 / 106.00	26.46 / 70.10	21.23 / 60.74	25.01 / 71.94	28.48 / 91.68
Summer	33.05 / 106.72	25.46 / 68.09	21.83 / 63.41	25.38 / 75.04	27.75 / 91.05
Autumn	28.54 / 91.47	24.07 / 64.00	18.34 / 52.99	23.37 / 68.35	24.87 / 81.12
Winter	28.55 / 92.13	21.98 / 57.80	18.35 / 52.37	22.25 / 65.77	22.26 / 73.44

Source: Own construction.

The results showed that EPV differences between seasons did not vary much if we consider the first approach (all criteria weighting equally) or the second (criteria weighting differently) (according to table 8). In both approaches, Trail 1 was the trail with the highest EPV in all seasons, followed by Trail 5 with the second highest values and the Trail 3 with the lowest values. Differences between the two approaches were observed in Trails 2 and 4 when it was considered the first or the second approach. When considering the first, Trail 2 showed higher EPV than Trail 4 in almost all seasons except in winter. By taking the second approach Trail 4 showed higher EPV than Trail 2 in all seasons.

4. Discussion of the results

The great number of species recorded in warmer seasons can be explained by reptiles that tend to hibernate in the colder months and by the invertebrates that complete their life cycles in the warmer ones. Yet, migratory birds that adopt this region as feeding or nesting area in spring and summer can contribute to the highest S values recorded in these two seasons. Similarly, the autumn results can be explained by the huge number of fungi registered in this season. The highest species richness recorded by Trail 1 relies on the fact that this trail crosses dense oak forests, dry heaths, riparian galleries, rural areas subject to high human pressure and comprises steep slopes and uneven terrain. Together, they offer ideal conditions for a high variety of species. Note that all species that naturally occur in this territory could not be recorded. Rarely, all species can be recorded in a survey and the detection of an individual can vary among the observer, survey methods, sites and species themselves. This is particular true considering the elusive character of some animals or their rarity (Lennon et al., 2004).

The highest MVH showed by Trails 2 and 5 can be explained not only by their diversity of habitat types, but also for being the only trails where the rarest habitats could be seen. Trail 2 and Trail 5 comprise rare habitats like the 7140pt2 and 6230, respectively, increasing their MVH to higher levels. Contrarily, the lowest MVH of Trail 3 was due to the most common habitats it recorded.

Since most of the natural marks evaluated regards to water sources it is easily explicable how winter season recorded the highest values for almost all trails. Indeed, this region is one of the rainiest in the country, especially in the months of December and January (Honrado, 2003) which explain the high number of water courses registered in that season. Yet, in the driest months watercourses tend to evaporate which can explains the lowest results in summer. In a spatial analysis, Trail 1 highest results can be explained the human influence in this territory. There were several river artificial deviations for field's irrigation across the entire trail.

The highest AM results showed by Trail 5 were due to the ancestral tumuli from the Neolithic period that can be seen. It's easy to understand how Trail 5 recorded results ten times higher than Trail 2, which is the trail where the human presence is less felt, with almost no human structures in all its length – and consequently the one with the lowest AM results. The second highest results by Trail 1 can be explained by the three villages it crosses, by the presence of four bridges of different periods (roman period and Modern Age), and by the presence of several modern buildings with high representativeness in the local culture. The variation observed between annual seasons was due to the registration of the indigenous breeds. If they were not considered in this criterion, results were equal for all seasons.

In what concerns to the landscape criterion, even though Trail 1 and Trail 5 recorded almost the same LME, the last recorded the lowest LD values despite its length. Contrariwise, Trail 3 was the shortest trail and had the lowest LME results, but when the relative value of LD was calculated it showed the second highest result. This demonstrates that, although longer trails can record more LME, it doesn't necessarily mean they have highest LD results. The LD was one of the most difficult criteria to assess due to the subjectivity inherent to the aesthetic quality evaluation of the landscape. Honrado and Alonso (2010) by considering four LME in their LD evaluation, they also reckon three different attributes of aesthetical quality, namely the order of the LME, the spatial diversity and the scenic value of landscape to the observer. Moreover, they highlighted the perception and the evaluation of each of these three attributes may vary depending on the observer and the type of the methodology adopted. Also, other factors could be considered in this evaluation such as 'landscape visual range', 'best viewing distance' or 'the orientation of the landscape' (Li et al., 2005) or the 'diversity of services offered by the landscape' or their 'economic value' (Plottu & Plottu, 2012). Our final formula adopted to calculate the relative value of LD came from the necessity to have a valid value to compare between trails. If only all LME present in each trail was considered we would not get valid results to make the comparison and, probably, longer trails would obtain highest results.

Spring and summer results were influenced by the high number of invertebrates (weighted 0.5 points each) recorded in these seasons. Autumn results were influenced by the high number of fungi that were only recorded in this season (weighted 0.5 points each). Winter highest results can be explained by the lowest S recorded by this season. In fact, we divided the sum of VCS-PRD by S; therefore mathematically it is expected to obtain superior VCS-PRD relative results when there are less species recorded. Similarly, in a spatial analysis, Trail 3 obtained the highest results precisely because of its lowest S values. Nevertheless the results depend on the species recorded during the survey and on the conservation status data updated, which is oftentimes deficient, due to lack of data gathering (Hall, 2010). By dividing the sum of VCS-PRD results by the species richness we obtained a relative value that allows a valid comparison between seasons and between trails. This highlights the fact that if it was only considered the sum of VCS-PRD values, probably trails with more species would show higher results in this criterion, too.

The highest numbers of endemisms recorded in spring and summer could be attributed mainly to species of reptiles that were absent from colder months (since they hibernate in those months) and plants that can only be seen in these particular seasons. Although the heterogeneous character of this criterion, it provides relevant information about the sensibility of the area where recreational activities take place, helping to manage them, and to raise tourist awareness about the importance of maintain the surrounding environment (Hall, 2010).

Last, Trail 1 showed the highest EPV for all seasons in both approaches due to the highest results in S, NM and LD criteria and high results in AM, NE and VCS-PRD criteria. The second highest EPV obtained by Trail 5 is explainable mostly by the high number of different habitats it comprises and its respective MVH and by the highest results in AM criterion. Yet, the lowest EPV recorded by Trail 3 is explained by the lowest S, MVH, NM and NE results and lower results in AM criterion. It was only by LD and VCS-PRD criteria this Trail achieved somehow superior results. Differences occurred between Trails 2 and 4 when we look to results from the first or the second approach. When we assigned different weights to each criterion – second approach –Trail 4 exhibited more EPV than Trail 2 in all seasons. This is because Trail 2 had almost no AM, although it showed medium VCS-PRD results (the two most weighted criteria in this approach). However, if we look to the first approach, we verify that these two trails showed very similar results, with Trail 4 showing more ecotourism potential only in winter and Trail 2 in the other three seasons (according to table 8). The highest EPV of the warmer seasons cannot be explained by the AM values as this criterion showed very similar results between seasons, neither by the VCS-PRD values, which showed the highest results in winter season. They are only explainable by the number of species and endemisms recorded in spring and summer, somewhat higher than other seasons.

We made an exercise where we evaluated biological – S, NE – ecological – NH, MVH, NM, LD – and cultural variables – AM – and related them to one another to achieve the EPV of five trails in four different seasons. EPV is not easy to address since it comprises the evaluation of several criteria, and some of them being subjective. There are other parameters that could have been inserted in the formula, like the 'geodiversity', the 'economic value of forest areas' (Honrado & Alonso, 2010), the 'land use'and 'land cover'(Xiang, 1996) and the physical support structures like 'lodges proximity', 'interpretation centre' and 'car parks' available (Pena et al., 2010). Also, the criteria could be evaluated in different ways.

The assessment of spatiotemporal biological diversity allows inferences about when and where more species can be observed, as well as their conservation status. The negative effects that PA's suffer from the mass tourism (Spanou et al., 2012) namely in summer in PNPG (Mendes & Proença, 2011) can be avoided with the information provided by our results. This highlights the necessity to disclose the ecotourism potential of other seasons, allowing more tourists to visit these natural areas. Whether through the cultural legacy (Gössling, 1999; Álvares & Petrucci-Fonseca, 2002), the species and the endemisms that attract tourists willing to pay to see them (Reinius & Fredman, 2007), the flowers (Priskin, 2003), the landscape (Honrado & Alonso, 2010), or the fragile habitats in mountains regions, all seasons have the potential for the development of recreational activities. Moreover, the management of visitors throughout the year can enhance both the wildlife conservation and the local economy, achieving the main goal of ecotourism: the sustainable development (Spanou et al., 2012).

5. Conclusions

By linking ecological and cultural variables it was developed a novel way to assess the ecotourism potential of hiking trails. This approach might help to manage recreational activities in protected areas. Moreover, ecotourism companies can find here a basis to explore their activities throughout all the year, by assessing the potential of each season to explore natural and cultural attractions. This way, it is expected that they can contribute to the local economy at the same time they lessen the negative impacts of such activities on wildlife and ecosystems.

By showing that other seasons have higher potential for the development of recreational activities it is possible relieving the pressure associated to summer season in PA's, namely national parks, scattering tourists among the year. Here it was highlighted that nonetheless there are times where many species are not able to be seen, there are other ecological and cultural variables that can attract tourists. These tourists are willing to pay to contact with them and to be environmentally and culturally informed, which may contribute to the local economy by buying local products and to the wildlife conservation by financing conservation initiatives. By providing information about the species' conservation status and about the endemisms, future management studies can find here a basis.

The assessment of spatiotemporal biodiversity differences and the combination of natural and cultural data provide an important tool for the management of ecotourism in PA's. Further studies should comprise subjects of different areas such as Ecology and Sociology as it was done in this study. Only in this way it is possible to achieve the sustainable tourism.

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