

Using GPS data from Web 2.0 platforms to assess informal trail network and its impacts in protected areas

Luís Monteiro, Faculty of Environmental Sciences, Czech University of Life Sciences Prague, Czech Republic, monteiro@fzp.czu.cz

Introduction

Originally trail inventories and visitor surveys were conducted by recording information onto paper maps, but with the trivialization of Global Positioning System (GPS) surveys started to be implemented using different types of GPS devices (Marion et al., 2012). Recently with the incorporation of GPS hardware into consumer communication devices, common users started to be able to upload, search and download vast amounts of volunteered geographic information (VGI) from web-based services (Jiang and Thill, 2015).

VGI represent today a significant form of user-generated content compiling information about locations (e.g. places of interest), a phenomena or information (e.g. GPS tracking of bike and hiking routes), and can be stored into interactive track management services (e.g. Web 2.0 platforms) (Rinner et al., 2008).

The present explores the use of GPS-based visitor tracking data organized in a Web 2.0 platform as an alternative resource to assess the spatial distribution of informal trails networks and their level of impacts in protected areas. It has its application in Arrábida Natural Park (PNA), an important protected area in Portugal, located 37 km south of Lisbon, where informal trails are a constant management concern due to a lack of a structured and formal trail system, leading to some impacts and extensive areas of disturbance.

Methods

GPS-based data collection and spatial analysis

Based on Mendes et al., 2012 method, a core set of data was collected from a web-based GPS tracking platform called GPSies.com (GPSies) on March 19th, 2015, using a searching radius of 35 km from Palmela city and considering 10 activities (hiking, mountain biking, walking, motor biking, sightseeing, running, cycling, climbing, geocaching and racing bike) that are normally developed in roads, paths and trail systems. After the elimination of duplicates and entry errors, the park boundary polygon was used as a base layer and all tracks that didn't cross the park limits were removed. Besides, in order to absorb the GPS spatial errors of tracks collected by assisted GPS and smartphones under different atmospheric conditions and canopy cover, a 15 m buffer width of the formal park infrastructure (official roads and trail network) was created. Lastly, an interception between all tracks downloaded passing through the park limits and the 15 m buffer area was accomplished using ArcMAP 10.3. The result was a shape-files compiling all GPS tracks from activities that used the formal roads and trail system and in opposite the potential informal trails.

On-site visual survey of informal trails

To understand if the potential informal trails shape-file generated represented the existing situation, additional data was collected during a 10-day field survey, between July and September 2015. Informal trail mapping was performed in the most important parts of the park using a handheld GPS unit, together with an estimation of the average tread width and the division of mapped trail segments into different condition class categories based on a visual survey.

Trail-based fragmentation assessment

Post-processed GPS data from field work was then converted into shape-files and used to calculate different landscape fragmentation metrics index's (number of patches; mean patch size; large patch index; mean perimeter: area ratio) that allowed further assessment and description of spatial impacts associated with informal and formal trails within the park. The management zone map and other available ecological information's were used to summarize and compare the different fragmentation levels across the area.

Results

The final dataset downloaded from GPSies consisted of 7157 individual tracks, representing a total accumulated of 52745 km, with 4004 tracks (8230 km) passing through the limits of the study area. From this, 7007 km were considered using the park formal infrastructure and the remain 1223 km configured potential informal trails (Figure 1).

From the informal trail fragments verification, a total of 41 segments were mapped, totalling 133 km with different combination of condition classes. Informal



Figure 1. Spatial distribution of the formal park infrastructure and potential informal trail within Arrábida Natural Park

trails ranged in width from 0,48 to 3,34 m, with a mean of 0,86 m. The condition of informal trails was generally poor, with 68% of their total length exhibiting significant impacts to vegetation and soils due by trampling activity.

When using park zonation plan for calculate the level of landscape fragmentation it was possible to notice an increase in the number of patches present for all zones when comparing fragmentation caused by formal park infrastructure (N=116) with results obtained when considering the informal trail network (N=479). These results represent all the potential management conflicts between current uses and each management zone.

Conclusion

The results shows that VGI stored in Web 2.0 platforms can provide important clues regarding how the territory is being used, making it a valuable and alternative resource to evaluate the spatial distribution of informal trails and assess the fragmentation effects of trail networks. Like this sustainable management action can be instigated in order to minimize the creation and proliferation of visitor-created informal trails as a result of outdoor activities within recreational and protected areas.

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