

## 180 Using web share services to monitor high sensitive habitats. A GIS approach to Pedraforca, Spain.

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### Introduction

Over the last decades, recreational uses in Natural & Protected Areas (N&PA) have increased largely all over the world, requiring extra efforts among staff and management teams of these territories to deal with this reality. In many places, nature conservation has somehow even been replaced by tourism management due to social and economic factors altogether with the massification of visitors. Modern lifestyles have contributed to this situation where visitation peaks concentrate within short periods such as Holy Week, summer, or winter vacations depending on local culture and social habits. Quite often these visitation peaks largely exceed any ecological or social carrying capacity becoming a delicate subject to deal with, reducing in many cases the administration of N&PA to the management of visitors' crowds and traffic.

One of the situations that happen due to overuse is the proliferation of trails that can lead to ecological and soil impacts from erosion, roots/bare rock exposure to changes of species, or habitat fragmentation, among others. Even in N&PA with a well-structured trails network, the proliferation of variants of trails and paths can easily happen, becoming a serious problem for managers due to its ecological impacts but also due to risk and safety issues for visitors/users. Keeping tracking and monitoring trails proliferation is a demanding task, where technology such as high-resolution imagery or digital elevation models can provide a huge help. Nevertheless, although these data sources become more affordable and widely available they might not work for all places. In this paper, we discuss the use of smart data and technologies as a potential tool to provide new insights on how to deal with this issue by taking advantage of web-share platforms and a myriad of GPS tracks – what can be acknowledged as an advantage of modern uses of N&PA.

### Study Area and Datasources

Pedraforca is one of the most famous and iconic mountains in Catalonia, the northeasternmost region of Spain. Located in the Pre-Pyrenees region with a 2506m summit, Pedraforca is not visibly connected to any other adjacent mountains or ridges being classified under Natural Area of National Interest (1982), Special protection zone for Birds (1987), area of the Alpine region - Natura 2000 Network (2003) and Natural Park of Cadí-Moixeró (2004) (Figure 1). The last available estimations from Faías-Torbidoni & Morera (2019) point to a total of 345000 visitors/year for the entire park with one-third focusing around the Pedraforca Sector (Figure 1-a). Seasonal use of Pedraforca massif (Figure 1-b) typically spreads over three periods - Holly week, August, and October/November and core visitors are from the surrounding regions, with 2/3 coming from the province of Barcelona. Visitors arrive mainly by car (85%) and sightseeing, soft walks, trekking, mountaineering, and climbing are the main attractions to this sector. Although that the park touristic guide suggests only one circular route around the mountain (Pedraforca 360º - PRC-127), it's commonly accepted that there are 7 routes around this area starting from the nearest villages of Gósol and Saldes, ranging from 2,38 up to 16,86 km in length and taking between 1:30 to 8:00 hours to be completed.

Although four main trails lead to the summit from Gósol, Tartera de Saldes, and Mirador de Gresolet, official cartographic products show no trails or paths in the summit area (Figure 1-c). A quick search around web-share services such as AllTrails.com or Wikiloc.com can lead to over 5000 GPS tracks just for trekking and climbing around this sector (Figure 1-b and 1-d).

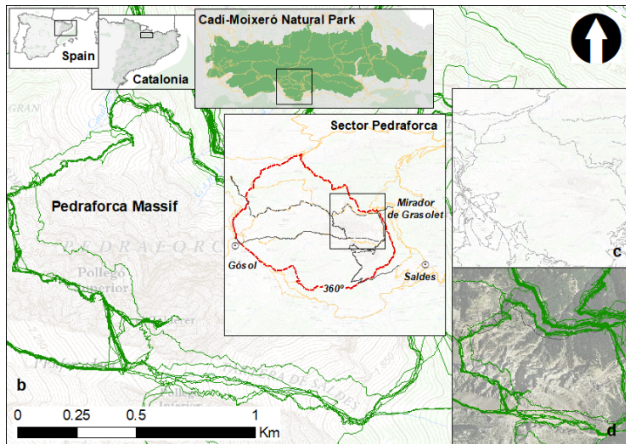


Figure 1 – Study area. Location of Cadi-Moixeró Natural Park. a) Pedraforca Sector and Route 360° - PRC-127; b) Pedraforca Massif and web-shared GPS tracks; c) Pedraforca Sector and official cartographic trails and paths from *Institut Cartogràfic i Geològic de Catalunya*; d) Detail of Pedraforca summit and web-shared GPS tracks.

### Preliminary Results and Discussion

A detailed analysis of the summit area shows that most of the GPS tracks are concordant with the main routes, meaning that most visitors comply with the desire trails network. Nevertheless, off-trail exists in some cases with trekkers moving over 150m from the trail what could jeopardize any rescue mission if needed. Regarding the proliferation of trails variants, the Tartera de Pedraforca is the path that suffers most from this issue. While most of the spacing of the tracks is within typical GPS error (10 to 30m), here these spread over 120m, reaching the entire width of the Tartera that includes fragile habitats such as scree and Festuca gautieri pasture. By 2009 severe ecological and trails impacts were already reported when trail users were around 16500/year (Tor & Soriano, 2011).

### References

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Web-share services have been extensively explored and used to monitor recreational activities over the last decade, taking advantage of the new relationships that healthy lifestyles and technological gadgets such as smartphones, smartwatches, and APP have produced in how visitors and users related with N&PA. Detail scale analysis under Geographic Information Systems has been used to show where and when users move, providing spatial behaviors from different activities with accuracy. Prices related to GPS units from 15/20 years ago have lower so much that each visitor can be a provider of Volunteer Geographical Information (Goodchild, 2007), but this does not happen. This doesn't mean that these data sources are all biased – as with any sampling strategy assumptions must be made to make good use of this information. Questions must always be raised considering technological limitations and positional errors due to many facts. Last, but not least, trends around lifestyles and social media such as web share services and many others are continuously changing requiring even more parsimony in the use of these technologies – that should always be coped with classic and well-established methods.

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