Using automatic counters and GPS technology for recreation monitoring: case of Sonian Forest (Brussels, Belgium)

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Introduction

Following a first estimation of the annual number of visits in the Walloon woodlands [COLSON V. 2009], the Brussels Institute of Environmental Management (BE-IBGE) wanted to have similar quantitative data for Sonian forest and understand its recreational use. Sonian forest is at the heart of a densely populated and urbanized area, and is crossed by several roads and railways. Since the forest has multiple entrances, it is difficult to get accurate information on the forest use. To answer this need, a pilot study was carried out by Ressources Naturelles Developpement (a Belgian non-profit organization specialized in forest development) and Eco-Counter (world leader in pedestrian and bicycle counters), with the collaboration of Sonian forest agents and rangers. The objectives were to assess visitor behavior and estimate their number. This exploratory study, which was undertaken in a delimited area, aimed to develop and test a methodology which can be extended to the whole Sonian forest.

Methods

18 automatic counters were installed at each entrance of the study area. The chosen equipment consisted of posts including a pyro-sensor and counting system. The Pyro sensor used passive infrared technology combined with a high-precision lens to detect changes in temperature when a person entered its range. The counter also detected people's direction of movement, so it was possible to differentiate people entering from those leaving the area.

The data was then automatically transmitted – via GSM connection – and integrated to the online data management platform *Eco-Visio*. Thus, data was deeply analyzed to observe how many visitors were counted for a specific entrance and specific period (hour / day / month), and to study temporal variations.

A field survey was carried out by BE-IBGE staff. Data was collected into two different sources: track logs through the distribution of GPS devices to visitors, and face to face questionnaires. The GPS devices stored geographical position information at regular time interval, from departure until return. This enabled to analyze visitor movements in the area as well as the duration of their activities. To understand the behavior better, the questionnaire gathered data on group size and composition, the origin of visitors, their age, activity and frequency of visit. The field work was carried out on different parking facilities located at the main entrances of the area. The gathering of data covered four days (from Thursday to Sunday) during three different periods: February, May, and October 2011. In total, 1,671 persons were interviewed and 603 GPS tracks were collected.

For data processing, each GPS track was linked to a questionnaire with a unique number. Relational database management and GIS were used for data storage and analyses. It was thus possible to segregate data in order to analyze visitors' behaviors according to defined criteria.

Results

Thanks to data collected by the counters during one year, the annual number of visits for the 84 hectares area was estimated at 700,000. Moreover, the analysis highlighted temporal variations, among them:

- there were twice more visitors on Sundays than on weekdays;
- there was an increase in the number of visitors during spring and autumn, often mentioned in surveys carried out in peri-urban forests [COLSON V. 2009].

These temporal variations are particularly useful for forest managers as they provide them information on the periods when wildlife is mostly affected by recreation, which help them deploy staff appropriately.

Analysis of the GPS tracks on GIS provided a great understanding of how the forest is used by the visitors. GPS technology and GIS enabled to:

- Identify the duration of visit in the forest;
- Visualize the exact paths people use during their activity, and illustrate spatial distribution of visits;
- Determine where people stop and for how long.

The database containing the information from questionnaires was linked to the GPS tracks; therefore it was possible to deeply compare behaviors according to visitor features. The results showed that visitors use a more limited part of the area during the weekdays compared to the weekends, whereas the duration of visit is equivalent whatever the day of visit. The study also highlighted visitors use specific recreational areas according to their activity.

Visitor flows were mapped on GIS and overlaid with the protected area layer to analyze effects of visitor pressure on the ecology. Figure 1 shows that visitors are highly concentrated in the protected area, which is in fact a hilly area with ponds and thus landscapes of interest for visitors. This kind of cartography is a powerful tool for managers as it helps them undertake appropriate measures to reduce the impacts arising from recreational activities on protected areas.

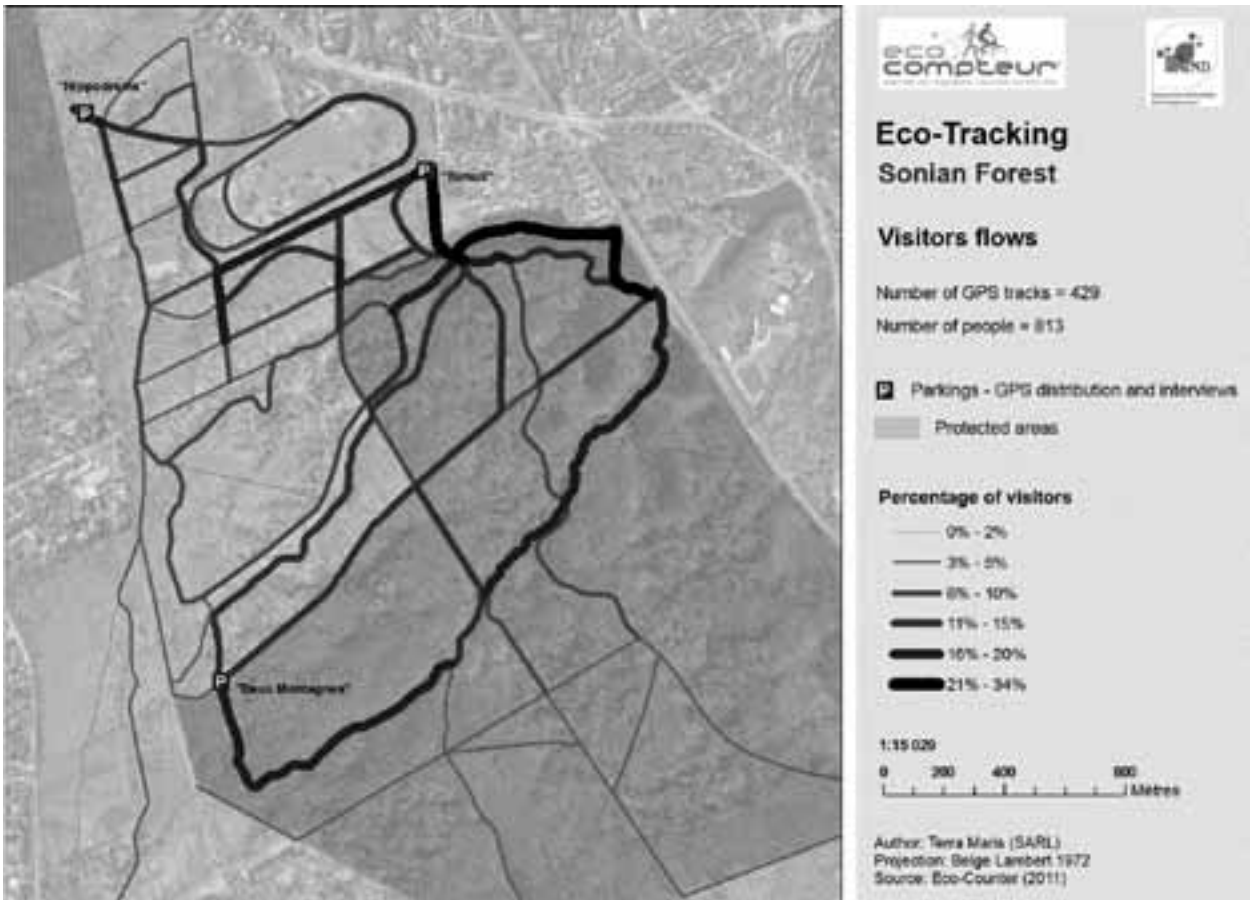

Figure 1. Impacts of visitor flows on protected areas

Further research

A specific GIS application enabling advanced modeling behavior patterns of visitors in recreational areas is being developed. The first objective of this tool is to categorize every GPS tracks according to their percentage of similarity (used paths, covered distance) in order to understand which are the typical routes and the proportion of visitors covering these routes. The tool will also provide a more exhaustive estimation of the number of visitors on the area. Indeed, depending on the localization of the counters on the site, people can be counted by several counters. Overlaying the geographical position of counters with GPS tracks, the application will define an algorithm to link the counters. Thus, the GIS-based instrument will provide reliable tools for visitor management.

Conclusion

The implementation of such a monitoring represents a successful long-term management tool which aims to evaluate the recreational zoning of the forest, and improve it if needed (Colson, Granet, Vanwijnsberghe, 2012). The estimation of number of visitors can help to receive public funding. Understanding the spatial distribution of recreation provides the basis to reduce the impacts arising from the increasing demands of recreation on protected areas. Eventually, it can aid decision makers to conceive appropriate policies combining visitors' recreational needs with nature conservation: redirect people away from the most sensitive sites, plan maintenance priorities, adapt infrastructure that will have minimal impact on the forest and deploy staff appropriately.

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