Designing visitor monitoring system in Estonian nature reserves combining passive mobile positioning with other counting methods

Antti Roose[1]

Keywords: visitor monitoring, nature reserves, mobile positioning

Visitation at wildlife areas in the nature protection areas (NPAs) is a controversial and sensitive issue in terms of nature protection. Obviously, the primary objective of NPAs is stated as preserving biodiversity, on the other hand and simultaneously, nature reserves provide public services for recreation, nature tourism and education. Setting visitation policy requires comprehensive impact assessment and planning to avoid crossing threshold levels of physical and ecological carrying capacity (Eagles & McCool 2002). Initiated by the Estonian environmental agency, the Visitor Monitoring System for the Estonian nature reserves has been designed to provide advice to the management of nature reserves. This is on the basis of an operational monitoring system and to allow sound, knowledge- based decision making while developing infrastructure for visitation and education. The system should assist in understanding visitor patterns, demands and behaviours. The approach includes biophysical impacts of visitation, use and the impact of settings and experiences on visitors. Monitoring has to allow early detection of potential problems and thus assists in the preservation of natural areas and allows management to identify whether their objectives are being met. The current trends in nature tourism in Estonia are summarised as follows: human visitation affects vegetation, fauna, soils, and hydrology; heritage sites and sites with comprehensive infrastructure are particularly crowded; local communities oppose tourism development, in general.

A pilot survey automatic monitoring based on cellular phone or mobile positioning was tested and deployed. In Estonia, cell phone based passive mobile positioning method, using automatically stored in the depersonalized log files of mobile operators, is applied already efficiently in visitor counting in crowded places at cities, events, commuting and transport surveys (Ahas et al. 2008). Passive mobile positioning data is normally collected with the precision of cellular network cells. The survey testing the feasibility, precision and qualities of the method for sparsely visited areas was carried out in Emajõe-Suursoo, Endla and Alam-Pedja nature protection areas in 2008. The analysis employed 5x5km grid. Using anchor point method, local residents and employees as passing by transit travellers are filtered and excluded from the dataset. This method allows the determination of the place of residence for the Estonian visitors and origin of international visitors as well their previous and next site of visitation. In general, passive mobile positioning expresses visitors' flows, though the counting precision is low in high season and very low in low season of visitation (Table 1).

The fitness of mobile positioning to the results of manual counting was the best in Emajõe-Suursoo, though visitor numbers were overestimated almost twice. Low precision is caused by sparse mobile network, where the handover of calls is frequent as the majority of calls 'jump' over open wetland landscapes, over-counting visitation numbers by this way. Data noise made by transit traffic at roads and occasional local visitors is not fully filtered from nature tourists and hikers. The strength of mobile positioning method is robust in the understanding of visitor flows and constant time-series of data, also retrospectively, in sparsely visited nature reserves. Groups of less than 150 persons are not detected and hidden in data noise of short-term transit. The small sample size poses other sampling concerns such as the question of privacy and data protection of tracked visitors.

[1] Department of Geography, University of Tartu, Vanemuise str 46, Tartu 51014, Estonia, Antti.Roose@ut.ee

Table 1. Direct and cell-phone based visitor counting in the Emajõe-Suursoo nature reserve

Month	Direct counting	Cell-phone based counting	Difference
Jan.08	97	1050	+982%
Feb.08	173	916	+429%
March 08	322	1154	+258%
Apr.08	465	1429	+207%
May 08	874	1462	+67%
June 08	895	1643	+84%
July 08	544	1430	+163%
Aug.08	778	977	+26%
Sept.08	543	1004	+85%
Total	4691	11065	136%

The development of the method should stress on testing new data filters adapted for sparsely populated areas in particular. In this way, data noise created by incidental mobility or transit could be eliminated. The comparative tests during the most silent winter days and the most crowded summer days could assist in seasonal fine-turning of data filters. Also, behaviour survey of cellular usage of nature reserve visitors is clearly needed to improve the precision of method. Also, new test areas which have optimal or better setting of cellular towers could serve well for method elaboration. Cell phone based method combined with other counting methods in visitor entrances allows to cover all area of nature reserve. The innovative methods challenge developing the Visitor Monitoring System in the Estonian nature reserves.

References

Ahas, R. Aasa, A., Roose, A., Mark, Ü. & Silm, S. (2008). Mobile positioning as a new data source and method for tourism surveys: an Estonian Case Study. In: Tourism Management 29 (3), p 469–486.

Eagles, P.F.J. & McCool S.F. (2002). Tourism in National Parks and Protected Areas. Planning and Management. CAP Publishing, 320 p.