14 Visits counting from point data to area and period estimates

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Introduction

"How many visitors do you have?" is a basic and frequently asked question to protected area managers. However, answering such a question is challenging in the case of recreational and protected areas that are characterized by free access and multiple entry points. Due to constraints in financial and personnel resources data collection cannot be anytime (time) and anywhere (space). Thus, the selection of suitable data collection methods and their proper combination arises (Muhar, Arnberger and Brandenburg, 2002, p.1).

Within this study, we answer the question for the Black Forest National Park by using counting devices and manual counting events. In addition to estimating the total number of visits, we estimate the relative importance of different use types such as hiking, biking and winter sports. As we are interested in monitoring changes over time, we put a special emphasis on developing a reproducible methodology that can be applied in upcoming years.

Methodology

Out of the many direct and indirect visitor monitoring techniques the use of counting devices is a widespread method to collect data over time. In our case, we started with 15 counting devices and used 13 of them for our final estimation. Together with experienced field staff we selected the individual counters close to the park boundary at high-volume entry points. We paid attention to build – out of individual counters - a device net that covers different use types and area usages (e.g. summer vs. winter). Our reporting period ranges from July, 1st 2018 to June, 30th 2019.

In order to use the point specific data of the device net to estimate the total number of visits on area level we needed to know the share of visits that is covered by the device net. Therefore, we organized at selected days manual counting events. On these days, our aim was to cover the number of entries to the whole area. At designated counting points (72 and 34 points on two counting events on October 14, 2018 and January 20, 2019) we recorded – separately for different use types - the route visitors took over the point and counted only those routes that we defined as first park entries. The sum of all these routes at all points was our total for the visits on the selected day. As the counting devices counted as well, we obtained a ratio of manual counts over counts by the device net. We used this ratio as a multiplier for the year-round data (from the point specific device net) to extrapolate to the whole park area.

To ensure the robustness of combining the device and manual data we ran a sensitivity analysis. Throughout the process we also addressed the accuracy of data collection (should we calibrate the count data or not, and if so, how?), the plausibility of collected data (ex-post examination to avoid false data collection) and the imputation of missing and implausible data.

Results

Out of the 13 counting devices we used only one direction per counter and got 411.179 visits for July 1st 2018 until June, 30th 2019. As a multiplier to extrapolate to the whole park area we got 1,893 as the weighted average of the multiplier that we observed during the manual counting events. Thus, the total number is around 778.000 visits per year. Concerning the usage types, we got 85% hiking, 10% biking and 5% winter sports.

To run the sensitivity analysis we varied the number of included counting devices, the weighting of the different multiplier as well as the degree of imputation of missing and unplausible data. Over 48 different scenarios we got 741.000 as the minimum and 847.000 as the maximum with 780.000 being the median.

To answer the calibration question we compared the manual counts and the device counts at the two selected manual counting events. Additionally, we ran manual comparisons of counts versus reality for six hours on each counter (except one for three hours). Although the individual counters sometimes over- or undercount, the device net is collectively quite accurate. The results are as follows. For October, 14th we obtained 4107 counts with 4333 being the real number (95% captured). On January 20th, there were 2858 counts with 2477 being the real number (115% captured). For the additional comparison we got 1652 counts with 1699 being the real number (97% captured). Based on this data we assessed that the counting devices are sufficiently precise at the aggregate level. Thus, we did not adjust with calibration factors and used the raw counts instead. Statistically, this can be seen as using a very simple model, avoiding the need for parameter estimation and the risk of overfitting (see e.g. James, Witten, Hastie, and Tibshirani, 2013).

To evaluate ex-post the plausibility of the data we developed four different models to compare the counting data with. These models are based on the following data: a) other counting devices, b) other direction of same counting device, c) weather variables and d) calendar variables. We identified 17 device-day combinations as possibly problematic and finally assessed five of them as unplausible. For these cases we replaced the counter data with the average of the four estimated models.

Discussion

Within this study we aimed to develop a reproducible methodology that can be applied in upcoming years to monitor changes over time. The combination of counting device data with manual counting events allowed us to approximate from (place and time) point data to area and period estimates.

In addition to being able to answer the question "How many visitors do you have?", the data can be used for staff roster planning and to inform strategic decisions regarding infrastructure and park development.

References

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