26 Using GPS monitoring to develop tools for managers to assess the impact of management interventions on visitor densities and bird populations

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Introduction

Achieving objectives for outdoor recreation as well as nature conservation in protected areas is a challenge as outdoor recreation can have negative impacts on nature (Larson et al. 2016). To manage the potential conflict between outdoor recreation and nature conservation, managers often need to intervene. One of the most common interventions is restricting visitors access (Hammitt et al. 2015). Although the necessity for such restrictions is easy to explain, managers need information on the effectiveness of these interventions. As visitor densities vary across protected areas and the combined impact of all visitors is difficult to assess, managers often lack this information. Here we present an approach based on GPS-tracking and bird monitoring, managers can use to assess the impact of different access scenarios for the New Forest, UK. For most part the approach and results have been describe in Pouwels et al. (2020).

Method

The used GPS-dataset has been collected in the New Forest during the breeding season in 2004 at several car parks. After outlier-removal, we used a travelling salesman's route algorithm to derive the most likely route visitors followed from the itinerary information of the tracks. For car parks with more than 10 routes we created a map of the expected visitor densities at the different paths resulting in a final dataset based on 36 car parks, a quarter of all car parks. A random forest model was developed to estimate the importance of landscape and environmental variables in explaining the spatial variation of visitor densities for the combined set of 36 car parks. We used this model to predict visitor densities for the other car parks to create a visitor density map for the whole area. The map was overlayed with distribution data of European nightjar (Caprimulgus europaeus) to assess the impact of visitor disturbance on the population size of this species. The European nightjar is one of the protected species in the New Forest and sensitive to disturbance.

To illustrate the use of the approach we created three reference scenarios and three intervention scenarios to assess the impact of changes in car park use on the population size of the European nightjar. Intervening in changes in car parks will not only have an impact on the population size, but also on visitors itself and we also assessed the percentage of visitors that will be affected by the interventions. The scenarios are:

1. No access: this scenario illustrates the maximum potential of the area for the Nightjar population.
2. Increase in visitors of 10%: this scenario was chosen together with the third scenario to give managers an indication of the sensitivity of the impact given a minor increase or decrease in visitors.
3. Decrease of visitor of 10%: -
4. Closing small car parks: All car parks with the capacity of less than 20 cars were considered closed. This scenario was chosen as small car parks might have a relative large impact on breeding bird densities compared to large car parks.
5. Closing three car parks: In this scenario we focused on suitable habitat and closed three relative isolated car parks that are located near areas with high numbers of breeding pairs.
6. Closing all but 20 car parks: In this scenario all visitors were distributed over 20 car parks evenly. This most extreme intervention was expected to concentrate visitors, resulting in large undisturbed areas and an increase in population size of European nightjar. The number of visitors per car park correspond with the two car parks that are used most in the current situation.

Results

As might be expected, the random forest model showed that distance to car park is the most important variable to explain the spatial variation of visitor densities (e.g. Meijles et al. 2014). Other important variables in the New Forest are distance to tarmac roads, openness (total visible area and variation in openness) and path type. Given the estimation that 13.3 million people visit the area each year, the random forest model estimated that visitor densities in the New Forest vary between 0 and 600 000 visitors per ha per year.

The reference scenarios show that a potential population size of 805 breeding pairs of European nightjar might be present in the New Forest when recreation is banned completely, implying that current recreational use lowers the population size by 38%. Only the third intervention, closing all but 20 car parks, shows a large impact on the population size (Table 1). However this will have an impact on at least 90% of the visitors. Scenario 5 shows that for each percentage of redistributed visitor, population size might increase with one percent. However, the number of locations where this potential might be achieved is limited. These insights help managers to discuss interventions with local stakeholders.

	scenario	breeding pairs New Forest	breeding pairs (increase %)	redistributed visitors
references	current (actual in 2004)	498		
	1: without recreation	805	62%	100%
	2: - 10% visitors	516	4%	10%
	3: + 10% visitors	483	-3%	0%
interventions	4: close small car parks	500	0%	9%
	5: close 3 car parks	515	4%	3%
	6: close all but 20 car parks	705	42%	91%

Table 1 Impact of three reference scenarios and three intervention scenarios on the population size of European nightjar and the visitors itself.

Discussion

For this study we used an already available dataset of GPS-tracks to understand what drives visitor patterns and densities in nature areas (Beeco et al. 2014). We developed a random forest model for managers to predict the impact of potential interventions. For our scenarios we focused on reallocating visitors, but interventions such as closing specific sites and changes to path type or vegetation type could also be assessed. Although the potential of the model is illustrated, the used approach requires a lot of data. Collecting and preparing the GPS-data for analyses is time consuming (see also Meijles et al. 2014). A drawback of the approach is that the random forest model is only applicable for the New Forest. Still we think these type of analyses are promising as they take into account the complexity of the relationship between different interacting variables and visitor densities. They also provide detailed information on visitor densities and preferences that can be used in agent-based recreation models like RBSim and MASOOR. These agent-based models can be made site-specific with local knowledge and local data more easily (Pouwels et al. 2011).

References

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