Title (150 words)

Pathways to socio-economic recovery in protected landscapes during the COVID-19 pandemic

Scientific/technical summary (max 250 words)

The COVID-19 outbreak has resulted in the sudden closure of national parks across the UK during Spring 2020. Re-opening national parks will assist in the economic recovery of local communities whose income depends on these protected areas. It will also improve people's mental and physical health. However, overcrowding incidents could lead to the re-emergence of COVID-19 hotspots and damage to biodiversity. In order to maximise the benefits from re-opening protected areas and minimize negative impacts, new policy tools are required grounded on scientific evidence and developed in collaboration with local stakeholders.

The proposed project aims to assist in this direction by: a) developing predictive models estimating the maximum capacity of visitors in specific national parks considering social distancing restrictions and local characteristics and; b) creating new policy and management tools, co-produced with local stakeholders, that can promote responsible environmental behaviour in protected landscapes while respecting social distancing rules.

Data from personal interviews (with European and UK partners), surveys, secondary databases and online participatory workshops will be collected and will inform the development of guidelines and tools for managing the impact of the outbreak in UK's national parks. Work will be initially completed in 4 sites (Summer 2020) followed by an additional 6 sites (Autumn 2020). The final aim of project will be to establish optimum approaches that permit these protected areas to stay open to the public throughout the later stages of the COVID-19 outbreak, thereby ensuring the financial recovery of local communities whilst also protecting biodiversity.

3.1. Please describe and justify the importance of the COVID-19 related knowledge gap and/or need that you are targeting (max 250 words)

National Parks are extremely important not just because of their high biodiversity value but also because of the socio-economic benefits they provide. National parks play a crucial role for physical and mental health assisting in the improvement of people's wellbeing. The large number of visitors that these areas attract is also a significant source of income for local communities. Lake District and Snowdonia National parks for example attract more than 15 million visitors per year. Re-opening national parks during the COVID-19 outbreak will be an extremely challenging task. Restrictions on foreign travel during 2020 and 2021 will result to an increase in demand for domestic holidays in the UK and National Parks are expected to be a very popular destination. Overcrowding incidents during the weekend 21-22nd of March when a number of national parks received unprecedented number of visitors for that time of the year revealed that there is a need to manage a high flow of visitors depending on the level of restrictions. However, there is no empirical evidence or prior experience on how behavioural change can be achieved in order for people to be able to visit protected areas safely while practicing social distancing and yet not disturb biodiversity if encouraged to spread out and avoid crowded locations. The proposed project aims to address this gap by: a) providing for the first time research evidence on how responsible environmental behavioural, when using national parks, can be combined and balanced with social distancing rules; b) estimating the maximum capacity of visitors in national parks depending on different levels of social distancing restrictions and local socio-economic characteristics; c) leading to the co-production (with local stakeholders) of a number of policy and management tools and techniques facilitating the safe re-opening of protected landscapes throughout the COVID-19 outbreak.

3.2. Please describe how the research impact(s) can be scaled to be useful to the UK as a whole (max 250 words).

The project is of the highest impact drawing from experience in European sites and proposing the co-production of new solutions tailor-made for UK national parks and other protected areas. The impact of the project is focused on three key issues:

Finding techniques to promote responsible behaviour during COVID-19: A number of tools will be tested through the project aiming to promote safe and responsible behaviour of users in protected areas. Through the creation of these tools it will be possible to maintain a safe and sustainable flow of visitors in these areas, allowing local economies to recover financially after the strict lockdown without risking the re-emergence of COVID-19 hotspots.

New scientific knowledge: The project will have significant scientific impact as it will provide the first evidence internationally on how behavioural change can be achieved during the COVID-19 outbreak in protected landscapes of both high recreational and biodiversity value. It will provide useful information for behavioural and social scientists and also researchers working in the systems science regarding the complex impacts of COVID-19 on wellbeing, income levels and responsible environmental and social behaviour.

Developing new policies: A number of tasks have been planned in order to ensure the project has a major impact at policy level including workshops and online events. A model developed during the project will allow practitioners to evaluate, depending on the number of visitors and the characteristics of a particular area, tipping points in relation to COVID-19 hotspots, people's wellbeing, impact on the local economy and human pressures on biodiversity. The creation of additional guidelines and tools (i.e. videos, leaflets, mobile app) will be carefully designed in order to tackle overcrowding in protected landscapes and minimize the risk of COVID-19 hotspots. Finally, the project's activities will facilitate the creation of strategies by National Park authorities across the UK aiming to manage these protected areas during the later stages of the outbreak.

Section 4. Plan of research including importance deliverables and resources

4.1. ***(max 1500 words) In this section you should provide an overview of the nature of the proposed research or project (study design, approach and deliverables). To include: How deliverables will provide/lead to benefit(s) relating to the health, social, economic, cultural and/or environmental impact of the COVID19 outbreak within 18 months***

Approach overview and key research objectives

We propose an interdisciplinary approach bringing together expertise from the fields of social and behavioural science, environmental policy and Bayesian statistics. The overall research question of the project is to explore **how protected landscapes, such as national parks, can remain open for the public during the COVID-19 outbreak while preventing negative impacts of overcrowding and facilitating economic recovery for local communities and sustained health benefits for users.**

Key Research Objectives (RO) are:

RO1: to develop ***predictive models*** estimating the maximum capacity for visitors taking into consideration the implementation of different levels of social distancing measures (i.e. alternating between strict and less strict measures) and local socio-economic characteristics.

RO2: to identify the most ***effective policy tools*** that can lead to behavioural change when using protected spaces during the COVID-19 pandemic. The tools will focus both on promoting responsible environmental behaviour, avoiding incidents of overcrowding risking the emergence of COVID-19 hotspots.

RO3: to co-produce with local stakeholders ***tools*** and ***new management guidelines*** for protected areas during the COVID-19 pandemic aiming to assist in the financial recovery of local communities, promote human wellbeing while minimizing risks of overcrowding.

The project has a duration of 18 months and the above ROs will be explored in two stages (Table 1). During the *first stage* (June-September 2020) the research team will collect data and co-produce tools for tackling overcrowding in four national parks (Snowdonia, Loch Lomond and the Trossachs, Broads, New Forest). These parks were selected because they attract a large number of visitors throughout the year and have experienced issues of overcrowding during the COVID-19 outbreak resulting in restrictions that soon will need to be revised. Collaborations with key stakeholders have been secured in all sites. In the *second stage* (October 2020-end of project) the research team will provide support to additional protected areas (maximum of 6) across the UK in order to adopt the tools developed during the project. Existing collaborations and communications with stakeholders at national level (National Parks UK, National Trust) will ensure the appropriate selection of case studies at this stage.

Description of Work-Packages (WPs)

The project will be implemented through 4 work-packages resulting to 9 deliverables of high scientific and policy impact.

WP1: Developing predictive carrying capacity models for visitors (RO1)

A simulation modelling framework will be designed estimating the **maximum capacity for visitors** considering local characteristics of the park and social distancing regulations. The framework will allow the inclusion of varying distributions to model uncertainty in the parameters of interest. Existing data will be utilized available in 'State of the Park' reports along with data from the Ministry of Transport and the Office of National Statistics (i.e. wellbeing, income). Our methodology is influenced by existing techniques measuring carrying capacity of national parks (Prato, 2001) but improved through the application of tailored made Bayesian models (appropriate software including WinBUGS and INLA will be used at this stage). The modeling framework will provide predictions on how reducing visitors numbers to various degrees will impact different aspects including revenues for local businesses and wellbeing levels.

Deliverables

1.1. Simulation modelling framework publicly available (after the initial testing) through the website of the project.
1.2. Short reports publicly available on the results of the model produced for the research sites in stages 1 (4 sites) and 2 (6 sites).

WP2: Exploring appropriate tools promoting behavioural change (RO2, months)

Interviews (on-line) with key stakeholders will be completed with representatives of European organisations that have already tested different tools to manage the outbreak in protected landscapes (European Project partners). These will be followed by interviews with local stakeholders from the pilot sites (10-12 interviews in each site). The results will feed into the modelling framework and the preparation of guidelines and tools for managing the impacts of COVID-19. The interviews will provide an insight on alternative tools that are realistic to be applied in protected landscapes depending on UK policy and management characteristics. Data from the interviews will be analysed using N-Vivo by experienced researchers (Dr James McGinlay, Mrs Victoria Maguire, 1 research assistant).

Local communities living in or near the boundaries of the national parks will be invited to participate in a **short online survey** (using Qualtrics) providing their feedback on proposed tools and changes in the management of protected areas. Locals will be invited via announcements in local information boards, social media and postal cards sent to 5% sample of the population. A **visitors' survey** will also be conducted across the UK (sample of 10,000, participants selected using existing pools from survey companies such as UK Gov) aiming to explore their views on a number of proposed changes when visiting national parks. All survey data will be analysed using traditional and advanced statistical techniques (with SPSS, R, WinBugs) in order to identify preferences in the proposed tools but also to explore the key socio-economic factors explaining these preferences.

Deliverables

2.1. Policy report analysing the different options available for national parks and other protected areas in order to manage visitors numbers and people's behaviour in the next 2 years.

WP3: **Co-producing and monitoring guidelines and tools to manage overcrowding in protected landscapes (RO3)**

After the completion of the interviews **one-day workshops** (using Zoom software) will be organised with participants from the four sites and practitioners from UK and European organisations involved in the management of Protected Areas. The aim of the workshops will be: a) to discuss the results of the predictive modelling and surveys; b) decide on specific guidelines and tolls which would be appropriate in each location in order to manage the impact of the outbreak in the next 18 months. The development of the guidelines and tools will be led by Dr Jones, Dr McGinlay and Dr Holtvoeth.

The tools will be tested in the pilot sites and will be closely monitored for a duration of 3 months. Monitoring will happen through:

- **A mobile application** developed and made available to visitors and locals which will act as a portal of information and data collection regarding compliance with new regulations and incidents of overcrowding. Through the applications users will be able to specify the areas where incidents of overcrowding happen along with incidents where social distancing measures could not be met according to the new recommendations.
- **Non-participant observations.** A researcher will visit the sites for 2 weeks every month between the 4th and 6th month of the project and observe visitors in key locations of the national parks. The researcher will record compliance levels but also explore whether certain tools are more efficient than others.

Deliverables:

3.1. Publicly available report on the effectiveness of different measures applied

3.2. Mobile application used by visitors and locals to provide feedback and utilised as a portal for overcrowding notifications

WP4: Disseminating the results of the project and rolling out the tools in protected areas across the UK (RO 1-4)

The data collected in WP2 will provide significant information for practitioners and the research team on the success of the tools and the level of compliance. ii) be combined with other parameters and data in order to understand the key factors that lead to overcrowding and non compliance; iii) will assist in the improvement of the modelling framework developed in WP1.

During the second stage of the project (from September 2020 onwards) the tools will gradually be refined and finalised and will be ready to be rolled out to other sites across the UK interested in managing overcrowding in the long-term. The research team will be able to

support up to six national parks with one to one meetings during this stage. Dissemination of the new guidelines and tools will be achieved in the following ways focusing both on users and management organisations:

- development of short videos promoting responsible use of protected landscapes
- promotional campaign via social media (twitter, facebook)
- project website
- media reports in national and local newspapers
- 3 on-line promotional events
- academic publications

Deliverables

4.1. Website of the project

4.2. Development of short videos distributed through social media explaining safe and responsible use of protected landscapes

4.3. 3 On-line events promoting the use of the tools in protected landscapes

4.4. Three open-access publications reporting a) the methodology of the simulation model; b) the results of interviews and surveys and c) the results of the monitoring process.

Table 1. Timetable of the project

	Months					
Task description	**1-3**	**4-6**	**7-9**	**10-12**	**13-16**	**17-18**
Predictive models & simulation	x	x	x			
Interviews and data analysis	x	x				
Surveys and data analysis	x	x	x			
Workshops	x	x				
Mobile monitoring application						
Non-participant observations		x	x	x		
Website & updates	x	x	x	x	x	x
On-line events			x	x	x	
Rolling out tools to other parks			x	x	x	x
Publications			x	x	x	x

Innovation and uniqueness of the project

Despite the significant and complex problems that COVID-19 will cause to the socio-economic and ecological systems of protected landscapes, currently only general guidelines exist about social distancing in green spaces (e.g. Natural England website). While several management authorities of protected areas are currently encouraging visitors to stay away it is clear that long-term strategies need to be developed in order for these areas to remain open to the public and assist in the financial recovery of local community. Currently no scientific evidence exists regarding the effectiveness of alternative tools in promoting responsible use

of protected areas. The proposed project aims to cover this gap providing the first scientific evidence on which are the optimum tools to be applied in order visitors to enjoy protected landscapes in a way that does not pose risks for local communities. The project will provide clear guidance in collaboration with local stakeholders on how to tackle the impacts of COVID-19 considering the complex links between different policy targets: protecting biodiversity, ensuring economic/financial recovery of local communities, improving human wellbeing and preventing the re-emergence of COVID 19 hotspots.