



Informing Wildfire Management and Land Restoration Activities at the National Trust Marsden Moor Estate

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Importance of UK peatlands

- UK peatlands are of great environmental importance (Figure 1). They are a major carbon store locking-in approximately 3.2 billion tonnes of carbon and cover 12% of UK land area (CEH, 2021).
- 80% of UK peatlands are damaged or in a deteriorating state.
- Wildfire disturbance in UK peatlands is of growing concern. The European Forest Fire Information System (EFFIS) reported 111 burned areas for the UK in 2019 burning a total of 28,754 ha. This is the highest total area burnt since EFFIS monitoring began in 2008. However, the number of fires is an underestimation due to EFFIS mapping wildfires of 30 ha or larger with many UK wildfires being below this threshold (Figure 2).

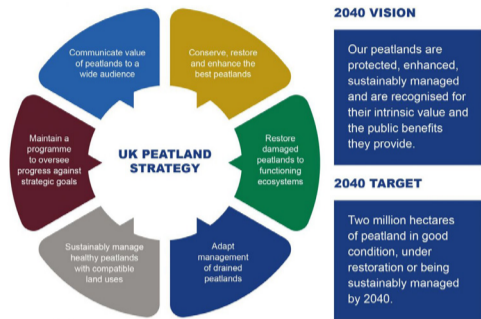


Figure 1. Peatland strategy for the UK (IUCN, 2018, p.12).

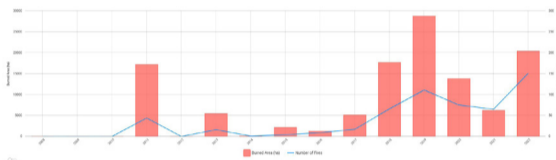


Figure 2. EFFIS burned area and number of fires per annum for the UK.

Study area

- The Marsden Moor Estate owned by the National Trust in West Yorkshire, UK, is a Site of Special Scientific Interest (SSSI), a Special Area of Conservation (SAC) and Special Protection Area (JNCC, 2021) and covers approx. 2300 ha of the South Pennines (Figure 3).
- This blanket bog habitat is home to rare upland species such as the mountain hare and red listed Birds of Conservation Concern 4 (BoCC4) such as the lapwing, skylark and the curlew (British Trust for Ornithology, 2021).

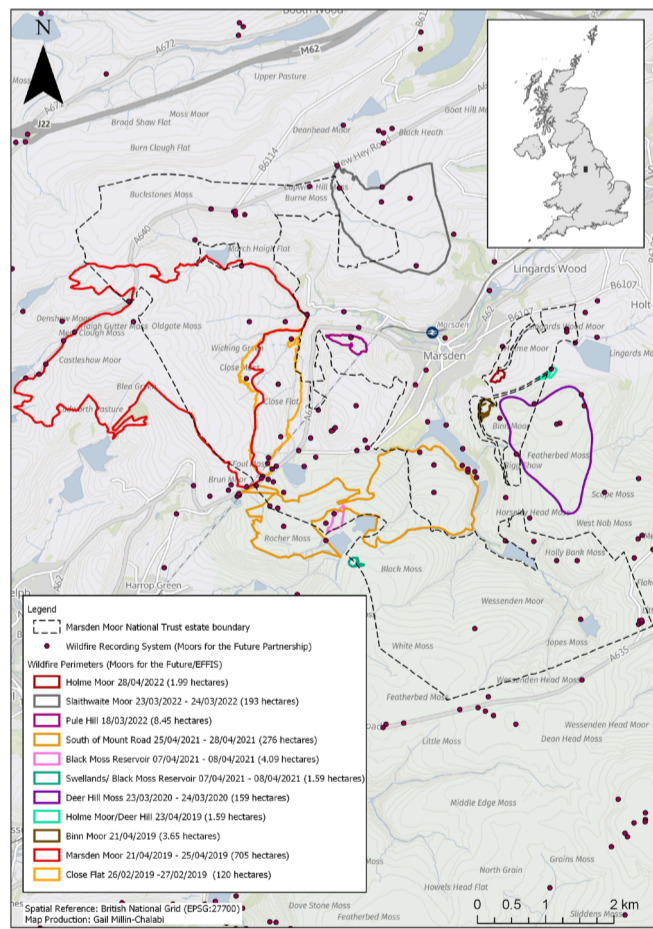


Figure 3. Wildfire perimeter locations for 2019 – 2022 on Marsden Moor National Trust Estate.

Land management challenges

- Since 2019, the National Trust reported a total of £700,000 worth of damage caused by wildfires on the Marsden Moor Estate with the largest wildfire damaging 705 hectares of land (Figure 3) and destroying habitats of ecological importance (Figure 4) (National Trust, 2021).
- The team at Marsden Moor identified that a detailed land cover map was required to define habitats and assess favourable condition of the estate e.g. the extent of invasive species such as purple moor-grass. The Centre for Ecology & Hydrology (CEH) landcover maps did not provide enough detail for practical estate management.



Figure 4. (A) Mountain Hare leveret in burned vegetation (B) Remains of a toad (C) Lapwing nest destroyed – Photographs courtesy of the National Trust (2021).

Research Aim, to produce a detailed land cover map of the different vegetation types using Vision-1 3.5m multispectral satellite data to inform wildfire management and land restoration activities (Figure 5a and 5b).

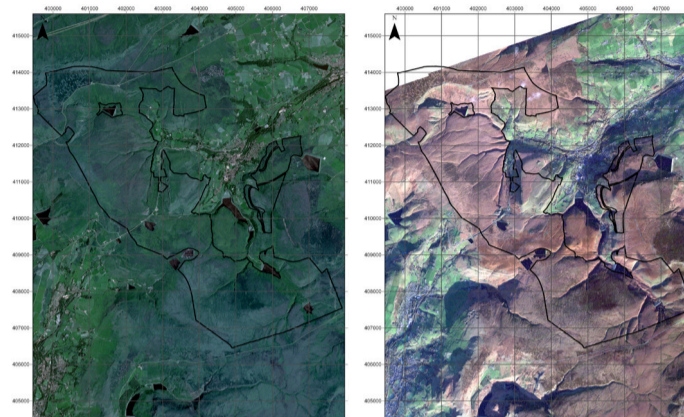
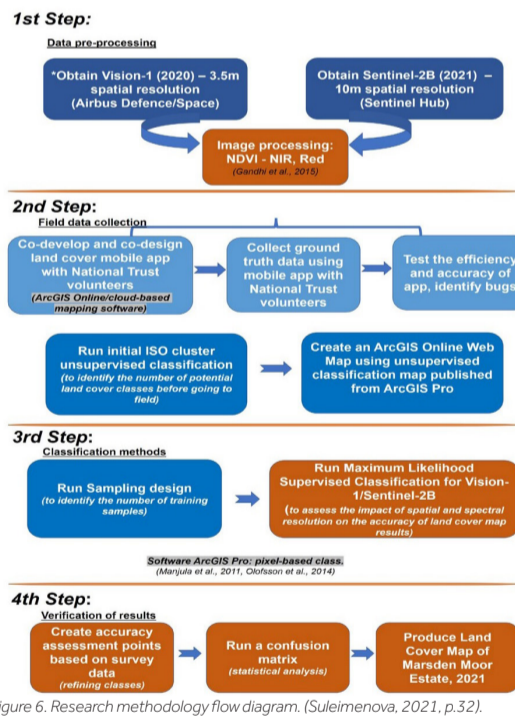


Figure 5(a) Vision-1 31/07/2020 true colour composite (b) Vision-1 21/11/2021 true colour composite © Airbus Defence and Space Limited, 2020.

Research objectives

- To co-develop and co-design a land cover mobile app using ArcGIS Survey123 with Marsden Moor National Trust volunteers for collecting ground truth data of land cover types (Figure 6, Figure 7a and 7b)
- To run a supervised Maximum Likelihood image classification based on Vision-1 data to produce a detailed land cover map for the Marsden Moor Estate (Figure 8).
- To validate and statistically assess the land cover map.

Methodology



Field visits and training

- 17 June 2021 – Consultation with National Trust and field visit around Pule Hill.
- 29 July 2021 – Prototyping the first iteration of the app and discussing how to improve the app with National Trust volunteers followed by some initial data collection in the field.
- 03 August 2021 – Field survey around Black Moss, Wessenden Moor and White Moss.
- 11 August 2021 – Field survey around Buckstones Moss.
- 15 December 2021 – Field survey around Buckstones Moss and mobile app training to National Trust volunteers and Tia Crouch – Resilient Landscapes Project Officer.

Accessing the App and User Guide : <https://bit.ly/3Uf1Yfu>

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Figure 7a. Marsden Moor Land Cover Survey App.

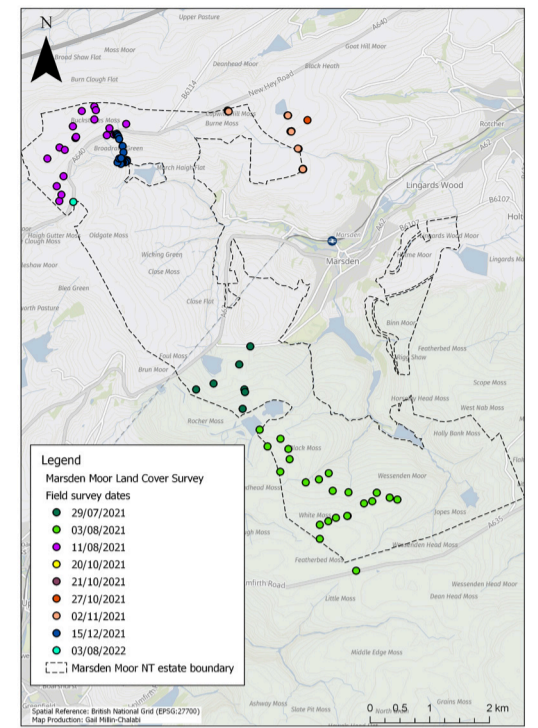


Figure 7b. Marsden Moor mobile app collaborative survey dates and location points collected by Marsden Moor National Trust volunteers and staff / University of Manchester staff and students.

Results

Eleven land cover classes were identified on Marsden Moor Estate and a new land cover map based on Vision-1 was produced. An accuracy assessment using a confusion matrix produced a Kappa Index of 0.68 indicating an overall accuracy of 68% (Figure 8).

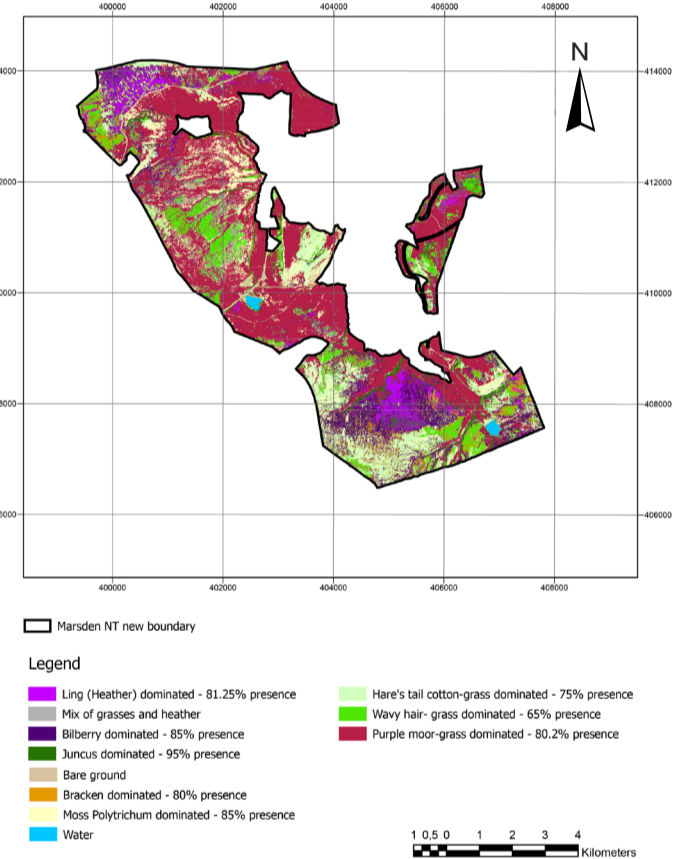


Figure 8. Land cover map of Marsden Moor Estate based on 31/07/2020 Vision-1 (3.5m) image © Airbus Defence and Space Limited, 2020. (Suleimenova, 2021, p.50).

The percentages were taken from the sum of the vegetation averages per field point. There is a dominance of purple moor grass *Molinia caerulea* throughout the estate. Volunteers commented on the lack of the bracken *Pteridium aquilinum* around Buckstones. This misclassification is likely due to a reduction of ground truthing in this area in the field.

Future Work

- To improve the land cover map using the 21/11/2021 Vision-1 data (Figure 5b) which may differentiate bracken and purple moor grass more easily due to the species being more phenological distinct during the winter period.
- To work with the National Trust Resilient Landscape Project Officer to get the app used regularly by National Trust volunteers during estate surveying activities. This additional field data will then improve the results of land cover maps generated for the estate in the future.
- Take forward recommendations from the usability survey e.g. tutorial on extracting field data from ArcGIS Online Survey123 system, solutions for using the app in wet weather and how to create new Survey123 forms for other applications such as peat depth surveys.
- Investigate if the mobile app would be useful to adopt for other peatland areas in the UK.

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