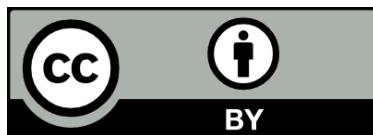




Peatland restoration age (Scotland, UK) can be better reproduced by a classification model based on Sentinel-2 than with high resolution aerial imagery

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Hutton
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in bold: project lead and main contact;
underlined: the remote sensing specialists;
in italics: the ecologists and field crew

- **WHY?** Peatland restoration in the UK has attracted large public investment, yet the outcomes are rarely monitored.
- **WHERE?** This project used one of the longest running, landscape scale, restoration experiment in the UK, to test whether remote sensing can be useful in assessing success. Currently assessed for use at regional/national scale.
- **QUESTION:** Can the 'restoration age' (time passed since restoration efforts) be reproduced, i.e. is there a consistent trajectory towards a reference state?



Photo: IUCN UK Peatland Programme



Photo: Early in restoration process; R Artz



Methods – training/validation data

- **1.** High resolution mapping of spatially collocated peatland restoration sites (purple) that had previously been converted to plantation forestry, including info on restoration dates and management.
- **2.** Standing forestry (green) from National Forest Inventory (field-validated)
- **3.** Target state blanket bog surrounds the restoration/forestry sites: Point data from transects of habitat management surveys (red points) were used to locate suitable reference points.



Photo: Reference blanket bog state. R Artz

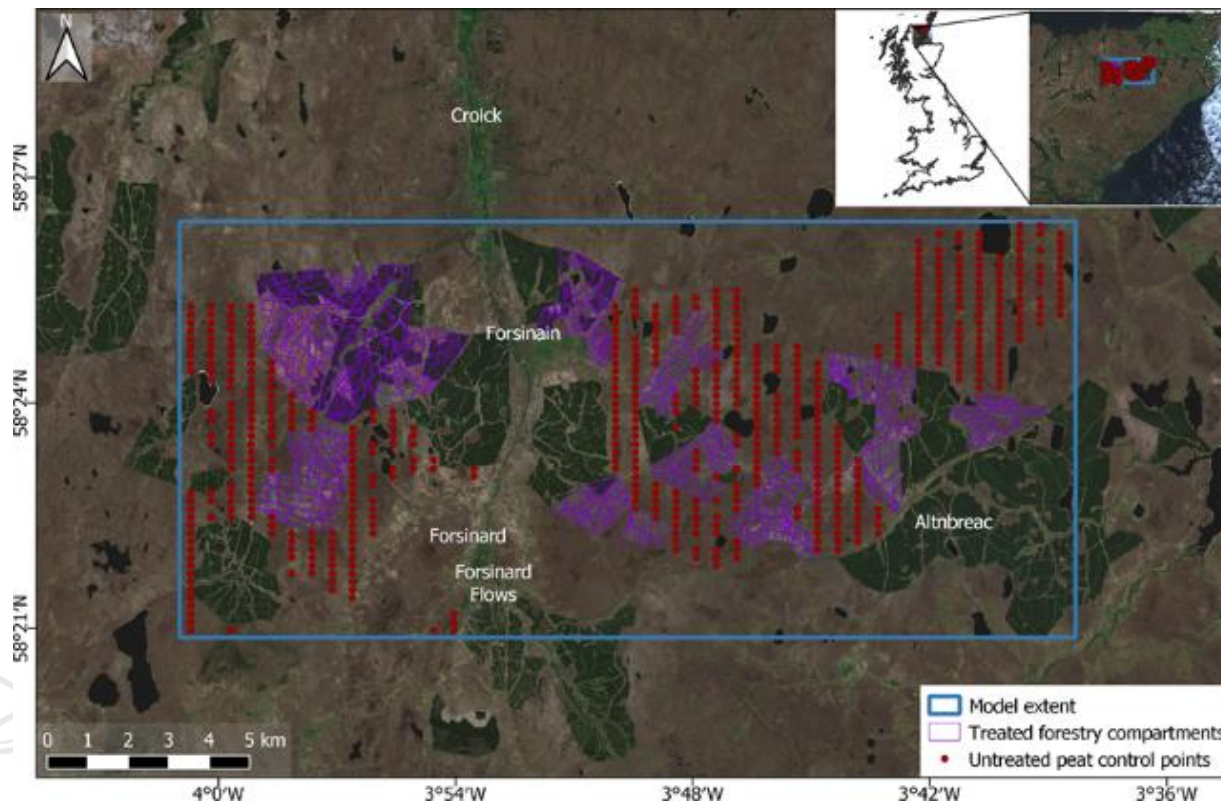


Photo: Early in restoration process. R Artz



Methods (II)

- Hybrid approach of creating points as a means of sampling small areas from a mixture of transect and polygon input data.
- Using a 10 m negative buffer within compartments, and then dissolving by age class $\times$ treatment.
- 570 points created in each but one age/treatment class.



Methods (III)

- Water bodies identified by image segmentation using the Large Scale Mean Shift (LSMS) algorithm in Orfeo Toolbox.
- Points were buffered to create 20 m circular polygons, and split 70/30 for training/validation*.
- Random forest classification model using Sentinel-2 or national scale aerial imagery (Getmapping, 25-50 cm resolution).
- A random forest classifier was instanced in GEE (ee.Classifier.randomForest) with 50 trees per class, minimum samples per node of 1 and 75% bagging and out-of-bag mode set to false.

Treatment	Years since treatment
Felled to waste (FTW)	1, 2, 4, 5, 9, 10, 11, 12, 18, 22
FTW and brash crushing and furrow blocking (BCFB)	0, 1, 2, 3, 4 (since BCFB)

***Table 1:** Classes by treatment of former forestry compartments.*



*Some small areas that are not on peat soil or areas not of interest (tracks, roads) within the AOI were manually classified as 'other'

Results

- Sentinel-2 imagery (summer 2016) results shown here for brevity.
- The Sen-2 based model achieved a kappa score of 0.754 in predicting the treatment class without slope as a parameter.
- Least well predicted treatments were the 'middle' years (10 years +/- 2) since restoration began.
- Recently restored areas and those areas that have had 18 or more years since treatment were the best predicted.
- Target state reasonably well predicted.

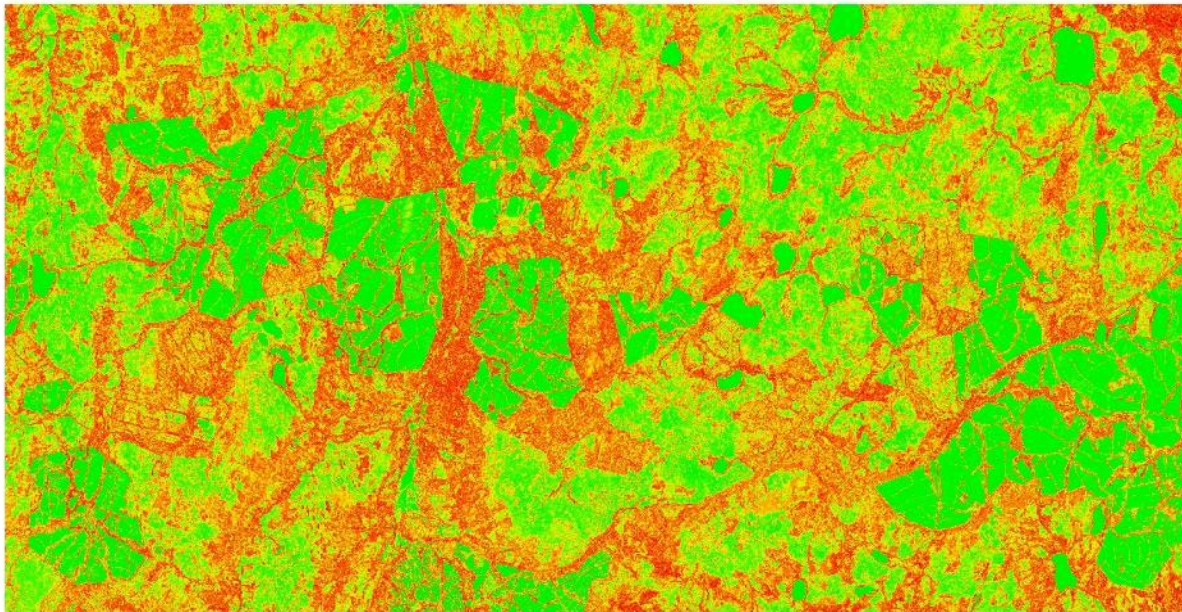
Treatment	False Positive	False Negative	Recall	Precision	F-score
FTW + 1y	28	22	0.96	0.95	0.96
FTW + 2y	102	57	0.89	0.82	0.86
FTW + 4y	52	46	0.92	0.91	0.92
FTW + 5y	75	69	0.87	0.86	0.86
FTW + 9y	206	115	0.78	0.67	0.72
FTW + 10y	244	223	0.59	0.57	0.58
FTW + 11y	209	291	0.46	0.54	0.49
FTW + 12y	243	316	0.38	0.45	0.41
FTW + 18y	143	67	0.87	0.76	0.81
FTW + 22y	120	87	0.85	0.80	0.82
BCFB + 0y	186	273	0.47	0.56	0.51
BCFB + 1y	133	225	0.55	0.67	0.60
BCFB + 2y	92	66	0.85	0.80	0.83
BCFB + 3y	102	93	0.84	0.82	0.83
BCFB + 4y	174	65	0.87	0.71	0.78
Start (forestry)	10	2	1.00	0.98	0.99
Target (Peatland)	98	179	0.68	0.80	0.74
Water	7	8	0.98	0.99	0.99
Other	105	125	0.75	0.78	0.77

Table 3: Result metrics for RF model based on Sentinel 2, no slope, on GEE (+ Xy indicates time in years since restoration treatment effort. BCFB is a secondary treatment to FTW). Data for 2016 image.



Results (cont.),

- Confidence of prediction was good across the restoration, start and target states.
- It was hypothesized that the best restoration results would be found in flatter, less well drained areas. Here, a strong negative covariance might be expected between slope and confidence of prediction, but this was not seen (not shown).
- The same model effort with four-band GetMapping aerial imagery only achieved a kappa of 0.392.



Legend

forsinard_confidenceMap.tif

Value



Take-home messages and requests for feedback

- Training an RF model on Sen-2 imagery using 'age'-based classification of a chronosequence of peatland restoration plots can provide a good basis for modelling progress of peatland restoration.
- Any suggestions for further improvement gratefully received
😊 Thanks for viewing.

