POST-MINING RESTORATION OF HEATHLAND LANDSCAPES

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HISTORIC CULTURAL LANDSCAPE

WILD EXPANSE OF OPEN HEATHLAND DERIVED FROM TRADITIONAL MANAGEMENT ORIGINATING IN THE BRONZE AGE
HEATHLAND LOSSES IN CORNWALL

80,000 ha present in 1800

7,000 ha left in 1997 (when large scale restoration began)

Losses mainly due to changes in socio-economic fabric of farming that formerly maintained heathland
LOST LANDSCAPE DUE TO MINING OF KAOLIN

SUBSTANTIAL LOSSES DURING 20TH CENTURY DUE TO MINING FOR KAOLIN (CHINA CLAY) FROM LARGE OPEN-CAST PITS

490 MILLION TONNES OF WASTE TIPPED OVER 50 Km² OF THE HISTORIC LANDSCAPE ENCOMPASSING HEATHLAND, WOODLAND, SMALL ENCLOSED FIELDS
RESTORATION OF DISTINCTIVE LANDSCAPE

IN 2007
TIPPING REMAINS ACTIVE

RESTORATION OF 750 Ha HEATHLAND
RE-CREATE THE HISTORIC LANDSCAPE AND HABITAT DIVERSITY
QUARTZ FELDSPAR WASTE
EXTRACTION RATIO
1 KAOLIN : 9 WASTE
<table>
<thead>
<tr>
<th>Mesh size (mm)</th>
<th>% by wt.</th>
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<tbody>
<tr>
<td>6.35</td>
<td>7.9</td>
</tr>
<tr>
<td>2.00</td>
<td>36.5</td>
</tr>
<tr>
<td>1.00</td>
<td>15.2</td>
</tr>
<tr>
<td>0.05</td>
<td>15.1</td>
</tr>
<tr>
<td>0.212</td>
<td>10.6</td>
</tr>
<tr>
<td>&lt;0.212</td>
<td>14.7</td>
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ANALYSIS OF WASTE

pH 4.5
Cation exchange capacity 1.0 (milliequiv.100 g\(^{-1}\))
Total N (µg.g\(^{-1}\)) 18.3
Extractable P (µg.g\(^{-1}\)) 1.1
Extractable Ca (µg.g\(^{-1}\)) 4.0
EARLY RESEARCH – NPK FACTORIAL EXPERIMENT

Nitrogen a key nutrient
also calcium

Moribund vegetation
after two years
FAILED RESTORATION
NUTRIENT SUPPLY NOT SUSTAINABLE

Initial establishment

Nitrogen has leached away
NATURAL COLONISATION – SUCCESSIONAL TRAJECTORIES

Heathland phase
20-30 years

Scrub phase
20-30 years

After 100-120 years
oak-birch woodland

NOT SEQUENTIAL
DCA Ordination – there is no pattern for colonising sites

It’s a mess!
LEE MOOR, DEVON ‘MOONSCAPE’ QUARTZ FELDSPAR WASTE
BIOLOGICAL RESOURCE REQUIREMENTS FOR RESTORATION

- HEATHER LITTER / UPPER SOIL HORIZON
- HARVESTED SEED / CUT SHOOTS AND CAPSULES (BRASH)
- TRANSLOCATION OF TURF
- TRANSPLANTED SEEDLINGS / CUTTINGS
UPPER SOIL HORIZON
VERTICAL SEED DISTRIBUTION
EXISTING HEATHLAND
LEE MOOR DEVON,
STRIPPING HEATHLAND
TOPSOIL AS A RESTORATION
RESOURCE

MATERIAL RESCUED FROM AN
AREA SCHEDULED FOR WASTE
TIPPING
TIMING OF HARVEST VAILABLE CALLUNA SEED RAIN

Viable Calluna seed rain m⁻² from October to January

OCTOBER NOVEMBER DECEMBER JANUARY
SEASONAL PATTERN OF GERMINATION ON A MINERAL SUBSTRATE
STARTING POINT FOR RESTORATION

LEE MOOR
DEVON

SMALL SCALE EXPERIMENTS COMMENCED IN 1976

AIM TO RESTORE CHARACTERISTIC HEATHLAND VEGETATION
EXPERIMENTAL DESIGN

MAIN PLOT 25-30 MM MOORLAND TOPSOIL

1) DIRECT ON THE WASTE

2) ON 100mm LAYER OF TOPSOIL

SUB PLOTS 0, 100, 300 KG PER HA

17% N: 17% P₂O₅: 17% K₂O

± COMPANION GRASSES

AGROSTIS, LOLIUM, FESTUCA, NONE

± GRAZING
RESULTS AFTER 7 YEARS UNGRAZED
CONTRAST VEGETATION ON QUARTZ SAND OR SUBSOIL
HEATHLAND PLANT COMMUNITIES
17 YEARS AFTER RESTORATION
(QUARTZ SUBSTRATE)

% cover

- Erica tetralix
- Erica cinerea
- Calluna vulgaris

Treatments (grass species and fertilizer application)

Control
Lolium
Agrostis
Festuca
Undisturbed heathland

0 100 300
0 100 300
0 100 300
0 100 300
0 100 300
SAND/GRAVEL WASTE, DORSET MEDIUM SCALE EXPERIMENT
# EXPERIMENTAL DESIGN

<table>
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<tr>
<th>Harvested heather shoots</th>
<th>0.0</th>
<th>0.4kg m(^{-2})</th>
<th>0.6kg m(^{-2})</th>
<th>1.8 kg m(^{-2})</th>
<th>0.0</th>
<th>13.7kg m(^{-2})</th>
<th>21.1kg m(^{-2})</th>
<th>31.9kg m(^{-2})</th>
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<td>1 : 2</td>
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<td></td>
<td>1 : 5.2</td>
<td>1 : 3.4</td>
<td>1 : 2</td>
</tr>
<tr>
<td>Heathland topsoil</td>
<td></td>
<td>± Fertiliser</td>
<td>± Fertiliser</td>
<td>± Fertiliser</td>
<td>± Fertiliser</td>
<td>± Fertiliser</td>
<td>± Fertiliser</td>
<td>± Fertiliser</td>
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**EXPERIMENTAL PLOT LAYOUT**

- Fully randomised
- 3 block replicates
- Seventy two 6 m x 4 m plots
- Four separate ‘control’ transects (no treatment)
- Analysed as a split plot design
PLOT PREPARATION
– AGRICULTURAL MACHINERY
ESTABLISHED PLANT COMMUNITIES AFTER 9 YEARS

SHOOTS 0.6 kg.m$^2$   TOPSOIL 32 kg.m$^2$
SPECIES ASSEMBLAGE AFTER 9 YEARS

- Donor heath
- Harvested heather shoots
- Heathland topsoil

- M.caerulea
- A.curtisii
- U.minor
- E.tetralix
- E.cinerea
- C.vulgaris
HEATHLAND PLANT COMMUNITIES AFTER 9 YEARS (UNGRAZED) ON SAND AND GRAVEL WORKINGS
CAERLOGGAS DOWNS - CORNWALL
THE FIRST LANDSCAPE SCALE RESTORATION (60 Ha) ON QUARTZ WASTE (in 1995)

TIP PROFILE RE-ENGINEERED TO REMOVE STEEP SLOPES
RESTORED HEATHLAND AFTER 4 YEARS WHEN GRAZING COMMENCED
RESTORED HEATHLAND WITH

*Erica cinerea*, *Calluna vulgaris*,
*Ulex gallii* and *Agrostis curtisii*
LANDSCAPE SCALE RESTORATION

750 hectares of re-created heathland

12.5% UK BAP target for heathland re-creation

To be confirmed in 10 years time?

VIEW OF CAELOGGAS DOWNS
RECENTLY RESTORED RE-PROFILED TIPS
HEATHLAND OVER SUMMIT
GRASS/WOODLAND  LOWER SLOPES
THE CORNWALL HEATHLAND PROJECT

- 50 km square working area
- 1997-2004

Capital cost – €3.5 million
SUSTAINABLE LANDSCAPES

Reflects and reinforces local distinctiveness with culturally appropriate habitats.

Creates a functioning landscape with heathland and improved grassland in proportion, to support grazing animals.

Significant public benefits through increased access, improved visual amenity and environment.
ECONOMICALLY SUSTAINABLE MANAGEMENT OF RESTORED HEATHLAND IS ESSENTIAL

RANGE GRAZING OF BEEF CATTLE

Expanding market for heathland beef

Quality breeds at premium prices
SOCIAL & ENVIRONMENTAL GAIN
FROM LANDSCAPE RESTORATION

Social gain:
public benefits through greater access and improved amenity

Post-mining economic gain through local employment, agriculture and tourism
ACKNOWLEDGEMENTS

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