SUSTAINABLE HABITAT CREATION UTILISING SOIL INVERSION: EVIDENCE FROM CASE STUDIES

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Richard Scott: Eden Project ex Landlife

Stephen Lewis: Butterfly Conservation
SOIL INVERSION: Innovative habitat creation
A technique introduced by Landlife Liverpool

Habitat creation for species-rich grassland and heathland is constrained on former agricultural soils.

High P concentration key constraint + Nitrogen and high soil fertility.

Soil inversion - alternative solution to soil stripping, importing low fertility subsoils or recurrent cutting and removal of herbage.

Existing ‘weedy’ seedbank will be buried.

LANDLIFE - 700 ha inversion 60% grassland
25% woodland 6% heathland.

TWO CASE STUDIES

AIM

TO RE-CREATE
HEATHLAND HABITAT FOR
SILVER-STUDDED
BLUE BUTTERFLY

Last population of *Plebejus argus* in
the English Midlands
HEATHLAND RE-CREATION
AT PREES HEATH COMMON RESERVE

PRE-2006 Potatoes-Wheat-Beans

May 2006 BUTTERFLY CONSERVATION purchased 60ha of Prees Heath Common
PREES HEATH COMMON

Heathland heritage

Extent of heath in 1880 - 126ha

1942 - Bomber airfield - WW2

1950’s - Conversion to arable - 98% loss of heathland

Green shaded area = patchy relict heath
INVESTIGATION OF SOIL PROFILE

300 - 400 mm topsoil over sand and gravel post-glacial outwash 17,000 years ago

October 2006
SOIL CHEMICAL ANALYSIS
Undisturbed profile

<table>
<thead>
<tr>
<th>Profile depth</th>
<th>pH</th>
<th>P</th>
<th>K</th>
<th>Ca</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 100 mm</td>
<td>7.0</td>
<td>58</td>
<td>300</td>
<td>1588</td>
</tr>
<tr>
<td>250 - 350 mm</td>
<td>6.9</td>
<td>38</td>
<td>116</td>
<td>1341</td>
</tr>
<tr>
<td>800 - 900 mm</td>
<td>6.3</td>
<td>6</td>
<td>15</td>
<td>70</td>
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</tbody>
</table>

Chicken Manure
DEEP PLOUGHING, MARCH 2007

Archaeological constraints assessed

Immediately after ploughing pH 6 - 6.5 at surface

Acidified with elemental sulphur 1.25 tonnes/ha

Plough depth 900mm+

Two mouldboards
AN AERIAL VIEW AFTER SOIL INVERSION
Focus on Hangars Field bounded in red

Showing the old runway which contains remnant heathland which has supported the Silver-studded Blue population.

As the new heathland developed SSB colonised from this source area.
## SOIL CHEMICAL ANALYSIS 0-100mm

<table>
<thead>
<tr>
<th>Year of sampling</th>
<th>pH</th>
<th>P</th>
<th>Ca</th>
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<tbody>
<tr>
<td>Pre-plough 2006</td>
<td>7.0</td>
<td>58.0</td>
<td>1588</td>
</tr>
<tr>
<td>Post-plough 2007</td>
<td>4.1</td>
<td>11.9</td>
<td>119</td>
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<tr>
<td>Post-plough 2016</td>
<td>4.4</td>
<td>13.5</td>
<td>&lt;200</td>
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<tr>
<td>Grassland control</td>
<td>5.6</td>
<td>26.6</td>
<td>740</td>
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</table>
Progressive change in mean substrate pH in Hangars Field from October 2006 until June 2018 (0 - 100mm)

![Graph showing the change in mean substrate pH from October 2006 to June 2018. The graph displays a downward trend from October 2006 to February 2008, followed by a fluctuation until June 2018. The reference line for Heathland is also shown.]
SPREADING HEATHER BRASH NOVEMBER 2007
Heathland Source Cannock Chase

Tractor passes compress brash

Erica cinerea source Prees H
36,400 plugs

37,000 seeds Per m²

159 bales spread over 6.47 ha
HEATHLAND DEVELOPMENT 2017

Rabbit grazing beneficial

NVC
H12 or U1
EVIDENCE OF *Plebejus argus* BREEDING ON THE RESTORED HEATHLAND

Dependent on prior colonisation by mutualist black ant (*Lasius niger*).

Ants protect larvae and pupae from predation.

31st May 2014 larva + black ants first evidence of breeding

June 2018 - 700 adult butterflies recorded on one restored area in one day.
EVIDENCE OF Plebejus argus BREEDING ON THE RESTORED HEATHLAND

31st May 2014
MANAGEMENT LONG TERM

Maintain 15-20% open ground - crucial for black ants

Increase cover of *Erica cinerea* to 10-15%
Currently 2-3%

Regular removal of *Betula* young plants

Involvement of volunteers was crucial
NESS BOTANIC GARDENS
Creation of species-rich grassland

Previously experimental area left unmanaged as species-poor grassland
DEEP PLOUGHING IN MARCH 2008

Subsoil revealed low soil fertility

Archaeology checked
# SOIL CHEMICAL ANALYSIS

<table>
<thead>
<tr>
<th>Soil property</th>
<th>Year of sampling</th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>2007</td>
<td>2012</td>
<td>2015</td>
<td></td>
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<tr>
<td>pH</td>
<td>7.6</td>
<td>7.6</td>
<td>7.0</td>
<td></td>
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<tr>
<td>Phosphorus mg/l</td>
<td>42.0</td>
<td>23.6</td>
<td>13.0</td>
<td></td>
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<tr>
<td>Nitrate-N mg/kg</td>
<td>32.5</td>
<td>0.50</td>
<td>0.58</td>
<td></td>
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</tbody>
</table>
WILDFLOWER MEADOW
FIRST SPRING AND SUMMER
2008

23 species sown
originally – now over 125
recorded cumulatively

Cornfield annuals
dominant - 6 spp.
sown

Species
turnover at
least 25 spp.
June
ox-eye daisy
*Leucanthemum vulgare*

July/August
musk mallow
*Malva moschata*
Cowslip Primula veris

Estimated 26,000 rosettes in April 2018

June
Yellow rattle
A crucial ingredient to suppress grass competition
Hybrid Marsh orchids

Bee orchid

2018
CONTINUING MANAGEMENT

Late August - Mowing haymaking and baling

September - Disc harrowing

PLANT SPECIES RICHNESS

2009 – 55 species
Now over 125 species recorded cumulatively – circa 90 in any year

FLORA AND FAUNA BIOBLITZ 2014 over 750 spp.
Butterflies and bees recorded
20 species

Small Copper – 54 records in 2018

Common Blue on vetch
BENEFITS FOR INVERTEBRATES

Speckled Wood on knapweed

Painted Lady on creeping thistle
24 species
SOIL INVERSION - SUSTAINABLE OUTCOMES

Ness Gardens - species-rich grassland - greatly enhanced invertebrate biodiversity
Food plants - nectar - pollen  SOIL FERTILITY HAS FALLEN

Prees Heath - long term objective - on course to optimise habitat for Silver-studded Blue.

Needs more *Erica cinerea* cover - grazing regime - rabbits and cutting is insufficient - common land issues for cattle grazing.

SOIL FERTILITY IS LOW but is pH stable?

10 years monitoring - has contributed to evidence base for the sustainability of soil inversion.

ERHC SIG will be be crucial here- provision of guidance
ACKNOWLEDGEMENTS

Frances Lee - Rarehare and ERS

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Carl Clee - Liverpool World Museum

Butterfly Conservation - Charity

THANK YOU FOR LISTENING AND WATCHING