Improving Quarry Restoration Efficacy: Site Prioritisation, Connectivity Analysis and Erosion Control

Aims and Objectives

Aim: to support Tarmac's quarry restoration efforts in central England and Wales. 5 objectives guided our assessments and suggestions for **successfully improving the ecological status of restoration sites in a cost-effective way:**

1. Quarry site prioritisation
2. Focal species selection
3. Evaluation of environmental parameters for landscape connectivity analysis
4. Erosion risk assessment and recommendation of erosion control measures
5. Production of landscape connectivity maps and providing recommendations to optimise restoration

Species Selection

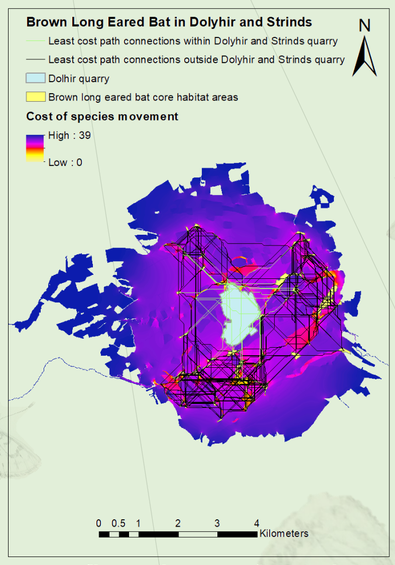
Focal species for the connectivity assessment were selected based on the habitat composition of the 5 prioritised quarry sites and on ecological surveys.

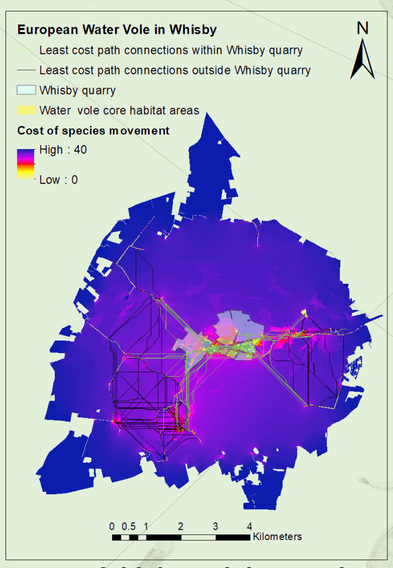
Species chosen

- Brown Long Eared Bat *(Plecotus auritus)*
- Reed Bunting *(Emberiza schoeniclus)*
- European Hare *(Lepus europaeus)*
- Marsh Fritillary Butterfly *(Euphydryas aurinia)*
- European Water Vole *(Arvicola amphibius)*

These are **protected** under **UK and/or European designations**. Together, they **cover a broad range of habitat requirements, behaviours** and **dispersal properties**.

Evaluation of Environmental Parameters and In-Depth Connectivity Analysis

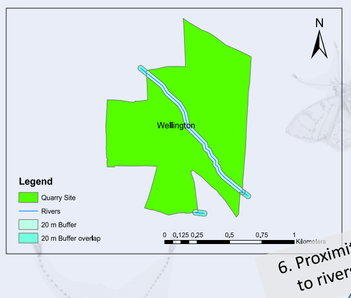


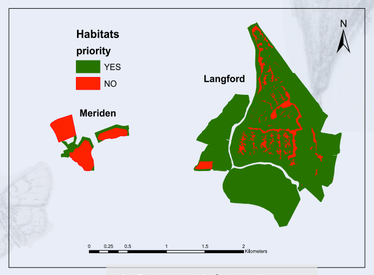


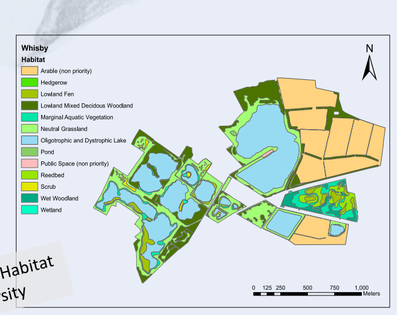
Various configurations of environmental parameters in the form of **different land use and habitat patches** were **evaluated** for each selected species. **Resistivity values**, required for connectivity analysis, were assigned accordingly. **Connectivity analysis** within **quarry sites** and **the wider landscape** was performed using Circuitscape 4.0 and ArcMap 10.5. **Areas of high and low resistance to dispersal** were mapped for each species. **Least cost paths between core habitat patches** within the quarry sites and the surrounding landscape were then produced.

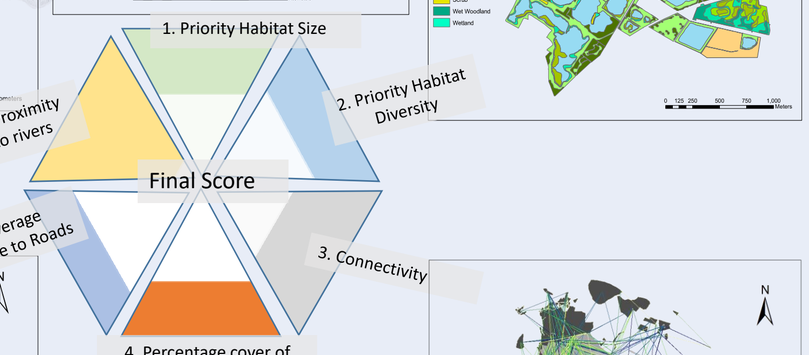
The number of least cost paths crossing a quarry site indicates its importance for landscape connectivity.

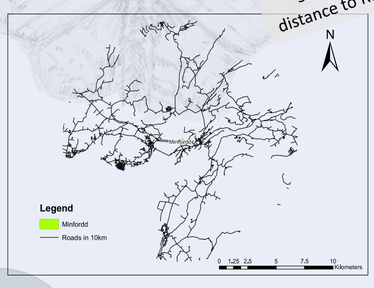
Quarry Site Prioritisation

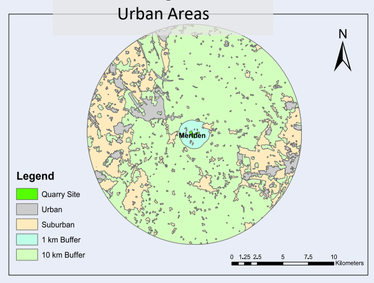


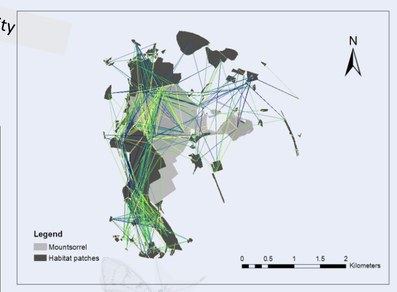










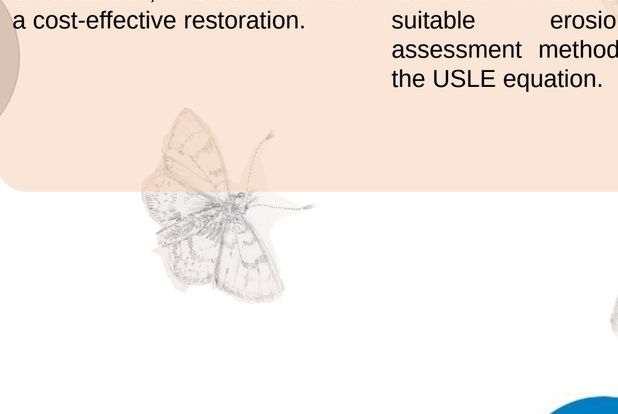


A **site selection process** based on **6 criteria** and a scoring system from 0-10 was used to rank the 28 sites. The **5 highest ranking sites** are suggested for prioritisation. These should get more attention and resources in the restoration process.

Site	1. Size	2. Diversity	3. Connectivity	4. Urban area	5. Roads	6. Rivers	Total	Rank
Whisby	9	10	4	9	4	7	47	1
Langford	10	10	2	9	4	6	45	2
Dolyhir and Strinds	5	7	3	10	5	7	42	3
Besthorpe	6	5	6	9	4	7	41	4
Wellington	5	8	2	9	3	10	40	5
Brooksby	1	6	5	8	3	10	36	6
Minfordd	1	2	2	9	10	2	36	7
Clifton	5	9	3	8	3	4	35	8
Crownfarm	4	9	6	8	3	1	34	9
Alrewas	5	10	1	8	3	3	33	10

Erosion Risk Assessment

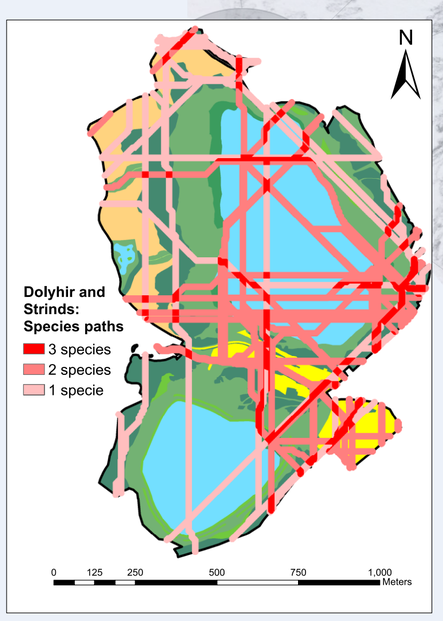
4 USLE factors



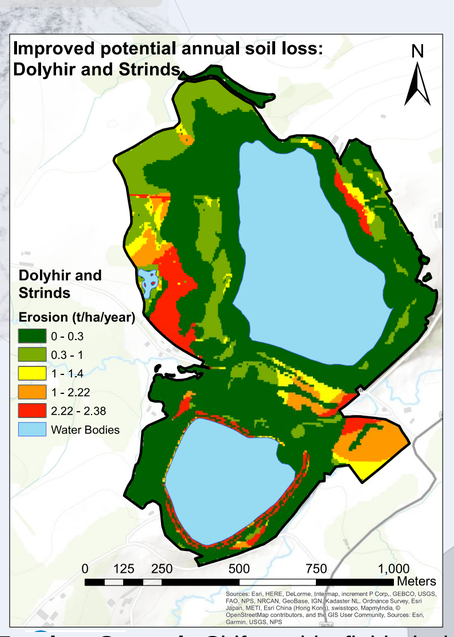
Soil erosion is a major **threat to** the success of **restoration schemes**. Transport of sediment and nutrients into water bodies causes turbidity and eutrophication, creating problems for aquatic communities and water treatment.

The USLE equation was used to generate approximate potential annual erosion values as the product of four factors. Most selected sites are not at a high risk of erosion; where needed, mitigation measures are recommended.

Recommendations



Connectivity: Restoration should be focused on areas in the quarry sites where least cost paths of one or more of the selected species agglomerate.



Erosion Control: Shift arable fields in high LS-factor areas to grassland or apply soil conservation methods. Woodland buffer strips are recommended near water courses.

Conclusion

A **systematic approach** to **select quarry sites** that should be **prioritised** in the allocation of resources, in order to ensure a cost-effective restoration.

Effective restoration requires **erosion control** measures in vulnerable areas. These can be identified and corrected through suitable erosion risk assessment methods such as the USLE equation.

Analysing habitat **connectivity** within quarry sites and the wider landscape enables informed decisions regarding areas that require improvement or continued maintenance of habitat patches and features that facilitate species movement on a landscape scale.

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