



# **THE VALUE OF QUARRY RESTORATION AT WHATLEY QUARRY TO LOCAL ECOLOGICAL NETWORKS**

**Final report submission to Quarry Life Award Competition.**

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## **Table of Contents**

<b>Abstract</b>	<b>3</b>
<b>Introduction</b>	<b>3-4</b>
<b>Objectives</b>	<b>4</b>
<b>Site Description</b>	<b>4</b>
<b>Methods</b>	<b>4-6</b>
<b>Results</b>	<b>6-8</b>
<b>Discussion</b>	<b>8-9</b>
<b>Conclusion</b>	<b>9</b>
<b>Acknowledgements</b>	<b>9</b>
<b>Appendices</b>	<b>10</b>



## Abstract

The importance of ecological networks has replaced traditional conservation efforts focussing on discrete areas. Manmade activities such as quarrying can often interfere with these networks preventing species from moving between areas of habitat. Therefore it is vital that activities that have the potential to disrupt ecological networks consider mitigation projects to try and reduce their impact. This project investigates whether plantations surrounding a quarry act as wildlife corridors for terrestrial and (aerial) species. Furthermore, the age and composition of plantations was considered to determine what factors affect natural colonisation of both flora and fauna from nearby species rich “core” areas.

This project investigated the plantations surrounding Whatley Quarry, Somerset, specifically looking at the presence of woodland specialist species for three taxonomic groups; plants, bats and ground beetles. Presence of these indicator species would help determine the quality of the plantation as a woodland habitat as well as providing some indication of the colonisation that has already taken place. A series of diurnal and nocturnal field surveys were undertaken to investigate the presence of indicator species at various sites around Whatley Quarry.

Due to the complexity of ecosystem relationships it is difficult to draw a conclusion about how successful the plantations have been as wildlife corridors. Results showed a range of woodland specialist species were present within all surveys. The data suggests that the northern edge of the quarry has experienced the highest level of colonisation based on the presence of our indicator species. Results also provided evidence that both lesser and greater horseshoe bats were using the site either as corridors or feeding grounds. Weather conditions during this project had a negative impact on the number of results collected and the types of surveys undertaken. Due to their importance, nationally, it would be of interest to determine how the lesser and greater horseshoe bats are using the site. Further investigation should also be undertaken on other taxa such as birds and how they have colonised around the quarry as well as a more direct comparison between different age plantations.

## Introduction

The importance of creating robust ecological networks has recently become a key element of planning and development policy in the UK. Both the Government’s Natural Environment White Paper (2011) and National Planning Policy Framework (2012) emphasise the importance of having species rich ‘core’ areas of habitat linked by a resilient network of ‘wildlife corridors’ and ‘stepping stones’. The aim of this project is to assess whether restored woodlands adjacent to an active quarry are positively contributing to the local ecological network by acting as wildlife corridors.

Our study took place at Whatley Quarry in Somerset. Hanson has installed woodland plantations designed to promote connectivity and increase biodiversity at this site. A project





led by the Somerset Wildlife Trust to map ecological networks has highlighted the potential importance of these woodland plantations to provide ecological connectivity between three nearby woodlands: Asham Wood SSSI, the largest remaining area of ancient semi-natural woodland in the Mendips; Melcombe Wood and Tedbury Covert/Vallis Vale. An SAC at Vallis Vale (Mells Valley SAC) was primarily designated for its exceptional greater horseshoe bat breeding population, comprising roughly 12% of the UK population<sup>1</sup>. The recently planted woodland habitats around the quarry are likely to serve as functional habitat corridors for some woodland species groups but not others.

## Objectives

This project aimed to assess whether the woodland plantations surrounding Whatley quarry comprise a functional element of local woodland networks for a range of different taxa. We focussed on three taxonomic groups: horseshoe bats, ground beetles and ground flora, chosen to represent a range of mobilities, dispersal mechanisms and species of local and national conservation concern.

## Site Description

Whatley Quarry is a limestone quarry owned by Hanson plc, near the village of Whatley on the Mendip Hills, Somerset, England (51°14'N, 2°23'W). Progressively between 1980 and 2014, approximately three miles of the site's perimeter (~85%) has been planted with a range of tree species, while other areas have regenerated naturally, resulting in a near-continuous linear wooded network around the perimeter of the site, although the newest plantations still comprise only saplings.

## Methods

The presence and distribution of woodland indicator species was surveyed within 'core' and plantation sites surrounding Whatley Quarry. Core sites were adjoining woodland/hedgerow sites which had the potential to act as sources of dispersal for woodland species (see figure 1). A total of six surveys were carried out between May and July 2014.

### *Botanical survey*

The frequency of a subset of ancient woodland and general woodland indicator species (table 1) was visually assessed within each core area and three adjacent plantations using the DAFOR scale. Two complete surveys were conducted in June and July 2014.

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<sup>1</sup> JNCC (2005). Mells Valley SAC Site Description. Accessed 26/09/14 at: <http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUCODE=UK0012658>



### *Ground beetle survey*

Two pitfall trap surveys were undertaken in Foxhole's Wood and three adjacent plantations (16-17, 18 and 32). Three traps were set in each location and left for two weeks prior to collection (total 336 trap days). Carabid species were identified using Luff and Turner (2007)<sup>2</sup>.

### *Horseshoe bat survey*

Two nocturnal surveys (May and July) of horseshoe bat presence were conducted using Batbox Duet frequency division bat detectors (Batbox Ltd, Steyning, UK) connected to Zoom H1 portable recorders. Survey teams were assigned one of four survey sectors and recorded echolocation calls on alternate walking transects and point sampling surveys at pre-determined sampling locations. Transects covered a total of approximately 2 miles of the quarry's perimeter woodland. Each point sample was ten minutes in length whilst transects were of variable duration. Surveys commenced thirty minutes before sunset and ran for ninety minutes in total. There were only three survey teams available for the second survey, so the NE sector wasn't surveyed since it had already provided positive results for both horseshoe species in the first survey.

The presence of Greater Horseshoe (*Rhinolophus ferrumequinum*) and Lesser Horseshoe (*R. hipposideros*) bats were subsequently identified from spectrograms produced using SASLab lite (Avisoft, Inc., Berlin).

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<sup>2</sup> Luff, M. L., & Turner, J. (2007). *The Carabidae (ground beetles) of Britain and Ireland*. Royal Entomological Society.



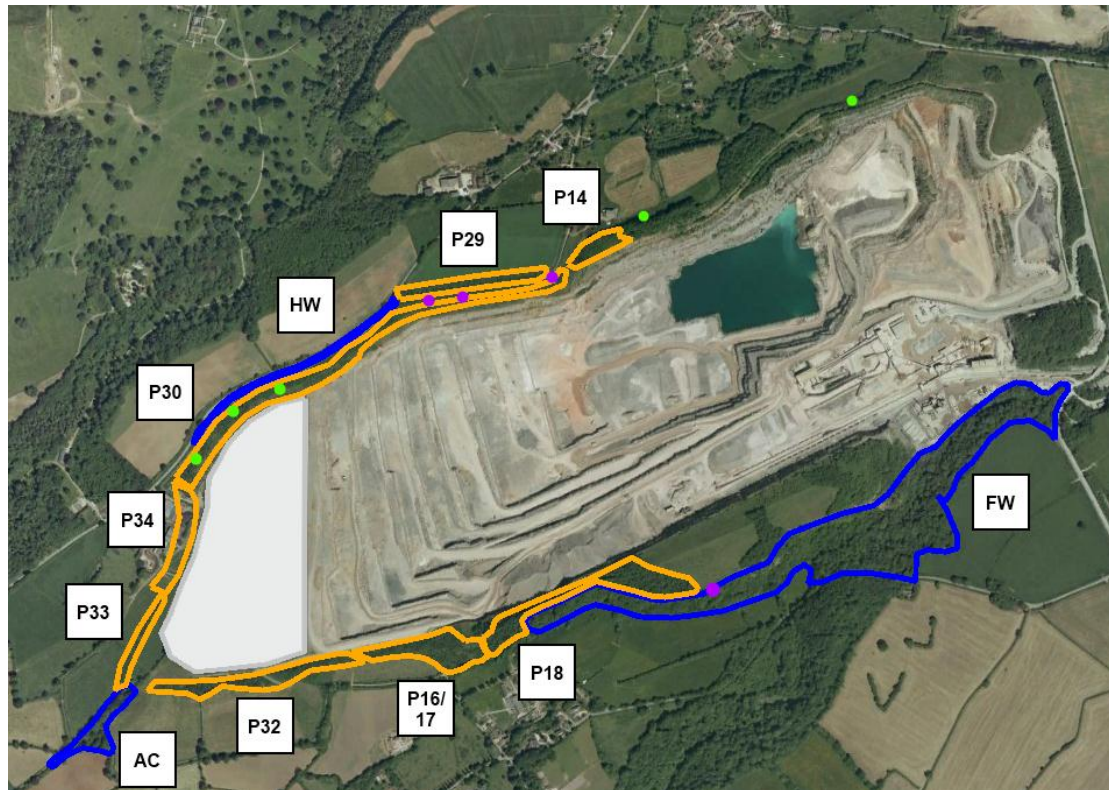


Figure 1: Locations of core sites (outlined in blue), plantations (orange). Also shown are locations of recordings of greater horseshoe bat (green dots) and lesser horseshoe bat (pink). The pale shaded area is a recent extension to the quarry not shown on the aerial photograph. Aerial photograph © Google Earth (2014).

## Results

### *Woodland flora*

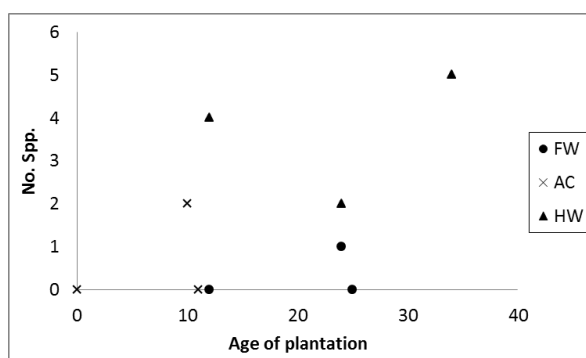
While no ancient woodland indicator species were observed outside of Foxhole's wood, there is some evidence that some of the plantations, particularly on the northern side of the site, are starting to develop ground flora typical of secondary woodland (table 1).

Table 1: Summary of botanical survey results. Plantation numbers are shown with planting dates in brackets. FW = Foxhole's Wood; AC = Angel Copse; HW = Hedge. Species' *a priori* classification as an indicator is given: AW = ancient woodland; W = woodland; O = non-indicator species



Species	Common Name	Ind.	Survey site											
			FW	P16/7 ('89)	P18 ('90)	P31 ('02)	AC	P32 ('02/4)	P33 ('04)	P34 ('14)	HW	P15 ('90)	P29 ('80)	P30 ('02)
<i>Anemone nemorosa</i>	Wood anemone	AW	O											
<i>Euphorbia amygdaloides</i>	Wood spurge	AW	R											
<i>Galium odoratum</i>	Sweet woodruff	AW												
<i>Lamium galeobdolon</i>	Yellow archangel	AW	R											
<i>Lathraea squamaria</i>	Toothwort	AW	R											
<i>Polygonatum multiflorum</i>	Soloman's Seal	AW												
<i>Arum maculatum</i>	Lords & ladies	W	R				F		R		R	R	O/R	R
<i>Geum urbanum</i>	Wood avens	W	F		R		F		R		R	O/F	F	O
<i>Hyacinthoides non-scripta</i>	Bluebell	W									R		R	R
<i>Mecurialis perennis</i>	Dogs mercury	W	A				A				F		O	R
<i>Oxalis acetosella</i>	Wood sorrel	W												
<i>Veronica montana</i>	Wood speedwell	W					F/O						R	
<i>Allium ursinum</i>	Wild garlic	O	•				•		•		•		•	
<i>Dactylorhiza fuchsii</i>	Common spotted orchid	O												•
<i>Fragaria vesca</i>	Wild strawberry	O	•	•								•		
<i>Primula vulgaris</i>	Primrose	O												•

While there is a general trend for older sites to contain more woodland indicators, the trend is not significant (Spearman's rank correlation:  $S = -0.326$ ;  $N = 9$ ;  $p = 0.392$ ; figure 1).



**Figure 2: Number of woodland indicator species in plantations of different ages. Symbols refer to the associated core area: FW = Foxhole's Wood; AC = Angel Copse; HW = Hedge.**

### Ground beetles

Adverse weather conditions hampered our sampling methods and the number of beetle species recovered was much lower than might have been expected. Ten species were recovered in total and there was little difference in the species richness between the core site ( $n = 5$ ) and the plantations (P16-17:  $n = 5$ ; p18:  $n = 4$ ; p31:  $n = 4$ ). None of the species





recorded are listed as woodland specialists in Luff and Turner (2007). A species list is presented in appendix 1.

#### *Horseshoe bats*

Across the two surveys, five recording of Greater Horseshoe Bats (*R. ferrumequinum*) were made, all along plantations on the northern side, while Lesser Horseshoe Bats (*R. hipposideros*) were present at three of the sites (see figure 1). Greater horseshoe bats were not recorded using the plantations around the southern side of the quarry.

## **Discussion**

Our results provide some evidence that the plantations surrounding Whatley Quarry, particularly those to the north of the quarry (i.e. plantations 15, 29 and 30), are beginning to function within the woodland ecological network. There is evidence that some ground flora typical of secondary woodland is beginning to establish in these plantations which suggest that the local environmental conditions in these plantations are promoting changes in the community. It is notable that even the younger of the plantations (30) planted in 2002 contained four out of six woodland indicator species whereas plantations 16-18, despite being over a decade older and closer to Foxhole's Wood contained just one indicator species. The appearance of dog's mercury (*Mercurialis perennis*) in plantation 30 is particularly interesting since the seeds of this plant are dispersed by ants. The fact that it has appeared so rapidly in such a young plantation may suggest a vigorous ant community within surrounding areas.

In general, colonisation by woodland plants within the southern plantations appears to be occurring much more slowly than in the northern plantations, despite appearing roughly similar in area and overall structure. There are a variety of reasons why this may be the case, but aspect may play a critical role. The majority of the southern plantations have a southerly aspect and therefore may experience drier, more open, conditions when compared to the northerly plantations. More intensive mapping of the locations of woodland plants within the plantations would elucidate the impact of aspect. It would also be important to consider the possible impacts of soil nutrient levels and the original source of the soil from which the quarry bund was created.

It appears that the northern plantations, at least, are beginning to act as functional dispersal corridors for some plant species associated with secondary woodland and therefore could be included within a woodland ecological network with some confidence. The same cannot be said currently for the southern plantations.

The data from the bat surveys suggests that some of the plantations are also functioning as conduits for bats moving between foraging grounds, and possibly for foraging themselves. Of particular note is that greater horseshoe bats appear to be regularly using the plantations to the north of the quarry. Extensive radio-tracking work carried out in the project area in 2005 showed no indication that the bats were commuting beyond a flyway between Asham





Wood and Tedbury Covert (Somerset Wildlife Trust, unpub. data). It appears that in the intervening nine years, the plantations have matured to the point where they now function as a corridor, possibly to Melcombe Wood. The growth of plantation 30 is likely to have been key to this change since in 2005 it was just three years old.

It is notable that there were many fewer horseshoe bat recordings from the southern plantations. One lesser horseshoe bat was recorded within Foxhole's Wood, where it may have been foraging, and no greater horseshoe bats were recorded at all. This is despite the outward structure of the linear route being similar to the plantations in the north with older growth woodland/plantations to the east and younger (12 yr old) plantations to west. It is possible that these flyways are not being used because they currently link into a wider network. It will be interesting to study whether the maturation of plantation 34 (planted in 2014) creates new links between the southern plantations and the northern ones and increases their use to both greater and lesser horseshoe bats.

Few conclusions can be drawn from the invertebrate data due to the paucity of the data. Whether woodland invertebrates are exhibiting the same general patterns as the ground flora and bats remains an interesting and open question.

## **Conclusion**

Our study suggests that the question of whether the plantations around Whatley Quarry can be considered to be true elements of the local woodland network is not straightforward. There are clearly factors above and beyond simply the age of the plantations which affect the speed at which woodland species may colonise a plantation; aspect may be a significant factor for the establishment of ground flora, whereas landscape-level connections to other woodlands and potential feeding ground may be important for horseshoe bats.

## **Acknowledgements**

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## Appendices

Appendix 1: ground beetle species list indicating location of trap. FW = Foxhole's Wood.

	FW	P16-17	P18	P31
<i>Abax parallelepipedus</i>	x	x	x	x
<i>Agonum</i> sp.				x
<i>Carabus monilis</i>		x		
<i>Carabus violaceus</i>		x		
<i>Clivina</i> sp.	x			
<i>Nebria refescens</i>		x	x	
<i>Nebria brevicollis</i>	x	x	x	x
<i>Necrophorus investigator</i>			x	
<i>Pterostichus madidus</i>	x			
<i>Pterostichus melanarius</i>	x			x