Cyfoeth Naturiol Cymru
Natural Resources Wales

Brownfield sites and their value for invertebrates – A survey of selected sand quarries in north-east Wales in 2013: Borras Quarry and Marford Quarry

Bryan Formstone and Mike Howe*
*Natural Resources Wales

NRW Evidence Report No. 21

About Natural Resources Wales

Natural Resources Wales is the organisation responsible for the work carried out by the three former organisations, the Countryside Council for Wales, Environment Agency Wales and Forestry Commission Wales. It is also responsible for some functions previously undertaken by Welsh Government.

Our purpose is to ensure that the natural resources of Wales are sustainably maintained, used and enhanced, now and in the future.

We work for the communities of Wales to protect people and their homes as much as possible from environmental incidents like flooding and pollution. We provide opportunities for people to learn, use and benefit from Wales' natural resources.

We work to support Wales' economy by enabling the sustainable use of natural resources to support jobs and enterprise. We help businesses and developers to understand and consider environmental limits when they make important decisions.

We work to maintain and improve the quality of the environment for everyone and we work towards making the environment and our natural resources more resilient to climate change and other pressures.

Evidence at Natural Resources Wales

Natural Resources Wales is an evidence based organisation. We seek to ensure that our strategy, decisions, operations and advice to Welsh Government and others are underpinned by sound and quality-assured evidence. We recognise that it is critically important to have a good understanding of our changing environment.

We will realise this vision by:

- Maintaining and developing the technical specialist skills of our staff;
- Securing our data and information;
- Having a well resourced proactive programme of evidence work;
- Continuing to review and add to our evidence to ensure it is fit for the challenges facing us; and
- Communicating our evidence in an open and transparent way.

This Evidence Report series serves as a record of work carried out or commissioned by Natural Resources Wales. It also helps us to share and promote use of our evidence by others and develop future collaborations. However, the views and recommendations presented in this report are not necessarily those of NRW and should, therefore, not be attributed to NRW.

Report series:	NRW Evidence Report
Report number:	21
Publication date:	March 2014
Contract number:	
Contractor:	Formstone JB
Contract Manager:	Howe MA
Title:	**Brownfield sites and their value for invertebrates – A survey of selected sand quarries in north-east Wales in 2013: Borras Quarry and Marford Quarry.**
Author(s):	**Formstone JB, Howe MA**
Technical Editor:	Howe MA
Peer Reviewer(s)	Howe MA
Approved By:	Drewett H
Series editor(s):	N/A
Restrictions:	None

Distribution List (core)

NRW Library, Bangor	2
National Library of Wales	1
British Library	1
Welsh Government Library	1
Scottish Natural Heritage Library	1
Natural England Library (Electronic Only)	1

Distribution List (others)

Richard May, NRW (Electronic)	1
Graham Berry, NWWT (Electronic)	1
Matt Shardlow, Buglife (Electronic)	1
Lafarge Tarmac (Electronic)	1
Flintshire County Council, Minerals (Electronic) (Gary Nancarrow & Tom Evans)	1

Recommended citation for this volume:

Formstone JB, Howe MA. 2014. Brownfield sites and their value for invertebrates – A survey of selected sand quarries in north-east Wales in 2013: Borras Quarry and Marford Quarry. NRW Evidence Report No: 21, 28pp. Natural Resources Wales, Bangor.

Contents

List of Figures

List of Tables

1. Crynodeb Gweithredol

Cofnododd arolygon rhywogaethau pryfed Chwarel Borras a Chwarel Marford o Fawrth hyd Awst 2013 gyfansymiau o 162 rhywogaeth yn y cyntaf, a 145 yn yr ail. Mae'r rhain yn cynnwys 14 rhywogaeth dywodgar a 70 rhywogaeth golynnog o Borras, a 8 rhywogaeth dywodgar a 69 rhywogaeth golynnog o Marford. Ar y cyfan, cofnodwyd 26 rhywogaeth dywodgar o bob un chwarel (allan o gyfanswm o 42 a gofnodwyd o bob chwarel dywod yng Nghymru). Cofnodwyd 135 rhywogaeth golynnog o Chwarel Borras a Chwarel Marford hyd yn hyn, a olyga fod y ddwy safle yn gydradd ail wrth ystyried yr amrywiaeth o rywogaethau yng Nghymru. Mae cadw tywod moel a chynefinoedd eraill sydd ar ddechrau'r olyniaeth ecolegol yn hanfodol os yw'r ddwy chwarel i barhau i gynnal y cynulliadau hyn o anifeiliaid di-asgwrn-cefn, sydd o bwys cenedlaethol.

Mae'r gwaith arolygu presennol wedi pwysleisio pwysigrwydd y cynulliad pryfed colynnog pren marw yn chwarel Marford, gan gynnwys y cofnod cyntaf yng Nghymru o'r wenynen *Crossocerus distinguendus*, sydd fel arfer yn byw ar ei phen ei hun. Cofnodwyd 36 rhywogaeth yno hyd yn hyn (o gymharu ag 20 rhywogaeth yn Chwarel Borras). Tynnir sylw at adael i bren marw sefyll (coed llwyfen a helyg, yn enwedig), ac argymhellir gwella'r adnodd.

Dylid ceisio canfod poblogaethau o rywogaethau tywodgar a phren marw nas cofnodwyd yn ystod y tair blynedd ar ddeg ddiwethaf.

2. Executive Summary

Surveys of the insect faunas of Borras Quarry and Marford Quarry from March to August 2013 recorded totals of 162 species and 145 species respectively. These included 14 psammophilic and 70 aculeate species from Borras, and eight psammophilic and 69 aculeate species from Marford. Overall, 26 psammophilic species have now been recorded from each quarry (out of a total of 42 recorded from all Welsh sand quarries). 135 aculeate species have been recorded from both Borras Quarry and Marford Quarry to date, ranking them the 2nd most species-rich sites in Wales. The maintenance of bare sand and other early-successional habitats is critical if the two quarries are to continue to support these nationally-important invertebrate faunas.

The current survey work has emphasized the importance of the dead-wood aculeate fauna at Marford Quarry, including a 1st Welsh record of the solitary wasp *Crossocerus distinguendus*, with 36 species being recorded to date (compared to 20 species at Borras Quarry). The retention of standing dead wood, particularly elm and sallow, is highlighted and recommendations are made to enhance the resource.

Efforts should be made to locate populations of psammophilic and dead-wood species which have not been recorded over the last 13 years.

3. Introduction

3.1. Background

Sand quarries provide ideal habitats for invertebrate species associated with sand and with early-successional habitats such as bare and partially-vegetated ground (Key 2000), pioneer and ruderal plant communities, and scrub. An additional suite of species is associated with hydrological features such as shallow pools, seepages, small stands of reeds and other emergents if these are present. This rich variety of habitats also offers a very heterogeneous landscape, critical to the life cycles of many invertebrates. Key invertebrate groups associated with sand quarry habitats include beetles (ground beetles, phytophagous species), flies (robberflies, soldierflies, hoverflies, picture-winged flies), aculeate bees and wasps, heteropteran bugs, moths and spiders. Butterflies can include the dingy skipper *Erynnis tages* and, occasionally, grizzled skipper *Pyrgus malvae*.

Sand quarries are very localized in Wales, with a handful near Cardigan in south Ceredigion (Banc y Warren Quarry SN202486) and north Pembrokeshire, and one or two near Bryncir (between Caernarfon and Porthmadog). By far the greatest concentration occurs in north-east Wales (vice-counties Flintshire and Denbighshire) (Figure 1), with clusters found to the immediate north and east of Wrexham (Ballswood Quarry [SJ349563], Borras Quarry [SJ362526], Fagl Lane Quarry [SJ300588], Marford Quarry [SJ357560]) and between Bodfari and Mold (Caerwys Tufa Quarry [SJ129718], Ddol Sand Pit [SJ137714], Fron Haul Quarry [SJ157707], Maes-mynan Quarry [SJ122720], Rhosesmor Quarry [SJ215670]). Their importance for wildlife has long been recognized (Day & Deadman, 1981) culminating in the protection of Marford Quarry as a SSSI for its psammophilic invertebrate assemblage and for wild liquorice *Astragalus glycophyllus*, and now part-owned and managed by the North Wales Wildlife Trust.

A CCW-commissioned survey in 1994 looked at the invertebrate interest of several Clwyd sand quarries and identified habitat conditions and threats (Edwards 1994). This work was based largely on sites previously surveyed by one of the authors (Bryan Formstone - JBF) who has been visiting some of the key quarry sites for invertebrates over the last 22 years. By 2005, 105 species of aculeate bees, wasps and ants had been recorded from Marford Quarry and 94 species from Borras Quarry (Formstone, 2005), including the spider-hunting wasp *Arachnospila minutula* and the solitary bee *Sphecodes reticulatus* as new to Wales. Since then, totals have increased to 118 species and 95 species for Marford Quarry and Borras Quarry respectively (JBF pers. obs.). Recent analysis of invertebrate records from Welsh sand quarries by NRW has highlighted that 42 species are restricted to sandy substrates, including 28 species of aculeates (see Appendix A), and identified key sites to be Ballswood Quarry, Borras Quarry, Marford Quarry and Banc y Warren Quarry.

Given the importance of sand quarries to invertebrates and other wildlife species and habitats (Buglife 2009; Davies 2007; Whitehouse 2008), sites can be lost all too easily to unsympathetic restoration schemes once a quarry comes to end of its working life. Planning conditions can require that they are returned to agriculture or landscaped for more amenity purposes, and some are used as land-fill sites. In

northeast Wales, the invertebrate interest at Alyn Waters (SJ328552), Maes-mynan (old) Quarry (SJ113723), Star Crossing Quarry (SJ099710) and Warren sand-pit (SJ099710) has been mostly lost over the last 20 years, and Pentir Quarry (SH578674), an isolated quarry on the outskirts of Bangor, Gwynedd has been completely lost to agricultural restoration. Disused quarries not subjected to restoration schemes can also be lost to succession, with scrub and secondary woodland invading open ground. If disused sand quarries are going to retain their wildlife interest, periodic intervention to restore early-successional conditions is required.

3.2. Objectives

The aims of this 2-year project are to identify which sand quarries currently support suitable conditions for invertebrates, focusing on sites in north-east Wales, to identify the key sites and to make recommendations for securing long-term sympathetic management of key sites. In 2012, surveys were undertaken at Borras Quarry, Fagl Lane Quarry and Fron Haul Quarry in 2012 (Formstone & Howe 2013). In 2013, the intention was to survey Ballswood Quarry and Rhosesmor Quarry but, in the absence of access permissions, further work was carried out at Borras Quarry and a survey of Marford Quarry was undertaken.

4. Methods

Borras Quarry (VC50: SJ364523) and Marford Quarry (VC50: SJ357562) were each visited by JBF on several occasions between April and August, ideally in warm, sunny conditions, to record the invertebrates present, focussing particularly on aculeate bees, wasps and ants, beetles and flies. Sampling techniques included visual searches, sweep-netting, pitfall-trapping and water-trapping. A list of the invertebrates recorded at each site has been produced, and a description of the key invertebrate habitats present and their current condition has been made, including a photographic record.

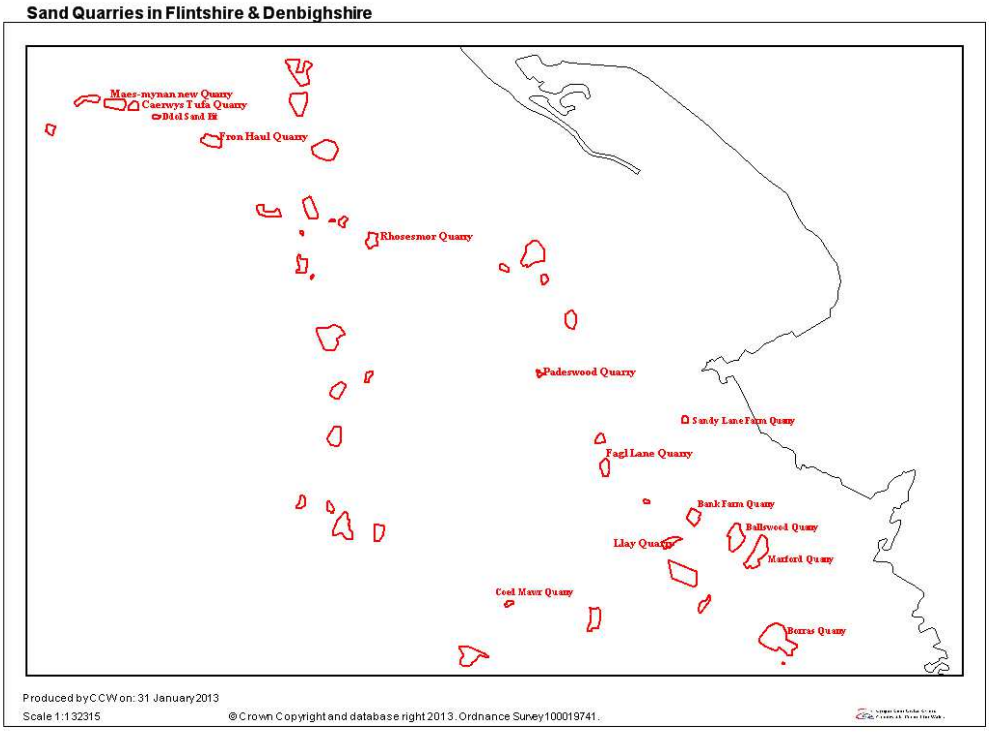

Figure 1: Sand & gravel quarries in Flintshire and Denbighshire, including the three study sites. Note that the figure includes some limestone quarries.

5. Results

The spring of 2013 was one of the coldest in recent years, and it wasn't until the end of April and early May before the temperatures rose high enough for invertebrate, and particularly aculeate, activity. The weather remained cool and changeable until late July/early August, with August at least staying relatively warm and settled. As with previous years, this undoubtedly had an impact upon invertebrate populations and the number of species found at each site. Although attempts were made to visit only during spells of sunny weather, this was not always possible.

A total of 246 insect species was recorded from the two sites, of which the majority was bees & wasps and flies (Table 1), and including 104 species of aculeate bees, wasps and ants (Table 3). There are records of 26 psammophilic species (as identified from the inventory maintained by NRW invertebrate ecologists) from each quarry, although only 14 and eight were recorded from Borras Quarry and Marford Quarry respectively in 2013 (Table 2). Overall, a total of 32 psammophilic species (3 beetles, 3 flies and 25 aculeates) has now been recorded from the two quarries, with 15 species recorded in 2012, and a total of 175 aculeate species (Table 3 & Appendix D).

Table 1: Number of invertebrate species recorded from the two sand quarries surveyed in 2013.

Order	No. Species	Borras Quarry	Marford Quarry
Odonata	5	4	3
Orthoptera	1	-	1
Trichoptera	1	1	-
Hemiptera	3	-	3
Coleoptera	25	19	12
Carabidae	14	13	5
Lepidoptera	37	31	20
Butterflies	18	14	12
Moths	19	17	8
Diptera	50	28	28
Syrphidae	28	16	18
Hymenoptera	119	79	74
Sawflies	9	4	5
Parasitica	9	5	4
Aculeates	101	70	69
TOTAL	**243**	**162**	**145**

Table 2: Psammophilic species recorded at the two sand quarries in 2013 (indicated by X). Pre-2013 records are included but not incorporated into the total figures.

Species	Order	Family	Status	Borras Quarry	Marford Quarry
Calathus mollis	Coleoptera	Carabidae	Local	2012	
Amara fulva	Coleoptera	Carabidae	Notable/Nb	2012	
Amara tibialis	Coleoptera	Carabidae	Local	**X**	
Philopedon plagiatum	Coleoptera	Curculionidae	Local		1996
Dysmachus trigonus	Diptera	Asilidae	Local		1997
Acrosathe annulata	Diptera	Therevidae	Local	2012	1995
Senotainia conica	Diptera	Sarcophagidae	Local	2012	2011
Hedychridium ardens	Hymenoptera	Chrysididae	Common	**X**	**X**
Arachnospila trivialis	Hymenoptera	Pompilidae	Local	**X**	2011
Ceropales maculata	Hymenoptera	Pompilidae	Local		2011
Episyron rufipes	Hymenoptera	Pompilidae	Local	**X**	
Pompilus cinereus	Hymenoptera	Pompilidae	Local	**X**	**X**
Cerceris arenaria	Hymenoptera	Crabronidae	Common	2012	**X**
Crabro peltarius	Hymenoptera	Crabronidae	Local	**X**	2000
Crossocerus quadrimaculatus	Hymenoptera	Crabronidae	Common	**X**	**X**
Crossocerus wesmaeli	Hymenoptera	Crabronidae	Common	**X**	2000
Diodontus luperus	Hymenoptera	Crabronidae	Local	**X**	2000
Diodontus minutus	Hymenoptera	Crabronidae	Common	Pre-2012	1994

Diodontus tristis	Hymenoptera	Crabronidae	Local		1997
Harpactus tumidus	Hymenoptera	Crabronidae	Local	2012	2000
Mellinus arvensis	Hymenoptera	Crabronidae	Common	**X**	**X**
Mimesa equestris	Hymenoptera	Crabronidae	Common	1990	
Mimesa lutaria	Hymenoptera	Crabronidae	Common		1994
Nysson dimidiatus	Hymenoptera	Crabronidae	Notable/Nb	Pre-2012	2011
Philanthus triangulum	Hymenoptera	Crabronidae	RDB2		2000
Tachysphex pompiliformis	Hymenoptera	Crabronidae	Local	**X**	2011
Ammophila sabulosa	Hymenoptera	Sphecidae	Local	1990	1995
Andrena barbilabris	Hymenoptera	Andrenidae	Local	**X**	**X**
Colletes cunicularius	Hymenoptera	Colletidae	RDB3	**X**	**X**
Colletes fodiens	Hymenoptera	Colletidae	Common	2012	
Sphecodes pellucidus	Hymenoptera	Halictidae	Local	**X**	**X**
Megachile maritima	Hymenoptera	Megachilidae		2012	2011
				14 spp	**8 spp**

Table 3: Aculeate species recorded from the two sand quarries. During the 2013 survey, six species were recorded for the first time at Borras Quarry and 18 species at Marford Quarry.

	Borras Quarry	Marford Quarry	Total
Chrysididae	6	6	9
Formicidae	6	8	9
Mutillidae	1	1	1
Pompilidae	11	11	15
Sapygidae	0	1	1
Tiphiidae	1	1	1
Vespidae	7	9	11
Crabronidae	28	35	42
Sphecidae	1	1	1
Andrenidae	15	13	16
Apidae	20	18	23
Colletidae	7	4	8
Halictidae	22	14	24
Megachilidae	10	13	14
TOTAL	**135**	**135**	**175**

5.1. Borras Quarry (VC50: SJ364523)

At 80ha, Borras Quarry is the largest sand and gravel quarry in Wales. Lying to the immediate east of Wrexham, it is one of a cluster of important sand quarries for invertebrates, with Marford Quarry, Ballswood Quarry and Fagl Lane Quarry found 3km, 3.5km and 8km respectively to the north.

The large areas of the quarry that are actively quarried for sand and gravel at the moment (Figure 2) are currently of very limited invertebrate interest. However, the quarry margins and old workings support areas of bare ground amongst extensive areas of early-successional, flower-rich grassland and are key to the rich aculeate

fauna found at Borras Quarry, and a series of freshwater pools, some with dense emergent vegetation, also supports significant invertebrate interest (see Formstone & Howe 2013 for images of these habitats).

Following the extensive survey work in 2012 (Formstone & Howe 2013), fieldwork continued in 2013 with JBF visiting the site on 17 occasions between 3rd April and 29th August. A total of 162 insect species was recorded (Appendix B), including 70 aculeate species (Table 1) and 14 psammophilic species (Table 2). With the addition of six new aculeates to the site (Table 4), the list for Borras Quarry now stands at 135 species (Table 3).

Figure 2: Borras Quarry in 2009 (supplied to CCW by Infoterra).

Table 4: The six aculeate species recorded new to Borras Quarry in 2013. Species in blue nest in dead wood.

Species	Common name	Family	UK Status
Crossocerus ovalis	a solitary wasp	Crabronidae	Local
Crossocerus tarsatus	a solitary wasp	Crabronidae	Common
Andrena angustior	a mining bee	Andrenidae	Local
Andrena cineraria	Grey Mining Bee	Andrenidae	Local
Bombus sylvestris	Four Coloured Cuckoo Bee	Apidae	Common
Osmia leaiana	A mason bee	Megachilidae	Common

Table 5: Nationally Rare and Scarce species recorded at Borras Quarry in 2013. The species in red is psammophilous.

Species	Common name	Order	Family	UK Status
Colletes cunicularius	Vernal Bee	Hymenoptera	Colletidae	RDB3
Hippodamia variegata	Adonis' Ladybird	Coleoptera	Coccinelidae	Nationally Scarce
Cucullia lychnitis	Striped Lychnis	Lepidoptera	Noctuidae	Nationally Scarce
Bembecia ichneumoniformis	Six-belted Clearwing	Lepidoptera	Sesiidae	Notable/Nb

Water traps and pitfall traps were set out in early May, but were nowhere near as attractive to aculeates and Coleoptera as in 2012. Interference to the traps was much greater than in 2012, with almost every pitfall dug up by the next visit. The watertraps fared little better, and they were often found overturned or on their sides with little contents left. Despite these setbacks, good numbers of the Vernal Bee *Colletes cunicularius* were seen in late April (some 300 to 400 adults), and the spider-hunting wasp *Episyron rufipes*, a psammophilic species, was recorded for the first time since 1996. Visits in May provided 1st records for *Andrena angustior* and *Bombus sylvestris*, and *Spinolia neglecta* was still at its only North Wales locality. *Crossocerus tarsatus*, *C. ovalis* and *Osmia leaiana* were all found new to Borras Quarry, netted from foliage in an area of the quarry where sapling sallows and alders have gained a foothold. Only four Nationally Rare and Scarce species were recorded (Table 5).

It was good to see at least 60 occupied sand martin nest holes in a ravine where they were safe from quarrying.

5.2. Marford Quarry (VC50: SJ357562)

The old workings at Marford Quarry covered an area of approximately 43ha, although more than half of the site (26ha) is now covered in conifer woodland. The SSSI is 16.26ha. It is one of a cluster of important sand quarries for invertebrates, with the neighbouring Ballswood Quarry just 0.7km to the west (Figure 3), and Borras Quarry lying 3km to the south. Whilst the SSSI is part-owned and managed by the North Wales Wildlife Trust (NWWT), open sandy areas are at a premium and there is a continual need to keep succession in check, and this is currently being addressed as part of an updated Management Agreement between NWWT and NRW. The clearance of scrub and trees needs to be tempered with the requirement to provide a variety of nectar and pollen sources - gorse may be an important source although much is currently leggy and over-mature – and the fact that Marford Quarry supports an important assemblage of aculeate species which nest in either standing dead wood or in old fence posts.

Marford Quarry was visited on 20 occasions between 29th March and 29th August 2013. A total of 145 insect species was recorded (Appendix C), including 69 aculeate species (Table 1) and seven psammophilic species (Table 2). With the addition of 18 new aculeates to the site (Table 6), the list for Marford Quarry now stands at 135 species (Table 3).

The cold spring delayed insect emergence and aculeate activity did not really begin until early May, with *Sphecodes monilicornis* recorded for a second time at Marford Quarry towards the end of the month, having been recorded here in 2011. Six aculeate species were found for the first time in June (Table 6), including *Monosapyga clavicornis* (two at the base of a dead wych elm), its likely host *Chelostoma florisomne* (also in dead elms), *Symmorphus gracilis*, *Crossocerus tarsatus* (at dead elms), *Osmia aurulenta* and *Bombus sylvestris*. This is probably a 2nd record of *M. clavicornis* in north Wales, having been previously recorded from Sontley Moor, Erddig in 1990. *S. gracilis* was netted from one of the only figwort plants in the quarry where it will have been looking for the weevil *Cionus scrophulariae* with which it provisions its nests.

A further nine species new to the quarry were recorded in July, three of which were nesting in the dead elms - *Crossocerus podagricus*, *Ectemnius lapidarius* (scarce in north Wales) and *Crossocerus distinguendus* – and *Pseudomalus auratus* will parastise deadwood-nesting solitary wasps. A male of *C. distinguendus* provided a 1st Welsh record, with a further 2 males netted in the following weeks. *Cerceris arenaria* was an important additon to the psammophilous fauna, *Lasioglossum parvulum* and *Colletes succinctus* were netted from ragwort, and the finding of *Andrena flavipes* was not too surprising, having been recorded new to Denbighshire from Borras Quarry in 2012 (Formstone & Howe 2013). It was pleasing to re-find *Stelis ornatula* on 12th July, having been previously recorded for the first time in north Wales at Marford Quarry in 2011 (Table 7). A single worker of the wasp *Dolichovespula saxonica* was also recorded on 12th July, following records at Fagl Lane Quarry and Fron Haul Quarry in 2012 (Formstone & Howe 2013). August added three new aculeate species, all associated with dead wood. *Ectemnius cavifrons* was found nesting in an old sallow stump, and *Ancistrocerus nigricornis* and *Crossocerus annulipes* were nesting in dead elms.

Whilst the only addition to the psammophilic fauna in 2013 was *C. arenaria*, the survey has highlighted the importance of the dead-wood fauna at Marford Quarry, with the addition of 11 aculeate species and the black-headed cardinal beetle *Pyrochroa coccinea* (Tables 6 & 7), which breeds under damp, rotten bark of large dead trees. Of the 40 aculeates associated with dead wood recorded from the two quarries, 36 species have been recorded at Marford Quarry and 20 at Borras Quarry. This reflects the successional state of the disused quarry and the presence of climax vegetation compared with the pioneer conditions offered within the working quarry. The dead-wood species at Marford Quarry are mostly associated with just a handful of rotting elm and sallow trees (see Appendix E for images) and it is important that these are retained if the fauna is to be maintained at the site. Indeed, the amount of available habitat could be easily enhanced by the erection of old fence posts or sections of old, rotten wood. These could be erected in sunny, quieter parts of the quarry, and have dead elm or sallow wired or bolted to them, perhaps from the dead elms by the Springfield Lane entrance to the quarry which will need felling as they are over the footpath. They would be colonised quickly if differing size holes were drilled into them, angled slightly uphill to prevent water entry. An alternative would be to sacrifice currently healthy trees in open, sunny positions by herbicide injection.

Figure 3: Marford Quarry and Ballswood Quarry in 2009 (supplied to CCW by Infoterra).

Table 6: The 18 aculeate species recorded new to Marford Quarry in 2013. Species in red are psammophilous, those in blue are dead-wood nesters.

Species	Common name	Family	UK Status
Pseudomalus auratus	a rubytail wasp	Chrysididae	Local
Monosapyga clavicornis	Club-horned Sapyga	Sapygidae	Nationally Scarce
Ancistrocerus nigricornis	a potter wasp or mason wasp	Vespidae	Local
Dolichovespula saxonica	a social wasp	Vespidae	RDB K
Symmorphus gracilis	a potter wasp or mason wasp	Vespidae	Local
Cerceris arenaria	Sand Tailed Digger Wasp	Crabronidae	Common
Crossocerus annulipes	a solitary wasp	Crabronidae	Common
Crossocerus distinguendus	a solitary wasp	Crabronidae	Nationally Scarce
Crossocerus podagricus	a solitary wasp	Crabronidae	Common
Crossocerus tarsatus	a solitary wasp	Crabronidae	Common
Ectemnius cavifrons	a solitary wasp	Crabronidae	Common
Ectemnius lapidarius	a solitary wasp	Crabronidae	Local
Andrena flavipes	Yellow Legged Mining Bee	Andrenidae	Local
Bombus sylvestris	Four Coloured Cuckoo Bee	Apidae	Common
Colletes succinctus	a solitary bee	Colletidae	Local
Lasioglossum parvulum	a solitary bee	Halictidae	Common
Chelostoma florisomne	Sleepy Carpenter Bee	Megachilidae	Local
Osmia aurulenta	Gold-fringed Mason Bee	Megachilidae	Local

Table 7: Nationally Rare and Scarce species recorded at Marford Quarry in 2013. *Crossocerus distinguendus* is new to Wales. Species in red are psammophilous, those in blue are dead-wood nesters or are saproxylic.

Species	Common name	Order	Family	UK Status
Colletes cunicularius	Vernal Bee	Hymenoptera	Colletidae	RDB3
Stelis ornatula	a cuckoo bee	Hymenoptera	Megachilidae	RDB3
Dolichovespula saxonica	a social wasp	Hymenoptera	Vespidae	RDB K
Pyrochroa coccinea	Black-headed Cardinal Beetle	Coleoptera	Pyrochroidae	Nationally Scarce
Strymonidia w-album	White Letter Hairstreak	Lepidoptera	Lycaenidae	Nationally Scarce
Cucullia lychnitis	Striped Lychnis	Lepidoptera	Noctuidae	Nationally Scarce
Chorisops nagatomii	a soldierfly	Diptera	Stratiomyidae	Nationally Scarce
Platycheirus podagratus	a hoverfly	Diptera	Syrphidae	Nationally Scarce
Arachnospila minutula	a spider-hunting wasp	Hymenoptera	Pompilidae	Nationally Scarce
Monosapyga clavicornis	Club-horned Sapyga	Hymenoptera	Sapygidae	Nationally Scarce
Crossocerus distinguendus	a solitary wasp	Hymenoptera	Crabronidae	Nationally Scarce

6. Discussion

The 2013 survey work has made a significant contribution to our knowledge of the insect faunas of both quarry sites. Whilst only a single new psammophilic species was recorded – *Cerceris arenaria* to Marford Quarry – the survey has confirmed the continued presence of a number of significant sand-loving species such as *Episyron rufipes* at Borras Quarry, where it was last recorded in 1996. A total of 26 psammophilic species has now been recorded at each site (Table 8). The total number of aculeate species recorded at each site is impressive (Table 8) and both Borras Quarry and Marford Quarry currently rank 2nd in Wales in terms of species numbers (Table 9). The invertebrate faunas at both quarries are of national importance.

Whilst it is critical to continue to provide pioneer conditions for the invertebrate and pasmmophilic faunas at Marford Quarry, the current survey has highlighted the importance of dead-wood fauna, and particularly dead-wood nesting aculeate species, and the need to retain standing dead wood. Indeed, it is recommended that the presence of dead wood is enhanced by the erection of old posts, sections of rotten wood or stem-injecting currently healthy trees.

Although both quarries support exceptional aculeate faunas, several species have not been found in recent years. There are no post-2000 records for 22 species (16% of the fauna) at Borras Quarry and 31 species (23%) at Marford Quarry, including some psammophilic and dead wood species (Table 10).

Table 8: Numbers of psammophilic, aculeate and dead-wood aculeate species recorded at Borras Quarry and Marford Quarry.

	Borras Quarry	Marford Quarry
Psammophilic species	26	26
Aculeate species	135	135
Dead-wood aculeate species	20	36

Table 9: Welsh sites supporting more than 100 species of aculeate bees, wasps and ants. Sites in bold are quarries in north-east Wales. Data from Howe *et al*. (2008, 2010) and Pavett (2005) augmented by data held by NRW.

Site	Number of aculeate species
Horton Cliffs	177
Borras Quarry	**135**
Marford Quarry	**135**
Merthyr Mawr Warren	134
Pembrey Coast	134
Oxwich Burrows	123
Gronant Dunes & Talacre Warren	111
Llangennith Burrows	109
Whiteford Burrows	107
Brownslade & Linney Burrows	102

Table 10: Aculeate species not recorded since 2000. Psammophilic species are highlighted in red, dead-wood species in blue.

Species	Borras Quarry	Marford Quarry
Chrysis ruddii	1992	No record
Pseudomalus violaceus	No record	1995
Anoplius concinnus		2000
Arachnospila anceps		1997
Ceropales maculata	1993	
Priocnemis coriacea	No record	1997
Priocnemis exaltata	1999	1994
Priocnemis susterai	No record	2000
Tiphia minuta	2000	1995
Ancistrocerus oviventris	1993	No record
Ancistrocerus trifasciatus	1999	
Symmorphus gracilis	1992	
Vespula rufa	No record	1997
Argogorytes mystaceus	No record	1994
Crabro peltarius		2000
Crossocerus cetratus	1994	
Crossocerus dimidiatus		1997
Crossocerus elongatulus	1993	No record
Crossocerus quadrimaculatus		2000

Crossocerus varus	1999	No record
Crossocerus wesmaeli		2000
Diodontus luperus		2000
Diodontus minutus	2000	1994
Diodontus tristis	No record	1997
Ectemnius cephalotes	No record	2000
Ectemnius continuus	1994	
Harpactus tumidus		2000
Mimesa lutaria	No record	1994
Nysson spinosus	No record	2000
Passoloecus gracilis	1997	No record
Passoloecus singularis		1995
Pemphredon inornatus	No record	1994
Rhopalum coarctatum	1995	1997
Ammophila sabulosa		1994
Andrena semilaevis		1995
Andrena subopaca	1998	
Anthophora furcata	No record	2000
Bombus ruderarius	2000	No record
Nomada integra	1990	No record
Hylaeus brevicornis		2000
Halictus tumulorum	1991	1995
Lasioglossum nitidiusculum	No record	1995
Sphecodes crassus	1994	1994
Sphecodes reticulatus	2000	No record
Megachile centuncularis	1994	
Megachile willughbiella		2000
Stelis phaeoptera	1997	

7. Recommendations

Invertebrate surveys should continue at both quarries, with a particular focus on re-finding species with no post-2000 records. As well as providing pioneer conditions at Marford Quarry, areas of standing dead wood should be retained and enhanced to safeguard breeding sites for dead-wood aculeates.

The most pressing matter is to assess the current fauna at Ballswood Quarry and further attempts should be made to gain access to Ballswood in 2014.

8. Acknowledgements

The authors thank the North Wales Wildlife Trust for allowing access to Marford Quarry and Lafarge Tarmac for access to Borras Quarry and continued interest in the invertebrate survey work.

9. References

Buglife. 2009. Planning for brownfield biodiversity: a best practice guide. Buglife – The Invertebrate Conservation Trust, Peterborough.

Davies, A. 2007. Nature after Minerals: a major role for quarries in nature conservation. British Wildlife, **18** (5): 305-312.

Day, P, Deadman, A. 1981. The nature conservation interest and importance of derelict land in north Wales. Nature in Wales, **17**: 230-240.

Edwards, M. 1994. Survey of Clwyd sand quarries, with particular reference to their bee, wasp and ant faunas, 4-11 August 1994. CCW Contract Science. **116**. Countryside Council for Wales.

Formstone, JB. 2005. Bees, wasps and ants recorded from Marford and Borras Quarries, Wrexham (VC50 Denbighshire), between 1990 and 2005. Journal of the Lancashire & Cheshire Entomological Society, **129**: 9-24.

Formstone, JB. 2008. Fagl Lane Quarry, Flintshire. Unpublished report of an entomological visit in September 2008.

Formstone, JB, Howe, MA. (2013). Brownfield sites and their value for invertebrates – A survey of selected sand quarries in north-east Wales in 2012. CCW Contract Science. **1020**. Countryside Council for Wales, Bangor.

Howe, MA, Knight, GT, Clee, C. 2010. The importance of coastal sand dunes for the terrestrial invertebrates in Wales and the UK, with particular reference to aculeate bees, wasps and ants. Journal of Coastal Conservation **14**: 91-102.

Howe, MA, Whitehouse, A, Knight, GT. 2008. Life on the edge - key coastal soft cliffs for invertebrates in England and Wales. British Wildlife **19**(3): 172-181.

Key, R. 2000. Bare ground and the conservation of invertebrates. British Wildlife, **11**: 183-191.

Pavett, PM. 2005. The aculeate Hymenoptera of Horton National Nature Reserve, Gower, west Wales. British Journal of Entomology and Natural History **18**: 213-217.

Whitehouse, AT. 2008. Managing aggregates sites for invertebrates: a best practice guide. Buglife - The Invertebrate Conservation Trust, Peterborough.

10. Appendices

10.1. Appendix A: Psammophilic invertebrate species recorded from Welsh sand quarries. Of the 42 species, 28 are aculeates. Note that the list in Formstone & Howe (2013) overlooked four species – *Calathus mollis*, *Cerceris arenaria*, *Colletes fodiens* and *Mimesa equestris* – and erroneously included the spider-hunting wasp *Evagetes dubius.*

Species	**Order**	**Family**	**UK Status**
Calathus cinctus	Coleoptera	Carabidae	Local
Calathus mollis	Coleoptera	Carabidae	Local
Amara fulva	Coleoptera	Carabidae	Notable/Nb
Amara tibialis	Coleoptera	Carabidae	Local
Bledius opacus	Coleoptera	Staphylinidae	Local
Tachyusa scitula	Coleoptera	Staphylinidae	pRDBK
Philopedon plagiatum	Coleoptera	Curculionidae	Local
Ceutorhynchus atomus	Coleoptera	Curculionidae	Na
Lithostege griseata	Lepidoptera	Geometridae	RDB3
Dysmachus trigonus	Diptera	Asilidae	Local
Philonicus albiceps	Diptera	Asilidae	Local
Acrosathe annulata	Diptera	Therevidae	Local
Trixoscelis obscurella	Diptera	Heleomyzidae	Local
Senotainia conica	Diptera	Sarcophagidae	Local
Hedychridium ardens	Hymenoptera	Chrysididae	Common
Anoplius infuscatus	Hymenoptera	Pompilidae	Local
Arachnospila trivialis	Hymenoptera	Pompilidae	Local
Episyron rufipes	Hymenoptera	Pompilidae	Local
Ceropales maculata	Hymenoptera	Pompilidae	Local
Pompilus cinereus	Hymenoptera	Pompilidae	Local
Cerceris arenaria	Hymenoptera	Crabronidae	Common
Crabro peltarius	Hymenoptera	Crabronidae	Local
Crossocerus quadrimaculatus	Hymenoptera	Crabronidae	Common
Crossocerus wesmaeli	Hymenoptera	Crabronidae	Common
Diodontus luperus	Hymenoptera	Crabronidae	Local
Diodontus minutus	Hymenoptera	Crabronidae	Common
Diodontus tristis	Hymenoptera	Crabronidae	Local
Entomognathus brevis	Hymenoptera	Crabronidae	Local
Harpactus tumidus	Hymenoptera	Crabronidae	Local
Mellinus arvensis	Hymenoptera	Crabronidae	Common
Mimesa equestris	Hymenoptera	Crabronidae	Common
Mimesa lutaria	Hymenoptera	Crabronidae	Common
Nysson dimidiatus	Hymenoptera	Crabronidae	Notable/Nb
Philanthus triangulum	Hymenoptera	Crabronidae	RDB2
Tachysphex pompiliformis	Hymenoptera	Crabronidae	Local
Ammophila sabulosa	Hymenoptera	Sphecidae	Local
Podalonia hirsuta	Hymenoptera	Sphecidae	Notable/Nb
Andrena barbilabris	Hymenoptera	Andrenidae	Local
Colletes cunicularius	Hymenoptera	Colletidae	RDB3
Colletes fodiens	Hymenoptera	Colletidae	Common
Sphecodes pellucidus	Hymenoptera	Halictidae	Local
Megachile maritima	Hymenoptera	Megachilidae	

10.2. Appendix B: Insect species recorded at Borras Quarry in 2013. The fourteen psammophilic species are highlighted in red; dead-wood species are in blue.

Species	Common Name	Order	Family	Status
Pyrrhosoma nymphula	Large Red Damselfly	Odonata	Coenagrionidae	Common
Ischnura elegans	Blue-tailed Damselfly	Odonata	Coenagrionidae	Common
Coenagrion puella	Azure Damselfly	Odonata	Coenagrionidae	Common
Sympetrum striolatum	Common Darter	Odonata	Libellulidae	Common
Brachycentrus subnubilus	a caddisfly	Trichoptera	Brachycentridae	Common
Cicindela campestris	Green Tiger Beetle	Coleoptera	Carabidae	Common
Dyschirius politus	a ground beetle	Coleoptera	Carabidae	Local
Poecilus versicolor	a ground beetle	Coleoptera	Carabidae	Local
Pterostichus madidus	Black Clock	Coleoptera	Carabidae	Common
Anchomenus dorsalis	a ground beetle	Coleoptera	Carabidae	Common
Calathus fuscipes	a ground beetle	Coleoptera	Carabidae	Common
Amara aenea	Common Sun Beetle	Coleoptera	Carabidae	Common
Amara communis	a ground beetle	Coleoptera	Carabidae	Common
Amara ovata	a ground beetle	Coleoptera	Carabidae	Common
Amara tibialis	a ground beetle	Coleoptera	Carabidae	Local
Harpalus affinis	a ground beetle	Coleoptera	Carabidae	Common
Harpalus rubripes	a ground beetle	Coleoptera	Carabidae	Local
Syntomus foevatus	a ground beetle	Coleoptera	Carabidae	Common
Cytilus sericeus	a pill beetle	Coleoptera	Byrrhidae	Local
Athous haemorrhoidalis	a click beetle	Coleoptera	Elateridae	Common
Hippodamia variegata	Adonis' Ladybird	Coleoptera	Coccinelidae	Nationally Scarce
Coccinella 7-punctata	Seven-spot Ladybird	Coleoptera	Coccinelidae	Common
Malachius bipustulatus	Malachite Beetle	Coleoptera	Melyridae	Common
Oedemera lurida	a thick-legged flower beetle	Coleoptera	Oedemeridae	Common
Thymelicus sylvestris	Small Skipper	Lepidoptera	Hesperidae	Common
Erynnis tages	Dingy Skipper	Lepidoptera	Hesperidae	Local
Pieris brassicae	Large White	Lepidoptera	Pieridae	Common
Pieris rapae	Small White	Lepidoptera	Pieridae	Common
Pieris napi	Green-veined White	Lepidoptera	Pieridae	Common
Anthocharis cardamines	Orange-tip	Lepidoptera	Pieridae	Common
Polyommatus icarus	Common Blue	Lepidoptera	Lycaenidae	Common
Aglais urticae	Small Tortoiseshell	Lepidoptera	Nymphalidae	Common
Inachis io	Peacock	Lepidoptera	Nymphalidae	Common
Hipparchia semele	Grayling Butterfly	Lepidoptera	Satyridae	Local
Pyronia tithonus	Gatekeeper	Lepidoptera	Satyridae	Common
Maniola jurtina	Meadow Brown	Lepidoptera	Satyridae	Common
Coenonympha pamphilus	Small Heath	Lepidoptera	Satyridae	Common
Aphantopus hyperantus	Ringlet	Lepidoptera	Satyridae	Common
Adela reaumurella	a longhorn moth	Lepidoptera	Incarvaridae	Common
Phyllonorycter viminella	a micro-moth	Lepidoptera	Gracillariidae	Local
Anthophila fabriciana	Nettle-tap	Lepidoptera	Choreutidae	Common
Agriphila latistria	White-streak Grass-veneer	Lepidoptera	Pyralidae	Local
Pyrausta purpuralis	Common Purple & Gold	Lepidoptera	Pyralidae	Local
Zygaena filipendulae	Six-spot Burnet	Lepidoptera	Zygaenidae	Common
Zygaena lonicerae	Narrow-bordered Five-spot Burnet	Lepidoptera	Zygaenidae	Common
Bembecia ichneumoniformis	Six-belted Clearwing	Lepidoptera	Sesiidae	Nationally Scarce
Xanthorhoe montanata	Silver-ground Carpet	Lepidoptera	Geometridae	Common
Camptogramma bilineata	Yellow Shell	Lepidoptera	Geometridae	Common
Perizoma flavofasciata	Sandy Carpet	Lepidoptera	Geometridae	Common
Aplocera plagiata	Treble Bar	Lepidoptera	Geometridae	Local
Hecatera bicolorata	Broad-barred White	Lepidoptera	Noctuidae	Common
Hadena bicruris	Lychnis	Lepidoptera	Noctuidae	Common
Cucullia lychnitis	Striped Lychnis	Lepidoptera	Noctuidae	Nationally Scarce
Panemeria tenebrata	Small Yellow Underwing	Lepidoptera	Stiriinae	Local
Autographa gamma	Silver Y	Lepidoptera	Plusiinae	Common
Nephrotoma appendiculata	a cranefly	Diptera	Tipulidae	Common

Nephrotoma flavescens	a cranefly	Diptera	Tipulidae	Common
Nephrotoma flavipalpis	a cranefly	Diptera	Tipulidae	Local
Nephrotoma scurra	a cranefly	Diptera	Tipulidae	Local
Tipula oleracea	a cranefly	Diptera	Tipulidae	Common
Dicranomyia mitis	a cranefly	Diptera	Limoniidae	Common
Dicranomyia morio	a cranefly	Diptera	Limoniidae	Local
Neiotamus cyanurus	Common Awl Robberfly	Diptera	Asilidae	Local
Sciapus maritimus	a dolichopodid fly	Diptera	Dolichopidae	Local
Cheilosia albitarsis	a hoverfly	Diptera	Syrphidae	Common
Cheilosia proxima	a hoverfly	Diptera	Syrphidae	Common
Chrysotoxum bicinctum	a hoverfly	Diptera	Syrphidae	Local
Eristalis arbustorum	a hoverfly	Diptera	Syrphidae	Common
Helophilus hybridus	a hoverfly	Diptera	Syrphidae	Local
Helophilus pendulus	a hoverfly	Diptera	Syrphidae	Common
Lejogaster metallina	a hoverfly	Diptera	Syrphidae	Common
Leucozona lucorum	a hoverfly	Diptera	Syrphidae	Common
Melanostoma scalare	a hoverfly	Diptera	Syrphidae	Common
Merodon equestris	a hoverfly	Diptera	Syrphidae	Common
Myathropa florea	a hoverfly	Diptera	Syrphidae	Common
Pipizella viduata	a hoverfly	Diptera	Syrphidae	Common
Platycheirus manicatus	a hoverfly	Diptera	Syrphidae	Common
Syritta pipiens	a hoverfly	Diptera	Syrphidae	Common
Syrphus ribesii	a hoverfly	Diptera	Syrphidae	Common
Xanthogramma pedissequum	a hoverfly	Diptera	Syrphidae	Local
Dichetophora obliterata	a snail-killing fly	Diptera	Sciomyzidae	Local
Zaira cinerea	a parasitic fly	Diptera	Tachinidae	
Ocytata pallipes	a parasitic fly	Diptera	Tachinidae	Common
Arge cyanocrocea	a sawfly	Hymenoptera	Argidae	
Dolerus bajulus	a sawfly	Hymenoptera	Tenthredinidae	
Tenthredo zona	a sawfly	Hymenoptera	Tenthredinidae	
Aglaeostigma fulvipes	a sawfly	Hymenoptera	Tenthredinidae	
Torymus affinis	a small parasitic wasp	Hymenoptera	Torymidae	
Gravenhorstis (Erigorgus) cerinops	an ichneumon wasp	Hymenoptera	Ichneumonidae	
Endromopoda nigricoxis	an ichneumon wasp	Hymenoptera	Ichneumonidae	
Schizopyga circulator	an ichneumon wasp	Hymenoptera	Ichneumonidae	
Chelonus inanitus	a small parasitic wasp	Hymenoptera	Braconidae	
Hedychridium ardens	a rubytail wasp	Hymenoptera	Chrysididae	Common
Pseodospinolia neglectus	a rubytail wasp	Hymenoptera	Chrysididae	Local
Lasius niger	Small Black Ant	Hymenoptera	Formicidae	Common
Myrmica rubra	Red Ant	Hymenoptera	Formicidae	Common
Myrmica scabrinodes	a red ant	Hymenoptera	Formicidae	Common
Myrmosa atra	Black Headed Velvet Ant	Hymenoptera	Mutillidae	Local
Anoplius concinnus	a spider-hunting wasp	Hymenoptera	Pompilidae	Local
Anoplius nigerrimus	a spider-hunting wasp	Hymenoptera	Pompilidae	Local
Arachnospila anceps	a spider-hunting wasp	Hymenoptera	Pompilidae	Local
Arachnospila trivialis	a spider-hunting wasp	Hymenoptera	Pompilidae	Local
Dipogon variegatus	a spider-hunting wasp	Hymenoptera	Pompilidae	Local
Episyron rufipes	a spider-hunting wasp	Hymenoptera	Pompilidae	Local
Pompilus cinereus	Leaden Spider Wasp	Hymenoptera	Pompilidae	Local
Ancistrocerus trifasciatus	a potter wasp or mason wasp	Hymenoptera	Vespidae	Local
Dolichovespula sylvestris	Tree Wasp	Hymenoptera	Vespidae	Common
Odynerus spinipes	Spiny Mason Bee	Hymenoptera	Vespidae	Common
Vespula germanica	German Wasp	Hymenoptera	Vespidae	Common
Cerceris rybyensis	Ornate Tailed Digger Wasp	Hymenoptera	Crabronidae	Local
Crabro peltarius	a solitary wasp	Hymenoptera	Crabronidae	Local
Crossocerus dimidiatus	Blunt Tailed Digger Wasp	Hymenoptera	Crabronidae	Local
Crossocerus ovalis	a solitary wasp	Hymenoptera	Crabronidae	Local
Crossocerus quadrimaculatus	4-spotted Digger Wasp	Hymenoptera	Crabronidae	Common
Crossocerus tarsatus	a solitary wasp	Hymenoptera	Crabronidae	Common
Crossocerus wesmaeli	Wesmael's Digger Wasp	Hymenoptera	Crabronidae	Common

Diodontus luperus	a solitary wasp	Hymenoptera	Crabronidae	Local
Mellinus arvensis	Field Digger Wasp	Hymenoptera	Crabronidae	Common
Oxybelus uniglumis	Common Spiny Digger Wasp	Hymenoptera	Crabronidae	Common
Passaloecus singularis	a solitary wasp	Hymenoptera	Crabronidae	Common
Pemphredon lethifer	Little Black Wasp	Hymenoptera	Crabronidae	Common
Tachysphex pompiliformis	a solitary wasp	Hymenoptera	Crabronidae	Local
Trypoxolon attenuatum	Slender Wood Borer Wasp	Hymenoptera	Crabronidae	Common
Andrena angustior	a mining bee	Hymenoptera	Andrenidae	Local
Andrena barbilabris	a mining bee	Hymenoptera	Andrenidae	Local
Andrena bicolor	Gwynne's Mining Bee	Hymenoptera	Andrenidae	Common
Andrena cineraria	Grey Mining Bee	Hymenoptera	Andrenidae	Local
Andrena flavipes	Yellow Legged Mining Bee	Hymenoptera	Andrenidae	Local
Andrena fulva	Tawny Mining Bee	Hymenoptera	Andrenidae	Common
Andrena haemorrhoa	Early Mining Bee	Hymenoptera	Andrenidae	Common
Andrena minutula	a mining bee	Hymenoptera	Andrenidae	Common
Andrena nigroaenea	a mining bee	Hymenoptera	Andrenidae	Common
Apis mellifera	Honey Bee	Hymenoptera	Apidae	Common
Bombus hortorum	Small Garden Bumble Bee	Hymenoptera	Apidae	Common
Bombus lapidarius	Large Red Tailed Bumble Bee	Hymenoptera	Apidae	Common
Bombus lucorum	White-tailed Bumble Bee	Hymenoptera	Apidae	Common
Bombus pascuorum	Common Carder Bee	Hymenoptera	Apidae	Common
Bombus pratorum	Early Bumble Bee	Hymenoptera	Apidae	Common
Bombus sylvestris	Four Coloured Cuckoo Bee	Hymenoptera	Apidae	Common
Bombus terrestris	Buff-tailed Bumble Bee	Hymenoptera	Apidae	Common
Epeolus variegatus	a nomad or mason bee	Hymenoptera	Apidae	Local
Nomada fabriciana	Fabricius' Nomad Bee	Hymenoptera	Apidae	Common
Nomada flavoguttata	a nomad or mason bee	Hymenoptera	Apidae	Common
Nomada goodeniana	Gooden's Nomad Bee	Hymenoptera	Apidae	Common
Nomade leucopthalma	a nomad or mason bee	Hymenoptera	Apidae	Local
Nomada marshamella	Marsham's Nomad Bee	Hymenoptera	Apidae	Common
Nomada panzeri	a nomad or mason bee	Hymenoptera	Apidae	Common
Colletes cunicularius	Vernal Bee	Hymenoptera	Colletidae	RDB3
Colletes daviesanus	a solitary bee	Hymenoptera	Colletidae	Common
Lasioglossum calceatum	Slender Mining Bee	Hymenoptera	Halictidae	Common
Lasioglossum leucopus	a solitary bee	Hymenoptera	Halictidae	Local
Lasioglossum morio	Brassy Mining Bee	Hymenoptera	Halictidae	Common
Lasioglossum parvulum	a solitary bee	Hymenoptera	Halictidae	Common
Lasioglossum punctatissimum	a solitary bee	Hymenoptera	Halictidae	Local
Lasioglossum rufitarse	a solitary bee	Hymenoptera	Halictidae	Local
Lasioglossum villosulum	Shaggy Mining Bee	Hymenoptera	Halictidae	Common
Sphecodes ephippius	a solitary bee	Hymenoptera	Halictidae	Common
Sphecodes monilicornis	a solitary bee	Hymenoptera	Halictidae	Local
Sphecodes pellucidus	a solitary bee	Hymenoptera	Halictidae	Local
Megachile willughbiella	Willughby's Leaf-cutter Bee	Hymenoptera	Megachilidae	Common
Osmia bicornis	Red Mason Bee	Hymenoptera	Megachilidae	Common
Osmia leaiana	a mason bee	Hymenoptera	Megachilidae	Common

10.3. Appendix C: Insect species recorded at Marford Quarry in 2013. The eight psammophilic species are highlighted in red; dead-wood species are in blue.

Species	Common Name	Order	Family	Status
Aeshna mixta	Migrant Hawker	Odonata	Aeshnidae	Local
Coenagrion puella	Azure Damselfly	Odonata	Coenagrionidae	Common
Sympetrum striolatum	Common Darter	Odonata	Libellulidae	Common
Meconema thalassinum	Oak Bush Cricket	Orthoptera	Tettigoniidae	Common
Pentatoma rufipes	Forest Bug	Hemiptera	Pentatomidae	Common
Philaenus spumarius	Cuckoo-spit Bug	Hemiptera	Aphrophorinae	Common
Oncopsis flavicollis	a leafhopper	Hemiptera	Macropsinae	Common
Cicindela campestris	Green Tiger Beetle	Coleoptera	Carabidae	Common
Carabus violaceus	Violet Ground Beetle	Coleoptera	Carabidae	Common
Pterostichus madidus	Black Clock	Coleoptera	Carabidae	Common
Amara ovata	a ground beetle	Coleoptera	Carabidae	Common
Harpalus rubripes	a ground beetle	Coleoptera	Carabidae	Local
Rhagonycha fulva	Common Red Soldier Beetle	Coleoptera	Cantharidae	Common
Dasytes aeratus	a malachite beetle	Coleoptera	Melyridae	Local
Oedemera nobilis	Swollen-thighed Beetle	Coleoptera	Oedemeridae	Common
Pyrochroa coccinea	Black-headed Cardinal Beetle	Coleoptera	Pyrochroidae	Nationally Scarce
Strangalia maculata	a longhorn beetle	Coleoptera	Cerambycidae	Common
Clytus arietis	Wasp Beetle	Coleoptera	Cerambycidae	Common
Chrysolina hyperici	a leaf beetle	Coleoptera	Chrysomelidae	Local
Thymelicus sylvestris	Small Skipper	Lepidoptera	Hesperidae	Common
Ochlodes venata	Large Skipper	Lepidoptera	Hesperidae	Common
Erynnis tages	Dingy Skipper	Lepidoptera	Hesperidae	Local
Pieris napi	Green-veined White	Lepidoptera	Pieridae	Common
Anthocharis cardamines	Orange-tip	Lepidoptera	Pieridae	Common
Strymonidia w-album	White Letter Hairstreak	Lepidoptera	Lycaenidae	Nationally Scarce
Lycaena phlaeas	Small Copper	Lepidoptera	Lycaenidae	Common
Polyommatus icarus	Common Blue	Lepidoptera	Lycaenidae	Common
Aglais urticae	Small Tortoiseshell	Lepidoptera	Nymphalidae	Common
Inachis io	Peacock	Lepidoptera	Nymphalidae	Common
Maniola jurtina	Meadow Brown	Lepidoptera	Satyridae	Common
Pararge aegeria	Speckled Wood	Lepidoptera	Satyridae	Common
Pyrausta purpuralis	Common Purple & Gold	Lepidoptera	Pyralidae	Local
Zygaena filipendulae	Six-spot Burnet	Lepidoptera	Zygaenidae	Common
Cydia compositella	Triple-stripe Piercer	Lepidoptera	Tortricidae	Local
Camptogramma bilineata	Yellow Shell	Lepidoptera	Geometridae	Common
Aplocera plagiata	Treble Bar	Lepidoptera	Geometridae	Local
Tyria jacobaeae	Cinnabar	Lepidoptera	Arctiidae	Common
Cucullia lychnitis	Striped Lychnis	Lepidoptera	Noctuidae	Nationally Scarce
Autographa gamma	Silver Y	Lepidoptera	Plusiidae	Common
Limonia chorea	a cranefly	Diptera	Limoniidae	Common
Limonia duplicata	a cranefly	Diptera	Limoniidae	Common
Chorisops nagatomii	a soldierfly	Diptera	Stratiomyidae	Nationally Scarce
Pachygaster atra	a soldierfly	Diptera	Stratiomyidae	Common
Platypalpus major	a dancefly	Diptera	Hybotidae	Local
Platypalpus ecalceatus	a dancefly	Diptera	Hybotidae	Nationally Scarce
Medetera truncorum	a dolichopodid fly	Diptera	Dolichopidae	Common
Cheilosia bergenstammi	a hoverfly	Diptera	Syrphidae	Local
Chrysogaster solstitialis	a hoverfly	Diptera	Syrphidae	Common
Chrysotoxum bicinctum	a hoverfly	Diptera	Syrphidae	Local
Chrysotoxum festivum	a hoverfly	Diptera	Syrphidae	Local
Criorhina floccosa	a hoverfly	Diptera	Syrphidae	Local
Epistrophe eligans	a hoverfly	Diptera	Syrphidae	Common
Epistrophe grossulariae	a hoverfly	Diptera	Syrphidae	Common
Episyrphus balteatus	a hoverfly	Diptera	Syrphidae	Common
Eristalis arbustorum	a hoverfly	Diptera	Syrphidae	Common
Helophilus pendulus	a hoverfly	Diptera	Syrphidae	Common

Paragus haemorrhous	a hoverfly	Diptera	Syrphidae	Local
Pipizella viduata	a hoverfly	Diptera	Syrphidae	Common
Platycheirus albimanus	a hoverfly	Diptera	Syrphidae	Common
Platycheirus podagratus	a hoverfly	Diptera	Syrphidae	Nationally Scarce
Sphaerophoria scripta	a hoverfly	Diptera	Syrphidae	Common
Syritta pipiens	a hoverfly	Diptera	Syrphidae	Common
Xanthogramma pedissequum	a hoverfly	Diptera	Syrphidae	Common
Xylota segnis	a hoverfly	Diptera	Syrphidae	Common
Conops quadrifasciata	a conopid fly	Diptera	Conopidae	Local
Tachina fera	a parasitic fly	Diptera	Tachinidae	Common
Ravinia pernix	a fleshfly	Diptera	Sarcophagidae	Common
Allantus cinctus	a sawfly	Hymenoptera	Tenthrediidae	
Athalia cordata	a sawfly	Hymenoptera	Tenthrediidae	Common
Cladius pectinicornis	a sawfly	Hymenoptera	Tenthrediidae	Common
Trichiocampus viminalis	a sawfly	Hymenoptera	Tenthrediidae	
Rhogogaster chambersi	a sawfly	Hymenoptera	Tenthrediidae	
Sussaba cognata	an ichneumon wasp	Hymenoptera	Ichneumonidae	
Perithous scurra	an ichneumon wasp	Hymenoptera	Ichneumonidae	
Tromatobia oculatoria	an ichneumon wasp	Hymenoptera	Ichneumonidae	
Tromatobia variabilis	an ichneumon wasp	Hymenoptera	Ichneumonidae	
Chrysis ignita	a rubytail wasp	Hymenoptera	Chrysididae	Common
Chrysis viridula	a rubytail wasp	Hymenoptera	Chrysididae	Local
Hedychridium ardens	a rubytail wasp	Hymenoptera	Chrysididae	Common
Pseudomalus auratus	a rubytail wasp	Hymenoptera	Chrysididae	Local
Lasius niger	Small Black Ant	Hymenoptera	Formicidae	Common
Arachnospila minutula	a spider-hunting wasp	Hymenoptera	Pompilidae	Nationally Scarce
Pompilus cinereus	Leaden Spider Wasp	Hymenoptera	Pompilidae	Local
Monosapyga clavicornis	Club-horned Sapyga	Hymenoptera	Sapygidae	Nationally Scarce
Ancistrocerus nigricornis	a potter wasp or mason wasp	Hymenoptera	Vespidae	Local
Dolichovespula norvegica	Norwegian Wasp	Hymenoptera	Vespidae	Common
Dolichovespula saxonica	a social wasp	Hymenoptera	Vespidae	RDB K
Dolichovespula sylvestris	Tree Wasp	Hymenoptera	Vespidae	Common
Symmorphus gracilis	a potter wasp or mason wasp	Hymenoptera	Vespidae	Local
Vespula germanica	German Wasp	Hymenoptera	Vespidae	Common
Vespula vulgaris	Common Wasp	Hymenoptera	Vespidae	Common
Cerceris arenaria	Sand Tailed Digger Wasp	Hymenoptera	Crabronidae	Common
Cerceris rybyensis	Ornate Tailed Digger Wasp	Hymenoptera	Crabronidae	Local
Crossocerus annulipes	a solitary wasp	Hymenoptera	Crabronidae	Common
Crossocerus cetratus	a solitary wasp	Hymenoptera	Crabronidae	Local
Crossocerus distinguendus	a solitary wasp	Hymenoptera	Crabronidae	Nationally Scarce
Crossocerus megacephalus	a solitary wasp	Hymenoptera	Crabronidae	Common
Crossocerus podagricus	a solitary wasp	Hymenoptera	Crabronidae	Common
Crossocerus quadrimaculatus	4-spotted Digger Wasp	Hymenoptera	Crabronidae	Common
Crossocerus tarsatus	a solitary wasp	Hymenoptera	Crabronidae	Common
Ectemnius cavifrons	a solitary wasp	Hymenoptera	Crabronidae	Common
Ectemnius lapidarius	a solitary wasp	Hymenoptera	Crabronidae	Local
Mellinus arvensis	Field Digger Wasp	Hymenoptera	Crabronidae	Common
Oxybelus uniglumis	Common Spiny Digger Wasp	Hymenoptera	Crabronidae	Common
Passaloecus corniger	Horned Black Wasp	Hymenoptera	Crabronidae	Common
Passaloecus singularis	a solitary wasp	Hymenoptera	Crabronidae	Common
Pemphredon lugubris	Mournful Wasp	Hymenoptera	Crabronidae	Common
Andrena bicolor	Gwynne's Mining Bee	Hymenoptera	Andrenidae	Common
Andrena barbilabris	a mining bee	Hymenoptera	Andrenidae	Local
Andrena carantonica	a mining bee	Hymenoptera	Andrenidae	Common
Andrena clarkella	a mining bee	Hymenoptera	Andrenidae	Common
Andrena flavipes	Yellow Legged Mining Bee	Hymenoptera	Andrenidae	Local
Andrena haemorrhoa	Early Mining Bee	Hymenoptera	Andrenidae	Common
Andrena minutula	a mining bee	Hymenoptera	Andrenidae	Common
Andrena nigroaenea	a mining bee	Hymenoptera	Andrenidae	Common

Andrena nitida	a mining bee	Hymenoptera	Andrenidae	Common
Andrena subopaca	a mining bee	Hymenoptera	Andrenidae	Common
Apis mellifera	Honey Bee	Hymenoptera	Apidae	Common
Bombus hortorum	Small Garden Bumble Bee	Hymenoptera	Apidae	Common
Bombus hypnorum	Tree Bumble Bee	Hymenoptera	Apidae	Common
Bombus lapidarius	Large Red Tailed Bumble Bee	Hymenoptera	Apidae	Common
Bombus lucorum	White-tailed Bumble Bee	Hymenoptera	Apidae	Common
Bombus pascuorum	Common Carder Bee	Hymenoptera	Apidae	Common
Bombus pratorum	Early Bumble Bee	Hymenoptera	Apidae	Common
Bombus sylvestris	Four Coloured Cuckoo Bee	Hymenoptera	Apidae	Common
Bombus terrestris	Buff-tailed Bumble Bee	Hymenoptera	Apidae	Common
Bombus vestalis	Vestal Cuckoo Bee	Hymenoptera	Apidae	Common
Epeolus variegatus	a nomad or mason bee	Hymenoptera	Apidae	Local
Nomada fabriciana	Fabricius' Nomad Bee	Hymenoptera	Apidae	Common
Nomada flavoguttata	a nomad or mason bee	Hymenoptera	Apidae	Common
Colletes cunicularius	Vernal Bee	Hymenoptera	Colletidae	RDB3
Colletes succinctus	a solitary bee	Hymenoptera	Colletidae	Local
Hylaeus communis	Common Yellow Face Bee	Hymenoptera	Colletidae	Local
Lasioglossum leucozonium	a solitary bee	Hymenoptera	Halictidae	Common
Lasioglossum morio	Brassy Mining Bee	Hymenoptera	Halictidae	Common
Lasioglossum parvulum	a solitary bee	Hymenoptera	Halictidae	Common
Sphecodes monilicornis	a solitary bee	Hymenoptera	Halictidae	Local
Sphecodes pellucidus	a solitary bee	Hymenoptera	Halictidae	Local
Sphecodes puncticeps	a solitary bee	Hymenoptera	Halictidae	
Chelostoma florisomne	Sleepy Carpenter Bee	Hymenoptera	Megachilidae	Local
Megachile versicolor	a leaf-cutter bee	Hymenoptera	Megachilidae	Local
Osmia aurulenta	Gold-fringed Mason Bee	Hymenoptera	Megachilidae	Local
Osmia bicornis	Red Mason Bee	Hymenoptera	Megachilidae	Common
Osmia leaiana	a mason bee	Hymenoptera	Megachilidae	Common
Stelis ornatula	a cuckoo bee	Hymenoptera	Megachilidae	RDB3

10.4. Appendix D: The 175 aculeate species recorded at the two quarry sites. The 25 species in red (22 species at both Borras Quarry and Marford Quarry) are psammophilous, those in blue (40 species – 20 at Borras Quarry, 36 at Marford Quarry) are dead-wood nesters.

Species	Family	UK Status	Borras Quarry	Marford Quarry
Chrysis angustula	Chrysididae	Local		X
Chrysis ignita	Chrysididae	Common	X	X
Chrysis ruddii	Chrysididae	Local	X	
Chrysis viridula	Chrysididae	Local	X	
Hedychridium ardens	Chrysididae	Common	X	X
Pseudomalus auratus	Chrysididae	Local		X
Pseudomalus violaceus	Chrysididae	Notable/Nb		X
Pseudospinolia neglectus	Chrysididae	Local	X	
Trichrysis cyanea	Chrysididae	Common	X	X
Formica fusca	Formicidae	Common	X	X
Formica lemani	Formicidae	Local		X
Lasius alienus	Formicidae	Local	X	
Lasius flavus	Formicidae	Common	X	X
Lasius niger	Formicidae	Common	X	X
Myrmica rubra	Formicidae	Common	X	X
Myrmica ruginodis	Formicidae	Common		X
Myrmica sabuleti	Formicidae	Local		X
Myrmica scabrinodis	Formicidae	Common	X	X
Myrmosa atra	Mutillidae	Local	X	X
Anoplius concinnus	Pompilidae	Local	X	X
Anoplius nigerrimus	Pompilidae	Local	X	
Arachnospila anceps	Pompilidae	Local	X	X
Arachnospila minutula	Pompilidae	Notable/Nb		X
Arachnospila trivialis	Pompilidae	Local	X	X
Ceropales maculata	Pompilidae	Local	X	X
Dipogon variegatus	Pompilidae	Local	X	
Episyron rufipes	Pompilidae	Local	X	
Evagetes crassicornis	Pompilidae	Local	X	X
Pompilus cinereus	Pompilidae	Local	X	X
Priocnemis coriacea	Pompilidae	Na		X
Priocnemis exaltata	Pompilidae	Local	X	X
Priocnemis parvula	Pompilidae	Local	X	
Priocnemis perturbator	Pompilidae	Local		X
Priocnemis susterai	Pompilidae	Local		X
Monosapyga clavicornis	Sapygidae	Nationally Scarce		X
Tiphia minuta	Tiphiidae	Notable/Nb	X	X
Ancistrocerus nigricornis	Vespidae	Local		X
Ancistrocerus oviventris	Vespidae	Local	X	
Ancistrocerus trifasciatus	Vespidae	Local	X	X
Dolichovespula norwegica	Vespidae	Common		X
Dolichovespula saxonica	Vespidae	RDB K		X
Dolichovespula sylvestris	Vespidae	Common	X	X
Odynerus spinipes	Vespidae	Common	X	
Symmorphus gracilis	Vespidae	Local	X	X
Vespula germanica	Vespidae	Common	X	X
Vespula rufa	Vespidae	Common		X
Vespula vulgaris	Vespidae	Common	X	X
Argogorytes mystaceus	Crabronidae	Local		X
Cerceris arenaria	Crabronidae	Common	X	X

Cerceris rybyensis	Crabronidae	Local	X	X
Crabro cribrarius	Crabronidae	Local	X	
Crabro peltarius	Crabronidae	Local	X	X
Crossocerus annulipes	Crabronidae	Common		X
Crossocerus cetratus	Crabronidae	Local	X	X
Crossocerus dimidiatus	Crabronidae	Local	X	X
Crossocerus distinguendus	Crabronidae	Nationally Scarce		X
Crossocerus elongatulus	Crabronidae	Common	X	
Crossocerus megacephalus	Crabronidae	Common		X
Crossocerus ovalis	Crabronidae	Local	X	X
Crossocerus podagricus	Crabronidae	Common	X	X
Crossocerus quadrimaculatus	Crabronidae	Common	X	X
Crossocerus tarsatus	Crabronidae	Common	X	X
Crossocerus varus	Crabronidae	Common	X	
Crossocerus wesmaeli	Crabronidae	Common	X	X
Diodontus luperus	Crabronidae	Local	X	X
Diodontus minutus	Crabronidae	Common	X	X
Diodontus tristis	Crabronidae	Local		X
Ectemnius cavifrons	Crabronidae	Common		X
Ectemnius cephalotes	Crabronidae	Common		X
Ectemnius continuus	Crabronidae	Common	X	X
Ectemnius lapidarius	Crabronidae	Local		X
Harpactus tumidus	Crabronidae	Local	X	X
Mellinus arvensis	Crabronidae	Common	X	X
Mimesa equestris	Crabronidae	Common	X	
Mimesa lutaria	Crabronidae	Common		X
Nysson dimidiatus	Crabronidae	Notable/Nb	X	X
Nysson spinosus	Crabronidae	Common		X
Oxybelus uniglumis	Crabronidae	Common	X	X
Passaloecus corniger	Crabronidae	Common		X
Passaloecus gracilis	Crabronidae	Common	X	
Passaloecus singularis	Crabronidae	Common	X	X
Pemphredon inornata	Crabronidae	Common		X
Pemphredon lethifer	Crabronidae	Common	X	
Pemphredon lugubris	Crabronidae	Common		X
Philanthus triangulum	Crabronidae	RDB2		X
Rhopalum coarctatum	Crabronidae	Local	X	X
Tachysphex pompiliformis	Crabronidae	Local	X	X
Trypoxylon attenuatum	Crabronidae	Common	X	
Trypoxylon figulus	Crabronidae	Common	X	X
Ammophila sabulosa	Sphecidae	Local	X	X
Andrena angustior	Andrenidae	Local	X	
Andrena barbilabris	Andrenidae	Local	X	X
Andrena bicolor	Andrenidae	Common	X	X
Andrena carantonica	Andrenidae	Common	X	X
Andrena cineraria	Andrenidae	Local	X	
Andrena clarkella	Andrenidae	Common	X	X
Andrena flavipes	Andrenidae	Local	X	X
Andrena fulva	Andrenidae	Common	X	X
Andrena haemorrhoa	Andrenidae	Common	X	X
Andrena minutula	Andrenidae	Common	X	X
Andrena nigroaenea	Andrenidae	Common	X	X
Andrena nitida	Andrenidae	Common	X	X
Andrena praecox	Andrenidae	Local		X
Andrena semilaevis	Andrenidae	Common	X	X
Andrena subopaca	Andrenidae	Common	X	X

Andrena wilkella	Andrenidae	Common	X	
Anthophora furcata	Apidae			X
Apis mellifera	Apidae	Common	X	X
Bombus campestris	Apidae	Common		X
Bombus hortorum	Apidae	Common	X	X
Bombus hypnorum	Apidae	Local		X
Bombus lapidarius	Apidae	Common	X	X
Bombus lucorum	Apidae	Common	X	X
Bombus pascuorum	Apidae	Common	X	X
Bombus pratorum	Apidae	Common	X	X
Bombus ruderarius	Apidae	Local	X	
Bombus sylvestris	Apidae	Common	X	X
Bombus terrestris	Apidae	Common	X	X
Bombus vestalis	Apidae	Common	X	X
Epeolus variegates	Apidae	Local	X	X
Nomada fabriciana	Apidae	Common	X	X
Nomada flava	Apidae	Common	X	X
Nomada flavoguttata	Apidae	Common	X	X
Nomada fucata	Apidae	Na	X	
Nomada goodeniana	Apidae	Common	X	X
Nomada integra	Apidae	Na	X	
Nomada leucophthalma	Apidae	Local	X	
Nomada marshamella	Apidae	Common	X	
Nomada panzeri	Apidae	Common	X	X
Colletes cunicularius	Colletidae	RDB3	X	X
Colletes daviesanus	Colletidae	Common	X	
Colletes fodiens	Colletidae	Common	X	
Colletes succinctus	Colletidae	Local		X
Hylaeus brevicornis	Colletidae	Local	X	X
Hylaeus communis	Colletidae	Local	X	X
Hylaeus hyalinatus	Colletidae	Local	X	
Hylaeus signatus	Colletidae	Notable/Nb	X	
Halictus tumulorum	Halictidae	Common	X	X
Lasioglossum albipes	Halictidae	Common	X	
Lasioglossum calceatum	Halictidae	Common	X	X
Lasioglossum cupromicans	Halictidae	Local	X	
Lasioglossum fratellum	Halictidae	Common		X
Lasioglossum lativentre	Halictidae		X	
Lasioglossum leucopus	Halictidae	Local	X	X
Lasioglossum leucozonium	Halictidae	Common	X	X
Lasioglossum minutissimum	Halictidae	Common	X	
Lasioglossum morio	Halictidae	Common	X	X
Lasioglossum nitidiusculum	Halictidae	Local		X
Lasioglossum parvulum	Halictidae	Common	X	X
Lasioglossum punctatissimum	Halictidae	Local	X	
Lasioglossum rufitarse	Halictidae	Local	X	
Lasioglossum smeathmanellum	Halictidae		X	
Lasioglossum villosulum	Halictidae	Common	X	
Sphecodes crassus	Halictidae	Notable/Nb	X	X
Sphecodes ephippius	Halictidae	Common	X	X
Sphecodes geoffrellus	Halictidae	Common	X	X
Sphecodes gibbus	Halictidae	Common	X	
Sphecodes monilicornis	Halictidae	Local	X	X
Sphecodes pellucidus	Halictidae	Local	X	X
Sphecodes puncticeps	Halictidae		X	X

Sphecodes reticulatus	Halictidae	Na	X	
Chelostoma florisomne	Megachilidae	Local		X
Coelioxys rufescens	Megachilidae			X
Hoplitis claviventris	Megachilidae	Common	X	X
Megachile centuncularis	Megachilidae	Local	X	X
Megachile ligniseca	Megachilidae	Common	X	
Megachile maritima	Megachilidae		X	X
Megachile versicolor	Megachilidae	Local		X
Megachile willughbiella	Megachilidae	Common	X	X
Osmia aurulenta	Megachilidae	Local	X	X
Osmia bicornis	Megachilidae	Common	X	X
Osmia caerulescens	Megachilidae	Common	X	X
Osmia leaiana	Megachilidae	Common	X	X
Stelis ornatula	Megachilidae	RDB3		X
Stelis phaeoptera	Megachilidae	RDB2	X	X
TOTAL			**135**	**135**

10.5. Appendix E: Habitats and species at Borras Quarry and Marford Quarry.

Borras Quarry - Kidney vetch, Ox-eye daisies seeding Poplars

Borras Quarry - Italian alder, Ox-eye daisy and and Willow-herb

Borras Quarry - Musk Mallow, Ox-eye daisies.

Borras Quarry – Malaise trap.

Borras Quarry – sand exposures.

Borras Quarry – solitary bee nests.

Marford Quarry - Sedum acre; a good pollen *Hylaeus*, *Cerceris* and *Bombus*.

Marford Quarry - the dead Wych Elm in source for which at least 7 new quarry species were found including *Crossocerus distinguendus* new to Wales.

Marford Quarry - old Sallow stump in which *Pemphredon*, *Crossocerus and Ectemnius* were nesting.

Chrysotoxum bicinctum

Ancistrocerus nigricornis from dead elm at Marford Quarry.

10.6. Data Archive Appendix

The data archive contains:

[A] The final report in Microsoft Word and Adobe PDF formats.

[B] Species records, which are held on the NRW Recorder 6 database.

Metadata for this project is publicly accessible through Natural Resources Wales' Library Catalogue http://194.83.155.90/olibcgi by searching 'Dataset Titles'. The metadata is held as record no 115679.

Published by:
Natural Resources Wales
Maes-y-ffynnon
Penrhosgarnedd
Bangor
Gwynedd
LL57 2DW

0300 065 3000 (Mon-Fri, 8am - 6pm)

Further copies of this report are available from:

Email: library@cyfoethnaturiolcymru.gov.uk