Cyfoeth Naturiol Cymru
Natural Resources Wales

A survey of the invertebrate fauna of Marford Quarry in 2018, with a particular focus on aculeates (bees, wasps and ants)

J.B. Formstone

NRW Evidence Report No. 328

YMDDIRIEDOLAETH natur WILDLIFE TRUST GOGLEDD CYMRU NORTH WALES

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: 328
Publication date: October 2019
Contract number:
Contractor: J.B. Formstone
Report Editor: Dr M.A. Howe
Title: **A survey of the invertebrate fauna of Marford Quarry in 2018, with a particular focus on aculeates (bees, wasps and ants)**
Author(s): J..B. Formstone
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)

Dr Mike Howe, NRW Invertebrate Ecologist, Bangor
Ian Hughes, NRW Conservation Officer, Buckley
Graham Berry, North Wales Wildlife Trust

Recommended citation for this volume:

Formstone, J.B. 2019. A survey of the invertebrate fauna of Marford Quarry in 2018, with a particular focus on aculeates (bees, wasps and ants). NRW Evidence Report No: **328**, 46pp. Natural Resources Wales, Bangor.

Contents

List of Figures & Plates

List of Tables

1. Crynodeb Gweithredol

Yn dilyn gwaith rheoli ym Maes y Pant i gynyddu maint y cynefin tywod moel sydd ar gael ar gyfer pryfed psammophilig, cofnododd arolwg yn 2018 118 rhywogaeth o wenyn pigog, gwenyn meirch a morgrug gan gynnwys 35 o rywogaethau sy'n newydd i'r safle. Mae'r rhestr o rywogaethau pigog cyfunol bellach yn cynnwys 171 o rywogaethau, gyda 81 o wenyn, 80 o wenyn meirch a 10 rhywogaeth o forgrug, sy'n gwneud Maes y Pant yn un o'r safleoedd mwyaf pwysig ar gyfer y grŵp tacsonomig hwn. Cofnododd yr arolwg hefyd bedair rhywogaeth bigog psammophilig newydd - *Anoplius infuscatus, Arachnospila wesmaeli, Coelioxys conoidea* a *Coelioxys inermis* - a'r chwilen ddaear psammophilig *Harpalus tardus* yn ei unig leoliad mewndirol yng Nghymru. Y cyfanswm cyffredinol ar gyfer y chwarel erbyn hyn yw 31 o rywogaethau psammophilig gan gynnwys 26 o rywogaethau pigog, dwy chwilen a thri phryfyn.

Canfuwyd chwe rhywogaeth bigog sy'n nythu mewn prennau marw - *Ancistrocerus gazella*, *Ancistrocerus scoticus*, *Megachile ligniseca*, *Psenulus pallipes*, *Stigmus solskyi* a chacwn meirch *Vespa crabro* - sy'n arwain at gyfanswm cyffredinol o 43 o rywogaethau (42 o rywogaethau pigog ac un chwilen).

Ar hyn o bryd, ystyrir bod y casgliad o ffawna psammophilig a'r casgliad prennau marw mewn cyflwr ffafriol er bod **angen brys i ddarparu mwy o gynefin pren marw** sydd yn werthfawr iawn. Mae hefyd yn bwysig i gynnal cynefinoedd tywodlyd olyniaethol cynnar gan raglen o waith cloddio rheolaidd.

Gellir dadlau mae darganfod y wenynen feirch Gorytes laticinctus ym Maes y Pant yw'r cofnod mwyaf arwyddocaol yn arolwg 2018 o ystyried ei ddosbarthiad yn y DU ac mae'n dangos estyniad amrediad mawr. Gwnaed cofnodion pwysig eraill o bryfed eraill gan gynnwys pryfed tachinid *Freraea gagatea* (sy'n newydd i Gymru), *Gymnosoma rotundatum* a *Wagneria gagatea* (gyda'r ddwy rywogaeth yn bresennol mewn ail leoliadau yng Nghymru) a *Leucostoma simple*x (sy'n newydd i ogledd Cymru), chwilen *Agelastica alni* (sydd wedi'i weld yn Chwarel Lôn Ffagl), a'r gwenyn meirch parasitig *Sphecophaga vesparum* a *Haltichella rufipes* (gyda'r ddwy rywogaeth yn newydd i Gymru).

Troednodyn

O ganlyniad i oedi technegol o ran cyhoeddi'r adroddiad hwn, canfuwyd dwy rywogaeth bigog yn 2019 sy'n newydd i Faes y Pant gan yr awdur, sef y morgrugyn *Lasius platythorax* a'r wenynen feirch unig *Trypoxylon clavicerum*, sy'n rhoi cyfanswm cyfunol o 173 o rywogaethau pigog. Cofnodwyd y gwyfyn cliradain flaengoch *Synathedon formicaeformis* yn 2019 hefyd, a'r unig ardal yn VC50. Mae *S. formicaeformis* a *T. clavicerum* yn rhywogaethau saproxylic, gyda larfau'r gwyfynod yn bwydo tu mewn i foncyff yr helygen a'r helygen wiail a'r gwenyn meirch yn nythu o fewn prennau marw. Mae hyn yn dod â chyfanswm cyfunol y rhywogaethau sy'n nythu mewn prennau marw i 45 o rywogaethau, gan gynnwys 43 o rywogaethau pigog.

2. Executive Summary

Following management work in Marford Quarry to increase the amount of bare sand habitat for psammophilic insects, a survey in 2018 recorded 118 species of aculeate bees, wasps and ants including 35 species new to the site. The cumulative aculeate list now stands at 171 species, with 81 bees, 80 wasps and 10 ants, 80 wasps, making Marford Quarry one of the most important site in Wales for this taxonomic group. The survey also recorded four new psammophilic aculeates - *Anoplius infuscatus, Arachnospila wesmaeli, Coelioxys conoidea* and *Coelioxys inermis* - and the psammophilic ground beetle *Harpalus tardus* at its only Welsh inland locality. The overall total for the quarry now stands at 31 psammophilic species including 26 aculeates, two beetles and three flies.

Six new dead-wood nesting aculeates were found – *Ancistrocerus gazella*, *Ancistrocerus scoticus*, *Megachile ligniseca*, *Psenulus pallipes*, *Stigmus solskyi* and the Hornet *Vespa crabro* – resulting in a cumulative total of 43 species (42 aculeates and one beetle).

Both the psammophilic faunal assemblage and the dead-wood assemblage are considered to be currently in favourable condition although there is an **urgent need to provide more deadwood habitat** which is at a premium. It is also important to maintain early-successional sandy habitats by a programme of regular excavation work.

The finding of the solitary wasp *Gorytes laticinctus* in Marford Quarry is arguably the most significant record in the 2018 survey given its UK distribution and indicates a major range extension. Other important records were made of other insects including the tachinid flies *Freraea gagatea* (new to Wales), *Gymnosoma rotundatum* and *Wagneria gagatea (*both at 2nd Welsh localities) and *Leucostoma simple*x (new to north Wales), the Alder Leaf Beetle *Agelastica alni* (otherwise known from Fagl Lane Quarry), and the parasitic wasps *Sphecophaga vesparum* and *Haltichella rufipes* (both new to Wales).

Footnote

Due to a technical delay in the publication of this report, two more aculeate species were found new to Marford Quarry in 2019 by the author, the ant *Lasius platythorax* and the solitary wasp *Trypoxylon clavicerum*, giving a cumulative total of 173 aculeate species. The Red-tipped Clearwing moth *Synathedon formicaeformis* was also recorded new to the quarry in 2019, the only locality in VC50. Both *S. formicaeformis* and *T. clavicerum* are saproxylic species, the larvae of the moth feeding inside the stems of sallow and osier and the wasp nesting in dead wood. This brings the cumulative deadwood total to 45 species including 43 aculeates.

3. Introduction

3.1 Importance of Welsh Sand Quarries for Psammophilic Invertebrates

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 designation of Marford Quarry as a SSSI in 1989 for its psammophilic invertebrate assemblage and for wild liquorice *Astragalus glycophyllus*, and now part-owned and managed by the North Wales Wildlife Trust.

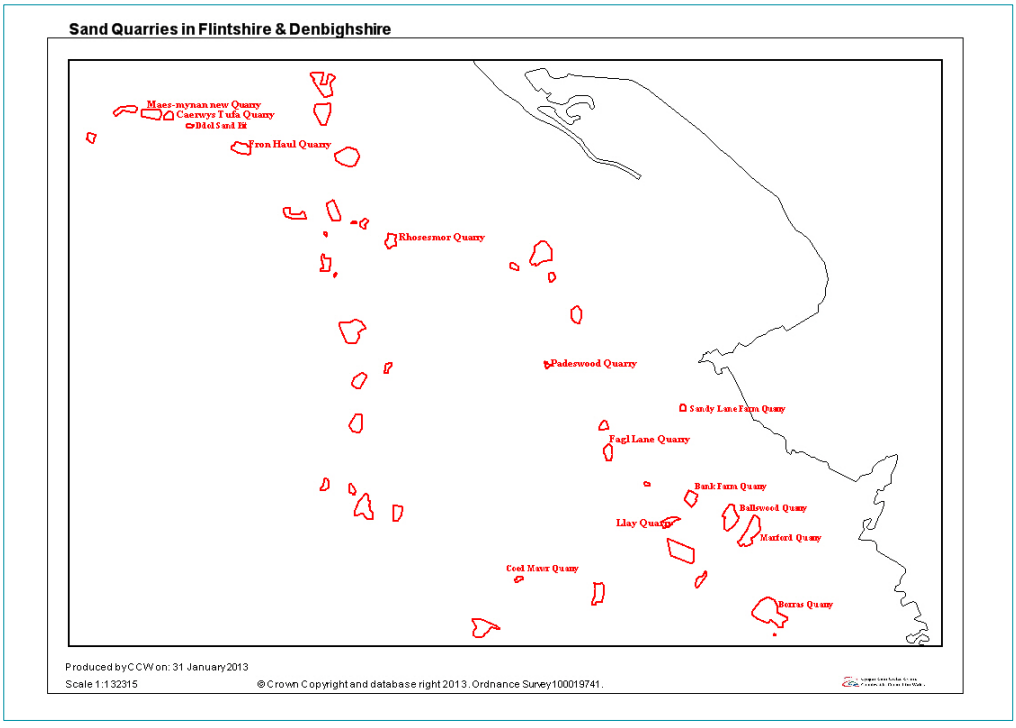

Figure 1: Sand & gravel quarries in Flintshire and Denbighshire. Note that the figure includes some limestone quarries.

A survey commissioned by the Countryside Council for Wales 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 the author of this report who has been visiting some of the key quarry sites for invertebrates over the last 27 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.

CCW-funded surveys of the invertebrate faunas of Borras Quarry, Fagl Lane Quarry and Fron Haul Quarry in 2012 recorded 20, 15 and 12 psammophilic species respectively, with an overall total of 24 psammophilic species (Formstone & Howe, 2013). The cumulative aculeate list for the three sites was 149 species, with 129 species at Borras Quarry, 74 at Fagl Lane Quarry and 65 at Fron Haul Quarry, ranking Borras Quarry as one of the most important aculeate sites in Wales. Combined with previous data, an overall total of 30 psammophilic species was realised at the three sites (26 at Borras Quarry, 17 at Fagl Lane Quarry and 13 at Fron Haul Quarry) out of a total of 39 psammophilic species known to occur on Welsh sand quarries at that time (based on NRW analyses), representing 62% of the fauna.

More intensive surveys funded by NRW were undertaken at Borras Quarry and Marford Quarry from March to August 2013, and these recorded 14 psammophilic and 70 aculeate species at Borras, and eight psammophilic and 69 aculeate species at Marford (Formstone & Howe, 2014). Combined with previous data, 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 in the top five sites in Wales (Howe *et al*., 2010).

More 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 (Formstone & Howe, 2014; see Table 1), and identified key sites to be Ballswood Quarry, Borras Quarry, Marford Quarry and Banc y Warren Quarry.

Table 1. Psammophilic invertebrates recorded from Welsh sand quarries, with date of last record at Marford Quarry.

Species	Order	Family	Status	Marford Quarry
Calathus cinctus	Coleoptera	Carabidae	Local	-
Calathus mollis	Coleoptera	Carabidae	Local	-
Amara fulva	Coleoptera	Carabidae	Nationally Scarce	-
Amara tibialis	Coleoptera	Carabidae	Local	-
Bledius opacus	Coleoptera	Staphylinidae	Local	-
Tachyusa scitula	Coleoptera	Staphylinidae	pRDBK	-
Philopedon plagiatum	Coleoptera	Curculionidae	Local	1996
Ceutorhynchus atomus	Coleoptera	Curculionidae	Nationally Scarce	-
Lithostege griseata	Lepidoptera	Geometridae	Nationally Rare	-
Dysmachus trigonus	Diptera	Asilidae	Local	1997
Philonicus albiceps	Diptera	Asilidae	Local	-
Acrosathe annulata	Diptera	Therevidae	Local	1995
Trixoscelis obscurella	Diptera	Heleomyzidae	Local	-
Senotainia conica	Diptera	Sarcophagidae	Local	2011
Hedychridium ardens	Hymenoptera	Chrysididae	Common	2013
Anoplius infuscatus	Hymenoptera	Pompilidae	Local	-
Arachnospila trivialis	Hymenoptera	Pompilidae	Local	2011

Species	Order	Family	Status	Marford Quarry
Episyron rufipes	Hymenoptera	Pompilidae	Local	-
Ceropales maculata	Hymenoptera	Pompilidae	Local	2011
Pompilus cinereus	Hymenoptera	Pompilidae	Local	2013
Cerceris arenaria	Hymenoptera	Crabronidae	Common	2013
Crabro peltarius	Hymenoptera	Crabronidae	Local	2000
Crossocerus quadrimaculatus	Hymenoptera	Crabronidae	Common	2013
Crossocerus wesmaeli	Hymenoptera	Crabronidae	Common	2000
Diodontus luperus	Hymenoptera	Crabronidae	Local	2000
Diodontus minutus	Hymenoptera	Crabronidae	Common	1994
Diodontus tristis	Hymenoptera	Crabronidae	Local	1997
Entomognathus brevis	Hymenoptera	Crabronidae	Local	-
Harpactus tumidus	Hymenoptera	Crabronidae	Local	2000
Mellinus arvensis	Hymenoptera	Crabronidae	Common	2013
Mimesa equestris	Hymenoptera	Crabronidae	Common	-
Mimesa lutaria	Hymenoptera	Crabronidae	Common	1994
Nysson dimidiatus	Hymenoptera	Crabronidae	Nationally Scarce	2011
Philanthus triangulum	Hymenoptera	Crabronidae	Nationally Rare	2000
Tachysphex pompiliformis	Hymenoptera	Crabronidae	Local	2011
Ammophila sabulosa	Hymenoptera	Sphecidae	Local	1995
Podalonia hirsuta	Hymenoptera	Sphecidae	Nationally Scarce	-
Andrena barbilabris	Hymenoptera	Apidae	Local	2013
Colletes cunicularius	Hymenoptera	Apidae	Nationally Rare	2013
Colletes fodiens	Hymenoptera	Apidae	Common	-
Sphecodes pellucidus	Hymenoptera	Apidae	Local	2013
Megachile maritima	Hymenoptera	Apidae	-	2011

3.2 Marford Quarry SSSI

Marford Quarry (SJ357563) is a 11ha disused sand and gravel quarry which was the source of the aggregate for the construction of the Mersey Tunnel. It is now owned and managed as a nature reserve by the North Wales Wildlife Trust and was notified as a SSSI in 1989. Management has focused on maintaining areas of open sand and gravel as well as early-successional habitats with sparse or partially-vegetated ground, with a shift in management practices in recent years to create additional sand and gravel features with a southerly aspect and increasing the availability of standing dead and decaying wood. The main aims are to provide and improve the availability of open sand habitat that may be suitable for the assemblage of invertebrates present and manage the land in such a way that unvegetated sand and gravel surfaces are always present by:

a) Maintaining the availability of areas of bare ground;
b) Increasing the availability of south facing sandy slopes;
c) Improving the availability of dead wood, including standing dead stems, dead branches and fallen timber;
d) Providing suitable pollen and nectar source in spring and summer.

Bare ground

Areas of bare ground have been created annually by exposing the underlying sandy substrate and, since 2014, the focus has been on producing small mounds and hollows with small, vertical faces of sandy exposures rather than a flat terrain.

Bund creation and management

Over the last decade, a series of south-facing sand bunds has been created on an annual basis in order to increase the availability of the south-facing sandy slopes preferred by most psammophilic species. Revegetating bunds have been cleared with a brush cutter, with a fifth of the most vegetated bunds mechanically reworked to provide a constant source of fresh, south-facing slopes free of vegetation. Given concerns that reworking may be inadvertently affecting the over-wintering stage of

key species, the bunds were allowed to re-vegetate naturally with additional bunds created to provide the bare sandy slopes required. Taking advantage of the topography of the land, new areas of bare ground were created in 2017 connected to bunds with small, south-facing clifflets in crescent hollows (Plates 1 & 2).

Plate 1. Ground disturbance and crescent-shaped hollows.

Plate 2. Newly-created bare ground and bund.

Deadwood

Standing dead and decaying wood have been increased gradually by ring-barking or stem-injecting sacrificial trees (see Section 3.3. below).

3.3 Marford Quarry Dead-wood Invertebrate Fauna

Previous surveys (Formstone & Howe, 2013, 2014) have highlighted 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. As such, Marford Quarry probably supports a saproxylic assemblage of national importance, primarily focussed on dead-wood nesting aculeates and the (clepto)parasitic aculeate species associated with these, as well as the Black-headed Cardinal Beetle *Pyrochroa coccinea* (Table 2). The retention of standing dead wood, particularly elm and sallow, is key to maintaining this assemblage.

Table 2. Dead-wood insects recorded at Marford Quarry.

Species	Order	Family	UK status	Last recorded
Pyrochroa coccinea	Coleoptera	Pyrochroidae	Nationally Scarce	2013
Chrysis angustula	Hymenoptera	Chrysididae	Local	2013
Chrysis ignita	Hymenoptera	Chrysididae	Common	2013
Pseudomalus auratus	Hymenoptera	Chrysididae	Local	2013
Pseudomalus violaceus	Hymenoptera	Chrysididae	Notable/Nb	1995
Trichrysis cyanea	Hymenoptera	Chrysididae	Common	2002
Monosapyga clavicornis	Hymenoptera	Sapygidae	Nationally Scarce	2013
Ancistrocerus nigricornis	Hymenoptera	Vespidae	Local	2013
Symmorphus gracilis	Hymenoptera	Vespidae	Local	2013
Crossocerus annulipes	Hymenoptera	Crabronidae	Common	2013
Crossocerus cetratus	Hymenoptera	Crabronidae	Local	2013
Crossocerus dimidiatus	Hymenoptera	Crabronidae	Local	1997
Crossocerus distinguendus	Hymenoptera	Crabronidae	Nationally Scarce	2013
Crossocerus megacephalus	Hymenoptera	Crabronidae	Common	2013
Crossocerus podagricus	Hymenoptera	Crabronidae	Common	2013
Crossocerus tarsatus	Hymenoptera	Crabronidae	Common	2013
Ectemnius cavifrons	Hymenoptera	Crabronidae	Common	2013
Ectemnius cephalotes	Hymenoptera	Crabronidae	Common	2000
Ectemnius continuus	Hymenoptera	Crabronidae	Common	2011
Ectemnius lapidarius	Hymenoptera	Crabronidae	Local	2013
Passaloecus corniger	Hymenoptera	Crabronidae	Common	2013
Passaloecus singularis	Hymenoptera	Crabronidae	Common	2013
Pemphredon inornata	Hymenoptera	Crabronidae	Common	2013
Pemphredon lugubris	Hymenoptera	Crabronidae	Common	2013
Trypoxylon figulus	Hymenoptera	Crabronidae	Common	2002
Anthophora furcata	Hymenoptera	Apidae	-	2000
Bombus hypnorum	Hymenoptera	Apidae	Local	2016
Chelostoma florisomne	Hymenoptera	Apidae	Local	2013
Coelioxys rufescens	Hymenoptera	Apidae	-	2013
Hoplitis claviventris	Hymenoptera	Apidae	Common	2011
Megachile centuncularis	Hymenoptera	Apidae	Local	2013
Megachile versicolor	Hymenoptera	Apidae	Local	2013
Megachile willughbiella	Hymenoptera	Apidae	Common	2016
Osmia caerulescens	Hymenoptera	Apidae	Common	2013
Osmia leaiana	Hymenoptera	Apidae	Common	2013
Stelis ornatula	Hymenoptera	Apidae	Nationally Rare	2013
Stelis phaeoptera	Hymenoptera	Apidae	Nationally Rare	2002

3.4 Threats to Sand Quarry Habitats

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 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.

The maintenance of bare sand and other early-successional habitats is critical if sand quarries such as Marford Quarry are to continue to support nationally-important invertebrate faunas.

3.5 Invertebrate Monitoring

Marford Quarry supports a nationally important invertebrate sand assemblage which is a Qualifying feature of the SSSI. To date, 26 psammophilic species have been recorded, with 14 species recorded in 2011 to 2013 (Table 1). To determine if the assemblage is in favourable condition, monitoring should focus on the 14 species recorded since 2000 which are regarded as locally or Nationally Scarce (Table 3). The assemblage would be regarded as favourable if 12 of these 14 species were present during a reporting cycle (10 have been recorded from 2011 to 2013). As key psammophilic species are found new to the site, they may need to be incorporated into the monitoring programme.

Table 3. Species accounts for the 14 psammophilic species used to determine feature condition at Marford Quarry.

Psammophilic species	Species account
Senotainea conica	Flesh fly. The larvae live in the nests of sand wasps (Sphecidae). Adult females apparently oviposit on female wasps carrying prey. Widespread and can be abundant in sandy places where the hosts are common. Last record 2011.
Arachospila trivialis	A medium sized (5-9mm) spider-hunting wasp mainly found on open loose sand. Most frequent on coastal dunes, but also found inland on sandy heaths and in sand workings. The preys are mainly crab spiders *Xysticus* spp. (Thomisidae), perhaps also wolf spiders (Lycosidae). Local in Wales and England north to Lancs. Can be abundant where it occurs. Last record 2011.
Ceropales maculata	A spider hunting wasp that is very local in the North. Females parasitise other spider-hunting wasps by intercepting and capturing paralysed prey, laying an egg and then abandoning the spider to be collected by the original host. Last record 2011.
Pompilus cinereus	A spider-hunting wasp found in sandy areas throughout Britain, but especially coastal. Preys on ground-dwelling spiders and nests in open, loose sand. Last record 2013.
Crabro peltarius	A large (7-13mm) black and yellow solitary wasp nesting in open, firm sand and preying on Diptera including Therevidae, Stratiomyidae, Empididae and Muscidae. Widely distributed north to Sutherland. Last record 2000.
Diodontus luperus	A small black solitary wasp nesting in open sand and preying on aphids. Local, but occasionally abundant where it occurs. Mainly southern Britain, but recorded north as far as Yorkshire. Last record 2000.

Psammophilic species	Species account
Harpactus tumidus	Black solitary wasp with red and white spots nesting in open, firm sandy places. Prey: cicadellid and cercopid hoppers. Southern species, N to Yorks, nowhere common. Last record 2000.
Nysson dimidiatus	Cleptoparasitic digger wasp laying eggs in nests of other digger wasps (*Gorytes* and *Lindenius*). Widespread in England and Wales. Nowhere common. Last record 2011.
Philanthus triangulum	A yellow and black digger wasp found in lowland heath, coastal sand dunes and cliffs where it excavates nest burrows in firm, sandy soil. The nest is provisioned with paralysed bees, mostly honeybees *Apis mellifera*, but wild species will also be taken. Last record 2000.
Tachysphex pompiliformis	Red and black solitary wasp nesting in open, firm sand. Predatory on grasshopper nymphs. Common in southern England, becoming more local in the north (Yorks and Lancs). Widespread north to Aberdeen. Last record 2011.
Andrena barbilabris	A solitary bee restricted to places with exposures of sand or light sandy soils, including sand pits, coastal dunes, landslips and sandy heaths. Nests may be scattered or in dense aggregations and are made in loose sand or exposed soil in open situations such as the edges of paths. A wide range of flowers are visited. Males are usually found near nesting sites and perform 'sun-dances', flying in groups low over the terrain in search of females. It is found throughout most of Britain north to central Scotland. Although abundant where it occurs, it is very local. Last record 2013.
Colletes cunicularius	A mining bee, confined to the sandhills of north-west England and Wales. Restricted to sand dunes where it colonises old erosion hollows, forming dense colonies on steep inclines, nesting in open, firm sand. Requires *Salix repens* as a pollen source. This species can be locally numerous within its range, but has a very restricted distribution and is therefore vulnerable to habitat damage, e.g. by human trampling of dune systems or coastal development. Last record 2013.
Sphecodes pellucidus	A small, black and red solitary bee which is cleptoparsitic on other bees of the genus *Andrena*. The only recorded host in Britain is *A. barbilabris*, a species of sandy situations, but it is likely that other host species are used. Widespread, locally abundant. Last record 2013.
Megachile maritima	Solitary bee. Sandy places, mainly on dunes but occasionally inland heaths, nesting in loose or firm sand. Local, North to Durham. Last record 2011.

With regard to the deadwood interest, the presence of 10 of 15 key species (14 aculeates and the black-headed cardinal beetle *Pyrochroa coccinea*; Table 4) during a reporting cycle would indicate favourable condition (12 were recorded from 2011 to 2013). Again, the monitoring list may need revising as new species are found at Marford Quarry.

Table 4. Key saproxylic species used to determine feature condition at Marford Quarry.

Species	Order	Family	UK status	Last recorded
Pyrochroa coccinea	Coleoptera	Pyrochroidae	Nationally Scarce	2013
Chrysis angustula	Hymenoptera	Chrysididae	Local	2013
Pseudomalus auratus	Hymenoptera	Chrysididae	Local	2013
Pseudomalus violaceus	Hymenoptera	Chrysididae	Notable/Nb	1995
Monosapyga clavicornis	Hymenoptera	Sapygidae	Nationally Scarce	2013
Ancistrocerus nigricornis	Hymenoptera	Vespidae	Local	2013
Symmorphus gracilis	Hymenoptera	Vespidae	Local	2013
Crossocerus cetratus	Hymenoptera	Crabronidae	Local	2013
Crossocerus dimidiatus	Hymenoptera	Crabronidae	Local	1997
Crossocerus distinguendus	Hymenoptera	Crabronidae	Nationally Scarce	2013

Species	Order	Family	UK status	Last recorded
Ectemnius lapidarius	Hymenoptera	Crabronidae	Local	2013
Chelostoma florisomne	Hymenoptera	Apidae	Local	2013
Megachile versicolor	Hymenoptera	Apidae	Local	2013
Stelis ornatula	Hymenoptera	Apidae	RDB3	2013
Stelis phaeoptera	Hymenoptera	Apidae	RDB2	2002

3.6 2018 Survey

The current survey was undertaken to determine the efficacy of recent management designed to increase the amount of available pioneer habitats including bare sand for psammophilic insects. An attempt has been made to evaluate the current condition of the nationally-important psammophilic invertebrate assemblage and the saproxylic invertebrate assemblage.

4. Methods

Regular visits were made to Marford Quarry between March and September 2018, ideally in warm, dry conditions. Whilst invertebrates were recorded throughout the site, particular survey effort was concentrated on recently-managed areas including de-vegetated existing bunds and newly-created bunds likely to be used for nesting by bees and wasps. Seach techniques included visual observations, sweep-netting, sifting of grass tussocks and leaf litter, and the use of water traps.

Figure 2 shows the key recording locations in 2018 and highlights the main nesting areas for Vernal Bee *Colletes cunicularius* and Bee Wolf *Philanthus triangulum*.

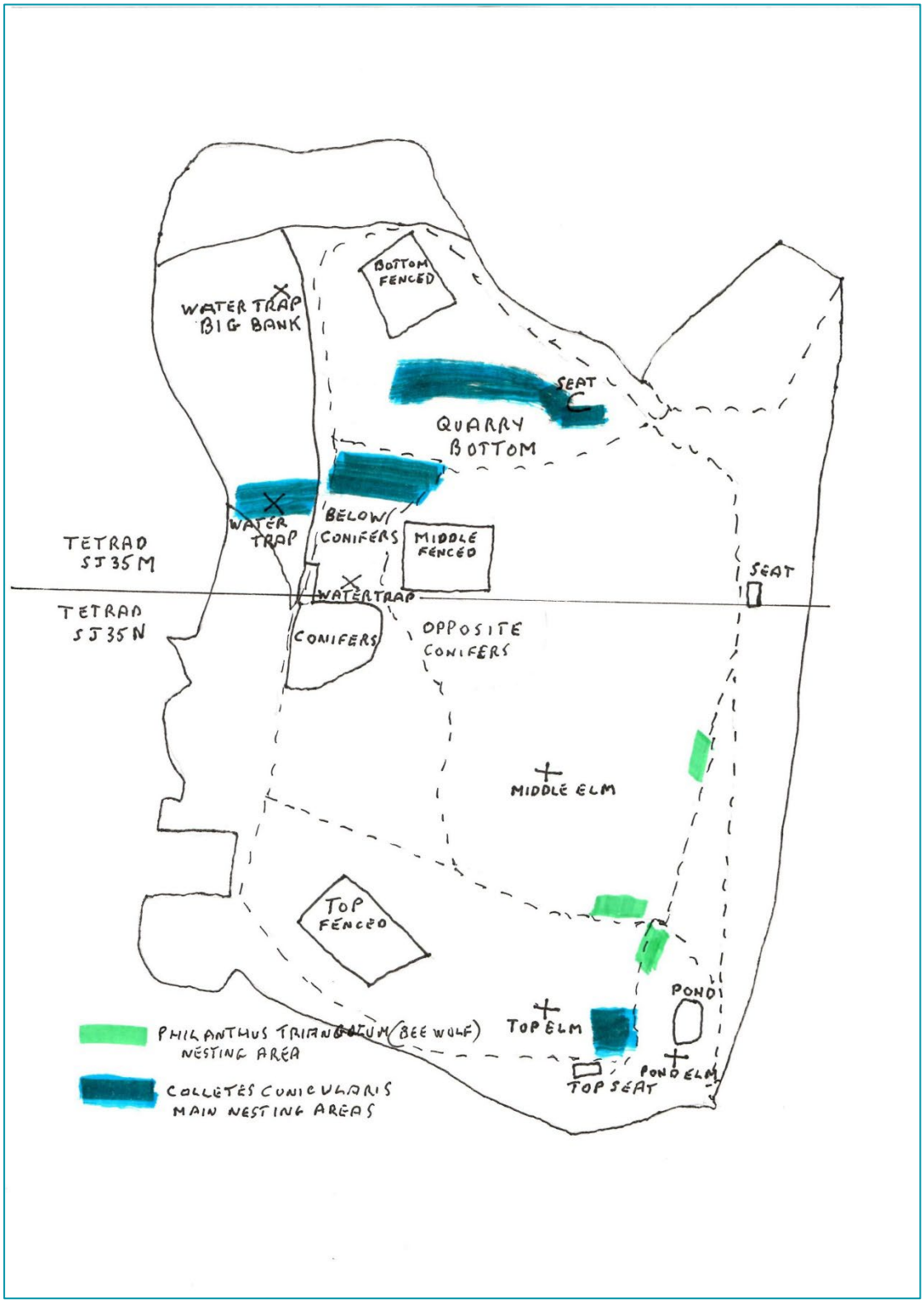

Figure 2. Key recording locations in 2018 and highlights the main nesting areas for the Vernal Bee *Colletes cunicularius* and the Bee Wolf *Philanthus triangulum.*

5. Results

A total of 118 aculeate bees, wasps and ants was recorded at Marford Quarry in 2018 (Appendix 1) including 35 species new to the site (Table 5 & Appendix 1). Of

these new species, four are psammophilic and six are dead-wood nesters. This bring the cumulative totals for the quarry to 171 aculeate species (10 ants, 80 wasps, 81 bees), including 26 psammophilic and 42 dead-wood species (Appendix 2; Tables 6 & 7). The solitary wasp *Gorytes laticinctus* was recorded new to Wales on 27th June 2018, a very significant find given its UK distribution, and several other species were recorded new to north Wales or to Denbighshire (VC50). In addition, the psammophilic ground beetle *Harpalus tardus* (see Appendix 3) was recorded in 2018 – its only inland Welsh locality - giving a cumulative count of 31 psammophilic insects now known from Marford Quarry (Table 6). The dead-wood fauna now stands at 43 species (1 beetle and 42 aculeates).

Table 5. The 35 aculeate species recorded new to Marford Quarry in 2018. Species in red are psammophilic, those in blue nest in dead wood.

Species	Family	UK status	Comment
Chrysis viridula	Chrysidae	Local	-
Tiphia femorata	Tiphiidae	Local	1st VC50 record
Anoplius infuscatus	Pompilidae	Local	1st VC50 record
Anoplius nigerrimus	Pompilidae	Local	-
Arachnospila spissa	Pompilidae	Local	-
Arachnospila wesmaeli	Pompilidae	Nationally Scarce	1st VC50 record
Dipogon variegatus	Pompilidae	Local	-
Ancistrocerus gazella	Eumenidae	Local	-
Ancistrocerus scoticus	Eumenidae	Local	1st VC50 record
Odynerus spinipes	Eumenidae	Local	-
Vespa crabro	Vespidae	Local	-
Leptothorax acervorum	Formicidae	Local	-
Lasius alienus	Formicidae	Local	-
Gorytes laticinctus	Sphecidae	Nationally Rare	1st Welsh record
Nysson trimaculatus	Sphecidae	Nationally Scarce	3rd Welsh locality
Psenulus pallipes	Sphecidae	Local	-
Stigmus solskyi	Sphecidae	Local	-
Colletes daviesanus	Apidae	Local	-
Colletes hederae	Apidae	Local	1st VC50 record
Hylaeus signatus	Apidae	Local	-
Andrena apicata	Apidae	Nationally Scarce	2nd VC50 record
Andrena cineraria	Apidae	Local	-
Andrena denticulata	Apidae	Local	-
Nomada flavopicta	Apidae	Nationally Scarce	1st VC50 record
Nomada lathburiana	Apidae	Local	-
Nomada leucopthalma	Apidae	Common	-
Nomada marshamella	Apidae	Common	-
Coelioxys inermis	Apidae	Nationally Scarce	-
Coelioxys conoidea	Apidae	Nationally Scarce	New to North Wales
Megachile ligniseca	Apidae	Local	-
Lasioglossum fulvicorne	Apidae	Local	-
Lasioglossum rufitarse	Apidae	Local	-
Lasioglossum villosulum	Apidae	Local	-
Sphecodes gibbus	Apidae	Local	-
Bombus rupestris	Apidae	Local	-

Table 6. Psammophilic invertebrates recorded from Marford Quarry, including 2018 records. * indicates recorded new to the quarry in 2018.

Species	Order	Family	Status	Marford Quarry
**Harpalus tardus*	Coleoptera	Carabidae	Local	2018
Philopedon plagiatum	Coleoptera	Curculionidae	Local	1996
Dysmachus trigonus	Diptera	Asilidae	Local	1997
Acrosathe annulata	Diptera	Therevidae	Local	1995
Senotainia conica	Diptera	Sarcophagidae	Local	2011
Hedychridium ardens	Hymenoptera	Chrysididae	Common	2018
**Anoplius infuscatus*	Hymenoptera	Pompilidae	Local	2018
Arachnospila trivialis	Hymenoptera	Pompilidae	Local	2018
**Arachnospila wesmaeli*	Hymenoptera	Pompilidae	Nationally Scarce	2018
Ceropales maculata	Hymenoptera	Pompilidae	Local	2018
Pompilus cinereus	Hymenoptera	Pompilidae	Local	2018
Cerceris arenaria	Hymenoptera	Crabronidae	Common	2018
Crabro peltarius	Hymenoptera	Crabronidae	Local	2018
Crossocerus quadrimaculatus	Hymenoptera	Crabronidae	Common	2018
Crossocerus wesmaeli	Hymenoptera	Crabronidae	Common	2018
Diodontus luperus	Hymenoptera	Crabronidae	Local	2000
Diodontus minutus	Hymenoptera	Crabronidae	Common	1994
Diodontus tristis	Hymenoptera	Crabronidae	Local	1997
Harpactus tumidus	Hymenoptera	Crabronidae	Local	2000
Mellinus arvensis	Hymenoptera	Crabronidae	Common	2018
Mimesa lutaria	Hymenoptera	Crabronidae	Common	1994
Nysson dimidiatus	Hymenoptera	Crabronidae	Nationally Scarce	2011
Philanthus triangulum	Hymenoptera	Crabronidae	Nationally Rare	2018
Tachysphex pompiliformis	Hymenoptera	Crabronidae	Local	2018
Ammophila sabulosa	Hymenoptera	Sphecidae	Local	1995
Andrena barbilabris	Hymenoptera	Apidae	Local	2018
Colletes cunicularius	Hymenoptera	Apidae	Nationally Rare	2018
Sphecodes pellucidus	Hymenoptera	Apidae	Local	2018
Megachile maritima	Hymenoptera	Apidae	Local	2018
**Coelioxys conoidea*	Hymenoptera	Apidae	Local	2018
**Coelioxys inermis*	Hymenoptera	Apidae	Local	2018

Table 7. Dead-wood invertebrates recorded from Marford Quarry, including 2018 records. * indicates recorded new to the quarry in 2018.

Species	Order	Family	UK status	Last recorded
Pyrochroa coccinea	Coleoptera	Pyrochroidae	Nationally Scarce	2013
Chrysis angustula	Hymenoptera	Chrysididae	Local	2013
Chrysis ignita	Hymenoptera	Chrysididae	Common	2018
Pseudomalus auratus	Hymenoptera	Chrysididae	Local	2013
Pseudomalus violaceus	Hymenoptera	Chrysididae	Notable/Nb	1995
Trichrysis cyanea	Hymenoptera	Chrysididae	Common	2002
Monosapyga clavicornis	Hymenoptera	Sapygidae	Nationally Scarce	2013
**Ancistrocerus gazella*	Hymenoptera	Vespidae	Common	2018
Ancistrocerus nigricornis	Hymenoptera	Vespidae	Local	2018
**Ancistrocerus scoticus*	Hymenoptera	Vespidae	Local	2018
**Vespa crabro*	Hymenoptera	Vespidae	Local	2018
Symmorphus gracilis	Hymenoptera	Vespidae	Local	2013
Crossocerus annulipes	Hymenoptera	Crabronidae	Common	2018
Crossocerus cetratus	Hymenoptera	Crabronidae	Local	2018
Crossocerus dimidiatus	Hymenoptera	Crabronidae	Local	2018
Crossocerus distinguendus	Hymenoptera	Crabronidae	Nationally Scarce	2013
Crossocerus megacephalus	Hymenoptera	Crabronidae	Common	2018
Crossocerus podagricus	Hymenoptera	Crabronidae	Common	2013
Crossocerus tarsatus	Hymenoptera	Crabronidae	Common	2013
Ectemnius cavifrons	Hymenoptera	Crabronidae	Common	2018
Ectemnius cephalotes	Hymenoptera	Crabronidae	Common	2000
Ectemnius continuus	Hymenoptera	Crabronidae	Common	2018
Ectemnius lapidarius	Hymenoptera	Crabronidae	Local	2013

Species	Order	Family	UK status	Last recorded
**Psenulus pallipes*	Hymenoptera	Crabronidae	Common	2018
**Stigmus solskyi*	Hymenoptera	Crabronidae	Local	2018
Passaloecus corniger	Hymenoptera	Crabronidae	Common	2018
Passaloecus singularis	Hymenoptera	Crabronidae	Common	2018
Pemphredon inornata	Hymenoptera	Crabronidae	Common	2013
Pemphredon lugubris	Hymenoptera	Crabronidae	Common	2018
Trypoxylon figulus	Hymenoptera	Crabronidae	Common	2002
Anthophora furcata	Hymenoptera	Apidae	-	2000
Bombus hypnorum	Hymenoptera	Apidae	Local	2018
Chelostoma florisomne	Hymenoptera	Apidae	Local	2013
Coelioxys rufescens	Hymenoptera	Apidae	-	2013
Hoplitis claviventris	Hymenoptera	Apidae	Common	2018
Megachile centuncularis	Hymenoptera	Apidae	Local	2013
**Megachile ligniseca*	Hymeoptera	Apidae	Common	2018
Megachile versicolor	Hymenoptera	Apidae	Local	2018
Megachile willughbiella	Hymenoptera	Apidae	Common	2018
Osmia caerulescens	Hymenoptera	Apidae	Common	2013
Osmia leaiana	Hymenoptera	Apidae	Common	2013
Stelis ornatula	Hymenoptera	Apidae	RDB3	2018
Stelis phaeoptera	Hymenoptera	Apidae	RDB2	2002

Important forage plants for bees and wasps within the quarry are given in Table 8.

Table 8. Forage plants (nectar and pollen sources) used by bees and wasps in Marford Quarry in 2018.

Species	Vernacular name	Comment
Lotus corniculatus	Common Bird's-foot-trefoil	-
Rubus fruticosus	Bramble	-
Hypochaeris radicata	Cat's-ear and other yellow composites	Mostly in rabbit free fenced areas and used by *Lasioglossum* spp.
Bellis perennis	Daisy	-
Taraxacum sp.	Dandelion	-
Ulex europaeus	Gorse	-
Glechoma hederacea	Ground-ivy	-
Crataegus monogyna	Hawthorn	-
Helleborus sp.	Hellebore	-
Centaurea nigra	Common Knapweed	-
Leucanthemum vulgare	Ox-eye Daisy	-
Senecio jacobaea	Common Ragwort	-
Chamerion angustifolium	Rosebay Willowherb	Used by Bee Wolf males for nectaring
Salix spp.	Sallows	-
Sedum spp.	Stonecrops	-
Fragaria vesca	Wild Strawberry	-
Cirsium spp.	Creeping Thistle, Spear Thistle	-
Reseda luteola	Weld	Only pollen source for *Hylaeus signatus*, known from VC50 & VC41
Achillea millefolium	Yarrow	-

As well as aculeates, important records were made of other insects such as the tachinid fly *Freraea gagatea* new to Wales, *Gymnosoma rotundatum* and *Wagneria gagatea*, both at a 2nd Welsh locality, *Leucostoma simple*x new to north Wales. The robberfly *Leptogaster guttiventris* was recorded new to Denbighshire (VC50), and a 2nd confirmed Welsh locality for the Alder Leaf Beetle *Agelastica alni*, having previously been record from Fagl Lane Quarry in 2012 (Formstone, 2014; Formstone & Howe, 2013). The parasitic wasp *Sphecophaga vesparum*, which breeds in wasp's

nests, and the small chalcid wasp *Haltichella rufipes* are probably both new to Wales. All records are given in Appendix 3.

6. Discussion

The warm summer of 2018 was undoubtedly a factor in the recording of so many new species of aculeate bees, wasps and ants at Marford Quarry but the high proportion of new species (30%; 35 of 118) was still a surprise. The addition of four psammophilic aculeates and a psammophilic beetle (*Harpalus tardus*) and six dead-wood nesting aculeates demonstrates the richness of both faunas and the availability of suitable habitat. Overall totals of 171 aculeate species, 31 psammophilic species (including 26 aculeates) and 43 dead-wood species (including 42 aculeates) makes Marford Quarry one of the richest sites in Wales and certainly trhe most important inland locality for psammophilic species. The Marford Quarry record of *Harpalus tardus* is the 1st inland record in Wales although it can be found at inland sites in England.

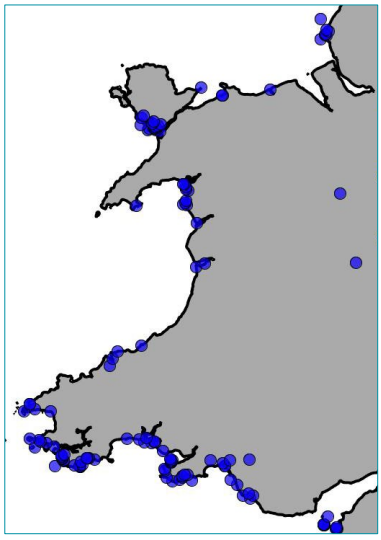

Figure 3. Welsh distribution of *Harpalus tardus* © NBN Atlas

Currently, the presence of 12 of 14 key (local, Nationally Scarce, Nationally Rare) psammophilic species recorded since 2000 found during a reporting cycle has been used to determine if the assemblage is in favourable condition, with 10 recorded from 2011 to 2013 (Formstone & Howe, 2014). Ten of the 14 were recorded in 2018 but an additional five key species were added to the psammophilic species list – *Harpalus tardus*, *Anoplius infuscatus*, *Arachnospila wesmaeli*, *Coelioxys conoidea* and *Coelioxys inermis*. If these were included in the monitoring programme, then 15 of 19 were recorded in 2018 representing a better reflection on the condition of the feature which should be regarded as being in favourable condition.

The habitat for ground nesting bees, wasps and ants in Marford Quarry has been greatly enhanced by recent management works, in particular the many sandy bunds and the creation of shallow, horseshoe-shaped scrapes. Those excavated in the sandier deposits below and to the side of the conifers were the most attractive to many species whilst those above the conifers proved much less suitable because of

the harder, stony soil conditions. The management done in winter 2017-18 will ensure that the habitat for ground-nesting aculeates will be in good order for the next few years. Older bunds which are becoming overgrown could be sympathetically weeded, but only half of each bund should be done in any one year to ensure that species occurring at very low densities will not be extirpated.

Currently, the presence of 10 of 15 key dead-wood species during a reporting cycle is used to indicate favourable condition, with 12 recorded in 2013 (Formstone & Howe, 2014). With the refinding of *Crossocerus dimidiatus* in 2018, updating a previous record from 1997, 13 of the 15 have been recorded between 2013 and 2018 reconfirming favourable condition. Consideration could be given perhaps to including *Ancistrocerus scoticus*, *Vespa crabro* and *Stigmus solskyi*, all added to the list in 2018, to the condition assessment but none is rare enough to warrant a significant change to the current approach. It should be noted, however, that deadwood habitat in the quarry for the 43 dead-wood species is very limited, in effect being about six dead elms and four piles of dead branches propped up against growing trees. The next phase of Marford Quarry management would do well to concentrate on the provision of many more dead-wood nesting opportunites for bees and wasps. Dead wood could be fastened to growing trees, or dug into the ground, but they must be secured so that they don't move and be in full sun. If the dead wood is to be used by aculeates quickly, different-sized holes could be drilled into the posts, including very small holes. It has to be seen to be believed how small the size of holes are that some of the smaller sphecid wasps use.

The finding of the solitary wasp *Gorytes laticinctus* in Marford Quarry is arguably the most significant record in the 2018 survey given its UK distribution (Figure 4) and indicates a major range extension.

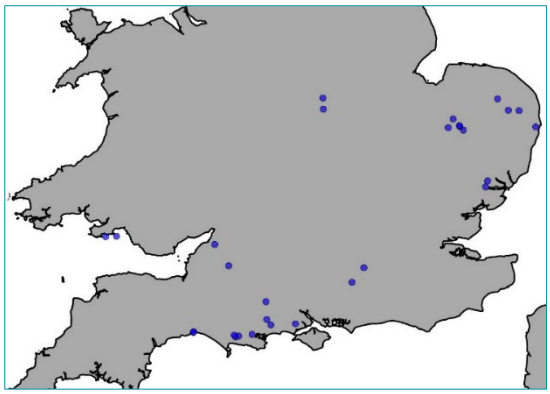

Figure 4. Distribution of *Gorytes laticinctus* © NBN Atlas. Mapped records for south Wales are unverified.

The current survey provided contemporary records for ten of the 34 aculeate species not recorded since 2000 (Table 9). The remaining 24 species with no recent record are given in Table 10.

Table 9. Aculeate species recorded in Marford Quarry in 2018 that had not been seen since at least 2000. Psammophilic species are in red, dead-wood species in blue.

Species	Family	UK status	Last record
Arachnospila anceps	Pompilidae	Common	1997
Priocnemis exaltata	Pompilidae	Local	1994

Species	Family	UK status	Last record
Crabro peltarius	Sphecidae	Common	2000
Crossocerus dimidiatus	Halictidae	Common	1997
Crossocerus quadrimaculatus	Halictidae	Local	2000
Crossocerus wesmaeli	Halictidae	Common	2000
Passoloecus singularis	Sphecidae	Local	1995
Hylaeus brevicornis	Colletidae	Local	2000
Sphecodes crassus	Halictidae	Nationally Scarce	1994
Megachile willughbiella	Megachilidae	Common	2000

Table 10. Aculeate species not recorded in Marford Quarry since at least 2000. Psammophilic species are in red, dead-wood species in blue.

Species	Family	UK status	Last record
Pseudomalus violaceus	Chrysidae	Nationally Scarce	1995
Formica fusca	Formicidae	Common	1994
Formica lemani	Formicidae	Local	1994
Myrmica ruginodes	Formicidae	Common	1994
Myrmosa atra	Mutillidae	Local	1997
Tiphia minuta	Tiphiidae	Local	1995
Anoplius concinnus	Pompilidae	Local	2000
Priocnemis coriacea	Pompilidae	Nationally Scarce	1997
Priocnemis perturbator	Pompilidae	Local	1995
Priocnemis susterai	Pompilidae	Local	2000
Vespula rufa	Vespidae	Common	1997
Ammophila sabulosa	Sphecidae	Local	1994
Diodontus luperus	Sphecidae	Local	2000
Diodontus minutus	Sphecidae	Common	1994
Diodontus tristis	Sphecidae	Local	1997
Ectemnius cephalotes	Sphecidae	Common	2000
Harpactus tumidus	Sphecidae	Local	2000
Mimesa lutaria	Sphecidae	Local	1994
Nysson spinosus	Sphecidae	Nationally Scarce	2000
Rhopalum coarctatum	Sphecidae	Local	1997
Andrena fulva	Andrenidae	Common	1995
Andrena semilaevis	Andrenidae	Local	1995
Anthophora furcata	Apidae	Local	2000
Lasioglossum nitidusculum	Halictidae	Local	1995

A recent Buglife report on bees in Wales (Olds *et al*., 2018) has highlighted the importance of Marford Quarry for threatened species including *Colletes cunicularius*, *Stelis ornatula* and *Stelis phaeoptera*, and for species of conservation concern such as *Andrena apicata*, *Bombus rupestris*, *Hylaeus signatus*, *Nomada flavopicta*, *Nomada lathburiana* and *Osmia aurulenta*, all six of which were recorded in 2018.

7. Acknowledgements

Thanks to Graham Berry (North Wales Wildlife Trust) and Ian Hughes (Natural Resources Wales) for commissioning the survey, and to Dr. Mike Howe (Natural Resources Wales) for comments on the report.

8. 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**: 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 Report No. **116**. Countryside Council for Wales, Bangor.
Formstone, B. 1993. Insects recorded at Ballswood Quarry, Clwyd. 1990-1992. *Clwyd Entomological Society Newsletter, 1992*: 13-14.
Formstone, B. 1996. Marford Quarry Reserve Entomological Survey 1995. CCW unpublished report. Countryside Council for Wales.
Formstone, B. 1998. Marford Quarry Insect Survey 1997. North Wales Wildlife Trust unpublished report.
Formstone, B. 1999. Bees and wasps of Borras Quarry 1990-1998. Appendix 6. Humphrey Rowell Associates HRA report.
Formstone, B. 2001. Marford Quarry 2000 survey. North Wales Wildlife Trust unpublished report.
Formstone, B. 2007. Bees, wasps & ants recorded from Marford Quarry (VC50 Denbighshire), between 1990 and 2007. *Natur*. 129: 21-23.
Formstone, B. 2014. *Agelastica alni* (Linnaeus) (Chrysomelidae) and *Stenus contumax* Assing (Staphylinidae) new to Wales. *The Coleopterist*. **23**: 36.
Formstone, J.B. 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, J.B. & Howe, M.A. 2013. Brownfield sites and their value for invertebrates – A survey of selected sand quarries in north-east Wales in 2012. CCW Contract Science Report No. **1020**. Countryside Council for Wales, Bangor.
Formstone, J.B. & Howe, M.A. 2014. Brownfield sites and their value for invertebrates – A survey of selected sand quarries in northeast Wales in 2013: Borras Quarry and Marford Quarry. NRW Evidence Report No. **21**. Natural Resources Wales, Bangor.
Howe, M.A., Knight, G.T. & Clee, C. 2010. The importance of coastal sand dunes for terrestrial invertebrates in Wales and the UK, with particular reference to aculeate Hymenoptera (bees, wasps & ants). *Journal of Coastal Conservation*. **14**: 91-102.
Key, R. 2000. Bare ground and the conservation of invertebrates. British Wildlife. **11**: 183-191.
Olds, L., Chmurova, L., Dinham, C. & Falk, S. 2018. Wales Threatened Bee Report. Buglife Cymru.
Whitehouse, A.T. 2008. Managing aggregates sites for invertebrates: a best practice guide. Buglife - The Invertebrate Conservation Trust, Peterborough.

9. Appendix 1. Aculeates recorded in Marford Quarry in 2018. A total of 120 species recorded including 35 new to Marford Quarry (highlighted in blue).

Species	Family	Status	Date	Abundance	Notes
Chrysis ignita	Chrysididae	Local	1.6.2018	1 m	on middle dead elm
Chrysis ignita	Chrysididae	Local	30.8.2018	4 ad	around top elm
Chrysis viridula	Chrysididae	Local	7.7.2018	1 f	New to Marford Quarry. In water trap at base of big bank
Hedychridium ardens	Chrysididae	Common	1.6-25.7.2018	several	throughout quarry
Tiphia femorata	Tiphiidae	Nationally Scarce	22.7.2018	1 f	New to Marford Quarry. In water trap at base of bank
Tiphia femorata	Tiphiidae	Nationally Scarce	25.7.2018	1 m	in water trap at base of bank
Lasius alienus	Formicidae	Local	8.4.2018	1 f	New to Marford Quarry. In sparsely-vegetated North seat area
Lasius flavus	Formicidae	Common	8.4.2018	2 f	in sparsely-vegetated North seat area
Lasius flavus	Formicidae	Common	4.7.2018	1 f	in bottom bank water trap
Lasius mixtus	Formicidae	Local	8.4.2018	2 f	in sparsely-vegetated North seat area
Lasius niger/platythorax	Formicidae	Common	-	-	abundant all over quarry
Leptothorax acervorum	Formicidae	Local	16.6.2018	2 workers	New to Marford Quarry. On fallen middle elm
Myrmica scabrinodes	Formicidae	Local	8.4.2018	1 f	in middle sandy area
Myrmica rubra	Formicidae	Common	4.7.2018	5 f	in bottom bank water trap
Anoplius infuscatus	Pompilidae	Local	23.6.2018	1 f	New to Marford Quarry. In water trap below conifers
Anoplius nigerrimus	Pompilidae	Local	23.6.2018	1 m	New to Marford Quarry. Near quarry entrance
Anoplius nigerrimus	Pompilidae	Local	23.6.2018	1 f	in water trap below conifers
Arachnospila anceps	Pompilidae	Local	23.6.2018	2 m; 1 f	in water trap below conifers
Arachnospila anceps	Pompilidae	Local	7.7.2018	1 f	in mid high bank water trap
Arachnospila spissa	Pompilidae	Local	22.7.2018	1 m	New to Marford Quarry. In mid high bank water trap
Arachnospila trivialis	Pompilidae	Local	23.6.2018	1 m	in water trap below conifers
Arachnospila trivialis	Pompilidae	Local	7.7.2018	1 f	in mid high bank water trap
Arachnospila wesmaeli	Pompilidae	Nationally Scarce	4.7.2018	1 m	New to Marford Quarry. In mid high bank water trap
Ceropales maculata	Pompilidae	Local	21.5.2018	1 f	below conifers
Dipogon variegatus	Pompilidae	Local	7.7.2018	2 f	New to Marford Quarry. In mid bank water trap
Evagetes crassicornis	Pompilidae	Local	21.5-7.7.2018	5 m; 7 f	-

Species	Family	Status	Date	Abundance	Notes
Pompilus cinereus	Pompilidae	Local	22.7.2018	1 f	in mid bank water trap
Priocnemis exaltata	Pompilidae	Local	4.7.2018	1 m	in mid bank water trap
Ancistrocerus gazella	Vespidae	Common	24.6.2018	1 m	New to Marford Quarry. On top elm
Ancistrocerus gazella	Vespidae	Common	8.8.2018	1 ad	on pond elm
Ancistrocerus nigricornis	Vespidae	Local	19.7.2018	2 m	on pond elm
Ancistrocerus scoticus	Vespidae	Local	2.7.2018	1 m	New to Marford Quarry. On ash trunk near quarry entrance
Ancistrocerus trifasciatus	Vespidae	Local	4.7.2018	1 m	on top elm
Dolichovespula saxonica	Vespidae	Local	4.7.2018	2 f	in bottom bank water trap
Vespa crabro	Vespidae	Local	30.8.2018	1 f	New to Marford Quarry. Pulping rotten wood for nest material from top elm
Vespa crabro	Vespidae	Local	27.9.2018	1 f	flying in ash wood
Vespa crabro	Vespidae	Local	17.10.2018	several	-
Vespula germanica	Vespidae	Common	19.4.2018	1 queen	middle of quarry
Vespula germanica	Vespidae	Common	25.7.2018	1 f	in bottom bank water trap
Vespula vulgaris	Vespidae	Common	19.4.2018	1 queen	middle of quarry
Odynerus spinipes	Vespidae	Local	21.5.2018	1 m	New to Marford Quarry. On mid high bank
Odynerus spinipes	Vespidae	Local	1.6.2018	1 f	on mid high bank
Cerceris arenaria	Sphecidae	Local	16.6-19.7.2018	25 nests	in small sand mounds near conifers
Cerceris rybyensis	Sphecidae	Local	16.6-25.7.2018	4 f	in small sand mounds near conifers
Cerceris rybyensis	Sphecidae	Local	25.7.2018	1 m	nectaring on rosebay willowherb
Crabro peltarius	Sphecidae	Local	27.6.2018	1 f	in newly-constructed bunds opposite conifers
Crossocerus annulipes	Sphecidae	Common	25.7.2018	1 f	from prostrate birch log outside top fenced area
Crossocerus cetratus	Sphecidae	Local	1.6-24.6.2018	3 m; 4 f	from top elm and middle elm
Crossocerus dimidiatus	Sphecidae	Local	4.7.2018	2 f	bank by pond
Crossocerus dimidiatus	Sphecidae	Local	30.8.2018	2 m; 1 f	on top elm
Crossocerus megacephalus	Sphecidae	Common	16.6.2018	1 f	from top elm
Crossocerus ovalis	Sphecidae	Local	22.5.2018	2 f	from prostrate fence posts way above pond
Crossocerus ovalis	Sphecidae	Local	11.7.2018	1 f	on creeping thistle
Crossocerus quadrimaculatus	Sphecidae	Common	22.7.2018	2 m	on newly-formed bunds opposite conifers
Crossocerus wesmaeli	Sphecidae	Local	19.7.2018	1 m	on bare sand area of quarry bottom
Ectemnius cavifrons	Sphecidae	Common	29.6.2018	1 m	on pond elm

Species	Family	Status	Date	Abundance	Notes
Ectemnius cavifrons	Sphecidae	Common	4.7.2018	1 m	on pond elm
Ectemnius continuus	Sphecidae	Common	1.6-30.8.2018	abundant	nesting in mid and top elm, lying fence posts and rotting sallow by railway
Gorytes laticinctus	Sphecidae	Nationally Rare	27.6.2018	1 f	New to Marford Quarry. By new bunds opposite conifers
Mellinus arvensis	Sphecidae	Common	19.7-27.9.2018	abundant	throughout quarry
Nysson trimaculatus	Sphecidae	Nationally Scarce	29.6.2018	1 f	New to Marford Quarry. On weld close to top fenced area
Oxybelus uniglumis	Sphecidae	Common	21.5-25.7.2018	frequent	throughout quarry
Passaloecus corniger	Sphecidae	Common	2.7.2018	1 m	on top elm
Passaloecus singularis	Sphecidae	Common	23.6-19.7.2018	2 m; 1 f	on top elm
Pemphredon lugubris	Sphecidae	Common	30.8.2018	1 f	entering old sallow stump opposite bottom seat
Pemphredon lugubris	Sphecidae	Common	27.9.2018	3 f	on top elm
Philanthus triangulum	Sphecidae	Nationally Rare	16.6-8.8.2018	92 nests	sandy bank by pond, in 2-year old bund and pond path to railway path
Philanthus triangulum	Sphecidae	Nationally Rare	25.7.2018	several m	on rosebay willowherb
Psenulus pallipes	Sphecidae	Common	19.7.2018	1 m	New to Marford Quarry. In bottom bank water trap
Stigmus solski	Sphecidae	Local	27.7.2018	2 f	New to Marford Quarry. In bottom bank water trap
Stigmus solski	Sphecidae	Local	27.9.2018	2 m; 3 f	on top elm
Tachysphex pompilliformis	Sphecidae	Local	23.6-7.7.2018	20 ad	water trap below conifers, in mid bank and bottom bank water trap
Colletes cunicularius	Apidae	Nationally Rare	9.4.2018	50 m	new bunds below conifers
Colletes cunicularius	Apidae	Nationally Rare	19.4.2018	1000 ad	throughout quarry
Colletes cunicularius	Apidae	Nationally Rare	21.5.2018	8 f	-
Colletes daviesanus	Apidae	Common	16.6.2018	1 m	New to Marford Quarry. On oxeye daisy in top fenced area
Colletes daviesanus	Apidae	Common	24.6.2018	2 m	in top fenced area
Colletes hederae	Apidae	Local	27.9.2018	1 f	New to Marford Quarry. Sandy bank
Hylaeus brevicornis	Apidae	Local	4.7.2018	2 f	on creeping thistle on new bund opposite conifers
Hylaeus communis	Apidae	Local	23.6.2018	1 m	on ash close to middle elm
Hylaeus signatus	Apidae	Nationally Scarce	4.7.2018	2 f	New to Marford Quarry. Near top fenced area
Andrena apicata	Apidae	Nationally Scarce	5.4.2018	1 m	New to Marford Quarry. From sunlit sycamore trunk below conifers
Andrena barbilabris	Apidae	Local	19.4-1.6.2018	frequent	throughout quarry
Andrena barbilabris	Apidae	Local	26.4.2018	14 m	opposite and below conifers
Andrena bicolor	Apidae	Common	5.4-23.6.2018		small numbers throughout quarry
Andrena carantonica	Apidae	Common	9.4.2018	1 m	on gorse by pond

Species	Family	Status	Date	Abundance	Notes
Andrena carantonica	Apidae	Common	14.5.2018	1 f	nesting in new bund below conifers
Andrena cineraria	Apidae	Local	19.4-14.5.2018	4 m; 6 f	New to Marford Quarry. Widely across quarry
Andrena clarkella	Apidae	Common	25.3.2018	4 m	by horseshoe seat
Andrena clarkella	Apidae	Common	8.4.2018	3 f	nesting in sandy face next to conifers
Andrena clarkella	Apidae	Common	9.4.2018	3 f	-
Andrena denticulata	Apidae	Local	19.7.2018	1 m; 1 f	New to Marford Quarry. On ragwort at path junction above pond
Andrena denticulata	Apidae	Local	22.7.2018	1 f	on knapweed near quarry entrance
Andrena haemorrhoa	Apidae	Common	14.5.2018	1 f	in quarry bottom
Andrena nitida	Apidae	Common	7.5.2018	1 f	below conifers
Andrena nigroaenea	Apidae	Common	19.4.2018	1 f	-
Andrena nigroaenea	Apidae	Common	23.6.2018	1 f	in conifer water trap
Andrena praecox	Apidae	Local	8.4.2018	1 f	in grassy area above conifers
Andrena subopaca	Apidae	Local	26.4.2018	1 m	by pond
Epeolus variegatus	Apidae	Local	29.6.2018	1 f	open sandy area in quarry bottom
Nomada fabriciana	Apidae	Common	8.4.2018	3 f	on new bunds below conifers
Nomada fabriciana	Apidae	Common	7.5.2018	2 f	on new bunds below conifers
Nomada flava	Apidae	Common	26.4-14.5.2018	4 f	on new bunds around conifers
Nomada flavoguttata	Apidae	Common	14.5-29.6.2018	1 m; 4 f	on new bunds around conifers
Nomada flavopicta	Apidae	Nationally Scarce	29.6.2018	1 m	New to Marford Quarry. On bunds opposite conifers
Nomada goodeniana	Apidae	Common	19.4-1.6.2018	3 m; 5 f	on new bunds below conifers
Nomada lathburiana	Apidae	Nationally Rare	19.4.2018	1 m	New to Marford Quarry. On gorse at middle of high bank
Nomada lathburiana	Apidae	Nationally Rare	14.5.2018	2 f	below conifers
Nomada leucopthalma	Apidae	Local	8.4.2018	1 m; 3 f	New to Marford Quarry. In new sandy area opposite conifers
Nomada marshamella	Apidae	Common	19.4.2018	1 m	New to Marford Quarry. On new bunds opposite conifers
Nomada marshamella	Apidae	Common	7.5.2018	1 f	on new bunds opposite conifers
Nomada panzeri	Apidae	Common	7.5.2018	1 f	above pond
Coelioxys inermis	Apidae	Local	23.6.2018	1 m	New to Marford Quarry. In water trap below conifers
Coelioxys conoidea	Apidae	Local	27.6.2018	1 f	New to Marford Quarry. At base of big bank in quarry bottom
Hoplitis claviventris	Apidae	Common	29.6.2018	1 f	in grassy area above conifers
Megachile ligniseca	Apidae	Common	1.6-4.7.2018	5 m; 2 f	New to Marford Quarry. In and around top fenced area

Species	Family	Status	Date	Abundance	Notes
Megachile maritima	Apidae	Local	16.6-2.7.2018	frequent	throughout quarry
Megachile maritima	Apidae	Local	29.6.2018	6 f	nesting in long-established bund in bottom enclosed area
Megachile versicolor	Apidae	Local	11.7.2018	1 f	on ragwort in bottom fenced area
Megachile willughbiella	Apidae	Common	21.5.2018	1 m	half way up big bank
Megachile willughbiella	Apidae	Common	16.6.2018	1 m	close to pond
Megachile willughbiella	Apidae	Common	4.7.2018	1 m	in top enclosure
Osmia aurulenta	Apidae	Nationally Scarce	7.5.2018	1 f	on new bunds below conifers
Osmia aurulenta	Apidae	Nationally Scarce	14.5.2018	1 m	on new bunds below conifers
Osmia bicornis	Apidae	Common	7.5.2018	1 f	below conifers
Osmia bicornis	Apidae	Common	14.8.2018	2 f	below conifers
Stelis ornatula	Apidae	Nationally Rare	1.6.2018	1 f	on new bunds below conifers
Halictus rubicundus	Apidae	Common	7.5.2018	1 f	on new bunds below conifers
Lasioglossum calceatum	Apidae	Local	14.5.2018	1 f	opposite conifers
Lasioglossum calceatum	Apidae	Local	11.7.2018	1 m	woodland edge at top of big bank
Lasioglossum fulvicorne	Apidae	Common	19.4.2018	7 f	New to Marford Quarry. Nesting in new sandy bund opposite conifers
Lasioglossum fulvicorne	Apidae	Common	7.5.2018	2 f	nesting in new sandy bund opposite conifers
Lasioglossum leucopus	Apidae	Local	14.5-19.7.2018	several	throughout quarry
Lasioglossum leucozonium	Apidae	Common	8.8.2018	1 m	-
Lasioglossum morio	Apidae	Common	26.4-25.7.2018	several	throughout quarry
Lasioglossum parvulum	Apidae	Common	14.5.2018	1 f	in middle fenced area
Lasioglossum parvulum	Apidae	Common	23.6.2018	1 m	along railway path
Lasioglossum rufitarse	Apidae	Local	21.5.2018	3 f	New to Marford Quarry. In middle fenced area
Lasioglossum rufitarse	Apidae	Local	25.7.2018	1 m	-
Lasioglossum villosulum	Apidae	Common	21.5.2018	2 f	New to Marford Quarry. In middle fenced area
Lasioglossum villosulum	Apidae	Common	25.7.2018	1 m	in bottom bank water trap
Sphecodes crassus	Apidae	Nationally Scarce	21.5.2018	1 f	from new bunds opposite conifers
Sphecodes ephippius	Apidae	Common	19.4.2018	1 f	on new bunds opposite conifers
Sphecodes ephippius	Apidae	Common	21.5.2018	2 f	on new bunds below conifers
Sphecodes geoffrellus	Apidae	Common	7.5-2.7.2018	several	on new bunds opposite and below conifers
Sphecodes gibbus	Apidae	Common	11.7.2018	1 f	New to Marford Quarry. On new bunds opposite conifers

Species	Family	Status	Date	Abundance	Notes
Sphecodes gibbus	Apidae	Common	11.7.2018	1 f	half way up big bank
Sphecodes monilicornis	Apidae	Local	25.7.2018	1 f	on bank just above pond
Sphecodes pellucidus	Apidae	Local	19.4-2.7.2018	frequent	throughout quarry
Sphecodes puncticeps	Apidae	Local	7.5.2018	2 f	on new bunds opposite conifers
Sphecodes puncticeps	Apidae	Local	14.5.2018	1 f	below conifers
Bombus hortorum	Apidae	Common	16.6.2018	1 f	in top fenced area
Bombus hypnorum	Apidae	Common	25.3.2018	1 f	-
Bombus hypnorum	Apidae	Common	5.4.2018	1 f	-
Bombus lapidarius	Apidae	Common	5.4-27.9.2018	abundant	throughout quarry
Bombus lucorum	Apidae	Common	5.4.2018	1 queen	-
Bombus pratorum	Apidae	Common	5.4-30.8.2018	frequent	throughout quarry
Bombus pascuorum	Apidae	Common	9.4-27.9.2018	abundant	throughout quarry
Bombus rupestris	Apidae	Nationally Scarce	22.7.2018	1 m	New to Marford Quarry. On bottom path by railway
Bombus terrestris	Apidae	Common	25.3.2018	2 queens	-
Bombus terrestris	Apidae	Common	5.4.2018	3 queens	-
Bombus vestalis	Apidae	Common	19.4.2018	1 f	-
Bombus vestalis	Apidae	Common	23.6.2018	2 m	in ash wood
Bombus vestalis	Apidae	Common	25.7.2018	2 m	in quarry bottom
Apis mellifera	Apidae	Common	25.3-23.6.2018	-	-

9. Appendix 2. Cumulative list of the 171 aculeate species recorded from Marford Quarry which includes 81 bees, 80 wasps and 10 ants, 26 psammophilic species (in red) and 42 dead-wood species (in blue).

Species	Family	UK status	Last record
Chrysis angustula	Chrysidae	Local	2013
Chrysis ignita	Chrysidae	Common	2018
Chrysis viridula	Chrysidae	Local	2018
Hedychridium ardens	Chrysidae	Common	2018
Pseudomalus aurata	Chrysidae	Local	2013
Pseudomalus violaceus	Chrysidae	Nationally Scarce	1995
Trichrysis cyanea	Chrysidae	Common	2002
Formica fusca	Formicidae	Common	1994
Formica lemani	Formicidae	Local	1994
Lasius alienus	Formicidae	Local	2018
Lasius flavus	Formicidae	Common	2018
Lasius niger	Formicidae	Common	2018
Leptothorax acervorum	Formicidae	Common	2018
Myrmica rubra	Formicidae	Common	2018
Myrmica ruginodes	Formicidae	Common	1994
Myrmica sabuleti	Formicidae	Local	2002
Myrmica scabrinodes	Formicidae	Common	2018
Myrmosa atra	Mutillidae	Local	1997
Tiphia femorata	Tiphiidae	Nationally Scarce	2018
Tiphia minuta	Tiphiidae	Local	1995
Monosapyga clavicornis	Sapygidae	Nationally Scarce	2013
Anoplius concinnus	Pompilidae	Local	2000
Anoplius nigerrimus	Pompilidae	Local	2018
Anoplius infuscatus	Pompilidae	Local	2018
Arachnospila anceps	Pompilidae	Local	2018
Arachnospila minutula	Pompilidae	Nationally Scarce	2013
Arachnospila spissa	Pompilidae	Local	2018
Arachnospila trivialis	Pompilidae	Local	2018

Species	Family	UK status	Last record
Arachnospila wesmaeli	Pompilidae	Nationally Scarce	2018
Ceropales maculata	Pompilidae	Local	2018
Dipogon variegatus	Pompilidae	Local	2018
Evagetes crassicornis	Pompilidae	Local	2018
Pompilus cinereus	Pompilidae	Local	2018
Priocnemis coriacea	Pompilidae	Nationally Scarce	1997
Priocnemis exaltata	Pompilidae	Local	2018
Priocnemis perturbator	Pompilidae	Local	1995
Priocnemis susterai	Pompilidae	Local	2000
Ancistrocerus gazella	Eumenidae	Common	2018
Ancistrocerus nigricornis	Eumenidae	Local	2018
Ancistrocerus scoticus	Eumenidae	Local	2018
Ancistrocerus trifasciatus	Eumenidae	Local	2018
Odynerus spinipes	Eumenidae	Local	2018
Symmorphus gracilis	Eumenidae	Local	2013
Dolichovespula norvegica	Vespidae	Common	2013
Dolichovespula saxonica	Vespidae	Local	2018
Dolichovespula sylvestris	Vespidae	Common	2013
Vespa crabro	Vespidae	Local	2018
Vespula germanica	Vespidae	Common	2018
Vespula rufa	Vespidae	Common	1997
Vespula vulgaris	Vespidae	Common	2018
Ammophila sabulosa	Sphecidae	Local	1995
Argogorytes mystaceus	Sphecidae	Local	2018
Cerceris arenaria	Sphecidae	Local	2018
Cerceris rybyensis	Sphecidae	Local	2018
Crabro peltarius	Sphecidae	Local	2018
Crossocerus annulipes	Sphecidae	Common	2018
Crossocerus cetratus	Sphecidae	Local	2018
Crossocerus dimidiatus	Sphecidae	Local	2018
Crossocerus distinguendus	Sphecidae	Nationally Scarce	2013
Crossocerus megacephalus	Sphecidae	Common	2018
Crossocerus ovalis	Sphecidae	Local	2018
Crossocerus podagricus	Sphecidae	Common	2013

Species	Family	UK status	Last record
Crossocerus quadrimaculatus	Sphecidae	Common	2018
Crossocerus tarsatus	Sphecidae	Common	2013
Crossocerus wesmaeli	Sphecidae	Common	2018
Diodontus luperus	Sphecidae	Local	2000
Diodontus minutus	Sphecidae	Common	1994
Diodontus tristis	Sphecidae	Local	1997
Ectemnius cavifrons	Sphecidae	Common	2018
Ectemnius cephalotes	Sphecidae	Common	2000
Ectemnius continuus	Sphecidae	Common	2018
Ectemnius lapidarius	Sphecidae	Local	2013
Gorytes lacticinctus	Sphecidae	Nationally Rare	2018
Harpactus tumidus	Sphecidae	Local	2000
Mellinus arvensis	Sphecidae	Common	2018
Mimesa lutaria	Sphecidae	Local	1994
Nysson dimidiatus	Sphecidae	Nationally Scarce	2011
Nysson spinosus	Sphecidae	Nationally Scarce	2000
Nysson trimaculatus	Sphecidae	Nationally Scarce	2018
Oxybelus uniglumis	Sphecidae	Common	2018
Passaloecus corniger	Sphecidae	Common	2018
Passaloecus singularis	Sphecidae	Common	2018
Pemphredon inornatus	Sphecidae	Common	2013
Pemphredon lugubris	Sphecidae	Common	2018
Philanthus triangulum	Sphecidae	Nationally Rare	2018
Psenulus pallipes	Sphecidae	Common	2018
Rhopalum coarctatum	Sphecidae	Local	1997
Stigmus solski	Sphecidae	Local	2018
Trypoxolon figulus	Sphecidae	Common	2002
Tachysphex pompiliformis	Sphecidae	Local	2018
Andrena apicata	Apidae	Nationally Scarce	2018
Andrena barbilabris	Apidae	Local	2018
Andrena bicolor	Apidae	Common	2018
Andrena caratonica	Apidae	Common	2018
Andrena cineraria	Apidae	Local	2018
Andrena clarkella	Apidae	Common	2018

Species	Family	UK status	Last record
Andrena denticulata	Apidae	Local	2018
Andrena flavipes	Apidae	Local	2013
Andrena fulva	Apidae	Common	1995
Andrena haemorrhoa	Apidae	Common	2018
Andrena minutula	Apidae	Common	2013
Andrena nigroaenea	Apidae	Common	2018
Andrena nitida	Apidae	Common	2018
Andrena praecox	Apidae	Local	2018
Andrena semilaevis	Apidae	Local	1995
Andrena subopaca	Apidae	Common	2018
Apis mellifera	Apidae	Common	2018
Bombus campestris	Apidae	Common	2009
Bombus hortorum	Apidae	Common	2018
Bombus hypnorum	Apidae	Common	2018
Bombus lapidarius	Apidae	Common	2018
Bombus lucorum	Apidae	Common	2018
Bombus pascuorum	Apidae	Common	2018
Bombus pratorum	Apidae	Common	2018
Bombus rupestris	Apidae	Nationally Scarce	2018
Bombus sylvestris	Apidae	Common	2013
Bombus terrestris	Apidae	Common	2018
Bombus vestalis	Apidae	Common	2018
Anthophora furcata	Apidae	Local	2000
Epeolus variegatus	Apidae	Local	2018
Nomada fabriciana	Apidae	Common	2018
Nomada flava	Apidae	Common	2018
Nomada flavoguttata	Apidae	Common	2018
Nomada flavopicta	Apidae	Nationally Scarce	2018
Nomada goodeniana	Apidae	Common	2018
Nomada lathburiana	Apidae	Local	2018
Nomada leucopthalma	Apidae	Local	2018
Nomada marshamella	Apidae	Common	2018
Nomada panzeri	Apidae	Common	2018
Colletes cunicularius	Apidae	Nationally Rare	2018

Species	Family	UK status	Last record
Colletes daviesanus	Apidae	Common	2018
Colletes hederae	Apidae	Unknown	2018
Colletes succinctus	Apidae	Local	2013
Hylaeus brevicornis	Apidae	Local	2018
Hylaeus communis	Apidae	Local	2018
Hylaeus signatus	Apidae	Nationally Scarce	2018
Halictus rubicundus	Apidae	Common	2013
Halictus tumulorum	Apidae	Common	2018
Lasioglossum calceatum	Apidae	Common	2018
Lasioglossum fratellum	Apidae	Common	2013
Lasioglossum fulvicorne	Apidae	Local	2018
Lasioglossum leucopus	Apidae	Local	2018
Lasioglossum leucozonium	Apidae	Common	2018
Lasioglossum morio	Apidae	Common	2018
Lasioglossum nitidusculum	Apidae	Local	1995
Lasioglossum parvulum	Apidae	Common	2018
Lasioglossum rufitarse	Apidae	Local	2018
Lasioglossum villosulum	Apidae	Common	2018
Sphecodes crassus	Apidae	Nationally Scarce	2018
Sphecodes ephippius	Apidae	Common	2018
Sphecodes geoffrellus	Apidae	Common	2018
Sphecodes gibbus	Apidae	Common	2018
Sphecodes monilicornis	Apidae	Common	2018
Sphecodes pellucidus	Apidae	Local	2018
Sphecodes puncticeps	Apidae	Unknown	2018
Chelostoma florisomne	Apidae	Local	2013
Coelioxys conoidea	Apidae	Local	2018
Coelioxys inermis	Apidae	Local	2018
Coelioxys rufescens	Apidae	Local	2013
Hoplitis claviventris	Apidae	Common	2018
Megachile centuncularis	Apidae	Local	2013
Megachile ligneseca	Apidae	Common	2018
Megachile maritima	Apidae	Unknown	2018
Megachile versicolor	Apidae	Local	2018

Species	Family	UK status	Last record
Megachile willughbiella	Apidae	Common	2018
Osmia aurulenta	Apidae	Local	2018
Osmia bicornis	Apidae	Common	2018
Osmia caerulescens	Apidae	Common	2013
Osmia leaiana	Apidae	Common	2013
Stelis ornatula	Apidae	Nationally Rare	2018
Stelis phaeoptera	Apidae	Nationally Rare	2013

11. Appendix 3. Insects other than aculeates and spiders recorded in Marford Quarry in 2018.

In April it was good to see an early emergence of Green Tiger Beetles *Cicindela campestris*, and by mid May, they could be seen all over the quarry in bare ground areas. On a good day more than 30 could be counted.

The butterfly success story was the numbers of Common Blue in its first and second broods. Other butterfly species in the quarry did not do so well, with only two individuals seen of each of Dingy Skipper and White-letter Hairstreak. I was very pleased to see one of the newly-arrived Silver Washed Fritillary by the bottom seat in early July. The day flying Orange Underwing moth was seen in early April flying around birches in the quarry bottom. Two males of the Nationally Scarce Six-belted Clearwing moth were seen half way up the big bank opposite the conifers, in mid July, the larvae of which feed at the roots of Bird's-foot-trefoil.

You would not choose Marford Quarry as a place to record dragonflies, and the sighting of eight species was quite a surprise. The Beautiful Demoselle would be from the nearby River Alyn, and the Club-tailed Dragonfly will be a wanderer from the River Dee. The source of the Black-tailed Skimmer and the Ruddy Darter is not so clear cut. The attraction to the site is probably the plentiful supply of insect food, and somewhere to shelter on windy days. In these more sheltered areas it was good to see dozens of grasshoppers on the warm sunny days. Apart from the two common species it was a surprise to record several Mottled Grasshoppers, and the sweeping of a male Speckled Bush Cricket at the edge of the railway path was a first record for the site.

Of the sixty species of Diptera recorded, *Chorisops nagatomii* is a Marford speciality, being infrequent elsewhere in North Wales. The robberfly *Leptogaster guttiventris* is the first record for Denbighshire VC50. At least 20 specimens of seven different species of Sarcophagidae (Flesh Flies) were attracted to the water traps in July and August. It makes you wonder why such numbers of all types of insects feel the need to enter a bowl of water six inches across. The parasitic tachinid fly *Gymsonoma rotundatatum* was netted at the base of the big bank in August, its hosts are said to be *Palomena* species of shieldbugs. This is only the second record for Wales.

The most notable beetle was the ground beetle *Harpalus tardus* which was found running on bare sand in early April. This species is usually coastal, and this is the first inland record for North Wales of this psammophilic species. A most unusual incident occurred, concerning the capture of beetles at the end of August. I had put a water trap in the Ash wood area about a week earlier. In the evening on the day I put out the trap, it became very windy and turned the trap over losing all the water. On going to collect the trap, I decided to hide the empty bowl under an Ash sapling, intending to bring some water to fill it next day. I forgot about the

trap, untill about a week later when I decided to pick up the empty bowl and take it to a new site. Imagine my surprise to find
it half full of rain water, and containing seven large orange and black burying beetles and two uncommon dung beetles. I then saw that there was also a dead shrew in the bowl, and that the beetles had been attracted to the decomposing corpse.

Several species of parasitic Hymenoptera were recorded including *Sphecophaga vesparum*, which breed in wasp's nests, and the small chalcid wasp *Haltichella rufipes*,
which may be new to Wales.

Family	Species	Date	Numbers	Notes
Butterflies	Common Blue	21/05/2018	12	All over the site
-	Dingy Skipper	02/05/2018	2	Two in top fenced area
-	Grayling	11/07/2018	1	On Big Bank
-	Large Skipper	23/06/2018	1	Top Fenced
-	Painted Lady	22/07/2018	1	Knapweed on bank
-	Silver Washed Fritillary	02/07/2018	1	Bottom Seat
-	Small Copper	13/08/2018	1	Top Fenced
-	Small Skipper	27/06/2018	8	All Areas
-	White-letter Hairstreak	11/07/2018	2	On Ragwort in mid quarry
Macro Moths	Cinnabar	01/06/2018	1	By Pond
-	Orange Underwing	05/04/2018	2	Flying around Birches
-	Six-belted Clearwing	19/07/2018	2m	Two at Big Bank base
Micro Moths	*Pyrausta purpuralis*	01/06/2018	1	Above Pond
Dragonflies	-	-	-	-
Southern Hawker	*Aeshnea cyanea*	29/06/2018	1	Bottom Fenced area
Brown Hawker	*Aeshnea grandis*	19/07/2018	1	Bottom Fenced area
Emperor Dragonfly	*Anax imperator*	29/06/2018	1m	Around pond
Beautiful Demoiselle	*Calopteryx virgo*	21/05/2018	1m	Birchwood area
Beautiful Demoiselle	*Calopteryx virgo*	01/06/2018	3m	Near Entrance
Club-tailed Dragonfly	*Gomphus vulgatissimus*	21/05/2018	1	Middle area
Black-tailed Skimmer	*Orthetrum cancellatum*	23/06/2018	1m	2nd dig behind conifers
Common Darter	*Pyrrhosoma nymphula*	14/05/2018	1	Path by pond
Ruddy Darter	*Sympetrum sanguineum*	02/07/2018	1f	Path by pond
Grasshoppers & Crickets	-	-	-	-
Common Field Grasshopper	*Chorthippus brunneus*	27/07/2018	1f	Water trap conifers
Mottled Grasshopper	*Myrmeleotettix maculatus*	07/07/2018	2m	Water trap bottom bank
Common Green Grasshopper	*Omocestus viridulus*	02/07/2018	6	Mid high bank area
Speckled Bush Cricket	*Leptophyes punctatissima*	02/07/2018	1m	Swept by railway path
Slender Groundhopper	*Tetrix subulata*	25/07/2018	1f	Bottom bank water trap
Spiders	-	-	-	-
Salticidae	*Evarcha falcata*	22/07/2018	1m	Mid bank water trap
Pisauridae	*Pisaura mirabilis*	27/06/2018	1m	Water trap conifers
Salticidae	*Salticus scenicus*	30/08/2018	1f	Top Elm
Sawflies	-	-	-	-

Family	Species	Date	Numbers	Notes
-	*Aglostigma acuparia*	14/05/2018	1f	North east corner
-	*Aglostigma fulvipes*	14/05/2018	1f	North east corner
-	*Cephus spinipes*	21/04/2018	1m	Swept in mid section
-	*Macrophya annulata*	21/05/2018	3m	North east corner
Mecoptera	-	-	-	-
Scorpion Fly	*Panorpa germanica*	14/05/2018	1m	Top fenced area
Diptera	**-**	-	-	-
Tipulidae	*Dicranomyia modesta*	07/05/2018	1f	Near top Seat
Tipulidae	*Nephrotoma flavescens*	23/06/2018	3m 1f	Ash Wood
Tipulidae	*Nephrotoma scurra*	30/08/2018	1f	Ash Wood
Tipulidae	*Nephrotoma submaculosa*	14/08/2018	1f	Middle below conifers
Tipulidae	*Nephrotoma submaculosa*	21/05/2018	3m 6f	Middle below conifers
Stratiomyidae	*Chloromyia formosa*	04/07/2018	3f	Bottom bank water trap
Stratiomyidae	*Chorisops nagatomii*	13/08/2018	1m	Sweeping Sallow
Stratiomyidae	*Chorisops nagatomii*	30/08/2018	1f	Sweeping Sallow
Stratiomyidae	*Sargus bipunctatus*	24/06/2018	1f	Water trap below conifers
Stratiomyidae	*Sargus flavipes*	04/07/2018	1f	Big bank water trap
Asilidae	*Dioctria atricapilla*	23/06/2018	1f	Swept by top seat area
Asilidae	*Dioctria baumhari*	27/06/2018	1f	Swept Bottom Oak
Asilidae	*Leptogaster guttiventris*	24/06/2018	1f	Opposite pond
Rhagionidae	*Rhagio lineola*	27/06/2018	1m	Water trap conifers
Bombylidae	*Bombylius major*	09/04/2018	5	Top seat area
Bombylidae	*Bombylius major*	19/04/2018	6	Some on Sallows
Dolichopidae	*Dolichopus griseipennis*	30/08/2018	1m	Mid grass area sweeping
Dolichopidae	*Sciapus platypterus*	23/06/2018	1f	Water trap below conifers
Scathophagidae	*Scathophaga inquinata*	09/04/2018	1m	Swept from Sallow
Scathophagidae	*Scathophaga stercoraria*	25/03/2018	1f	On Sallow
Conopidae	*Conops flavipes*	25/07/2018	1m	Netted from thistle
Syrphidae	*Baccha elongata*	21/05/2018	1f	From Elm by entrance
Syrphidae	*Cheilosia bergenstammi*	14/05/2018	1f	Below conifers
Syrphidae	*Cheilosia bergenstammi*	25/07/2018	1f	On Ragwort near top seat
Syrphidae	*Cheilosia lasiopa*	07/05/2018	1f	Netted inTop seat area
Syrphidae	*Cheilosia lasiopa*	14/07/2018	1f	Netted inTop seat area
Syrphidae	*Eristalis arbustorum*	16/06/2018	1f	Netted inTop seat area
Syrphidae	*Melangyna scalare*	07/03/2018	1f	Netted inTop seat area
Syrphidae	*Myathropa florea*	14/05/2018	1f	Netted inTop seat area
Syrphidae	*Pipizella viduata*	21/05/2018	1f	Swept in middle section
Syrphidae	*Pipizella viduata*	01/06/2018	2m	Opposite conifers
Syrphidae	*Rhingia campestris*	14/05/2018	1m	On High Bank
Syrphidae	*Syritta pipiens*	21/05/2018	2f	Swept middle section
Syrphidae	*Syritta pipiens*	16/06/2018	2m	Swept middle section
Syrphidae	*Volucella pellucens*	14/05/2018	1f	Below high bank
Syrphidae	*Xylota segnis*	14/05/2018	1m	On Sycamore Foliage
Micropezidae	*Micropeza corrigiolata*	01/06/2018	2m	On foliage by of Conifers
Lauxanidae	*Lyciella decempunctata*	13/08/2018	1m	Ash Wood

Family	Species	Date	Numbers	Notes
Lauxanidae	*Lyciella subfasciata*	13/08/2018	1m	Ash Wood
Heleomyzidae	*Sullia variegata*	30/08/2018	1f	Ash Wood
Opomyzidae	*Opomyza germinationis*	30/08/2018	1f	Ash Wood
Sciomyzidae	*Pherbellia cinerella*	30/08/2018	1m	Swept top fenced area
Ephydridae	*Psilopa nitidula*	30/08/2018	1f	Top seat area sweeping
Drosphilidae	*Scraptomyza pallida*	06/08/2018	1f	Top seat area sweeping
Tephritidae	*Anomoia purmunda*	06/08/2018	1f	Swept in Ash wood
Tephritidae	*Dioxyna bidentis*	25/07/2018	1m	From Oak north seat area
Sarcophagidae	*Brachicoma devia*	21/05/2018	1m	Bottom Water trap
Sarcophagidae	*Metopia argyrocephala*	14/05/2018	1f	Section below conifers
Sarcophagidae	*Metopia argyrocephala*	13/08/2018	1m	Section below conifers
Sarcophagidae	*Sarcophaga carnaria*	29/06/2018	1m	Top fenced water trap
Sarcophagidae	*Sarcophaga carnaria*	08/08/2018	3M	Botton of big bank
Sarcophagidae	*Sarcophaga filia*	25/07/2018	1m	Bottom bank water trap
Sarcophagidae	*Sarcophaga haemorrhoa*	25/07/2018	3m	Botton of big bank
Sarcophagidae	*Sarcophaga incisilobata*	25/07/2018	3m	Bank bottom water trap
Sarcophagidae	*Sarcophaga nigriventris*	08/08/2018	3m	Bank bottom water trap
Sarcophagidae	*Sarcophaga pumila*	25/07/2018	1m	Top fenced water trap
Sarcophagidae	*Sarcophaga variegata*	25/07/2018	1m	Bank bottom water trap
Sarcophagidae	*Sarcophaga variegata*	08/08/2018	2M	Bank bottom water trap
Pipuculidae	*Pipunculus thomsoni*	14/05/2018	1m	Swept in central in grass
Calliphoridae	*Calliphara vomitoria*	04/07/2018	1f	Mid Quarry
Calliphoridae	*Pollenia angustigena*	09/04/2018	1f	Bottom bank water trap
Tachinidae	*Bithia spreta*	22/07/2018	1m	Swept from Sallow
Tachinidae	*Freraea gagatea* ?	19/07/2018	1f	Bank bottom water trap
Tachinidae	*Freraea gagatea* ?	25/07/2018	1f	Bank bottom water trap
Tachinidae	*Gymnosoma rotundatum*	13/08/2018	1m	Netted at big bank base
Tachinidae	*Leucostoma simplex*	27/06/2018	1m	Sweeping top seat area
Tachinidae	*Tachina fera*	30/08/2018	2f	Water trap conifers
Tachinidae	*Wagneria gagatea*	14/05/2018	1m	Mid Elm
Muscidae	*Dasyphora cyanella*	09/04/2018	1m	Swept from grasses
Muscidae	*Mesembrina meridiana*	21/05/2018	1f	Swept from Sallow
Muscidae	*Musca autumnalis*	25/07/2018	2m	Mid bank water trap
Beetles	-	-	-	-
Carabidae	*Cicindela campestris*	25/03/2018	4	On raised open sand area
Carabidae	*Cicindela campestris*	05/04/2018	3	On flat sand area
Carabidae	*Cicindela campestris*	14/05/2018	30 plus	All areas of the Quarry
Carabidae	*Amara aenea*	19/04/2018	1	Bare sand area in quarry
Carabidae	*Harpalus rubripes*	14/05/2018	1f	Bare sand area in quarry
Carabidae	*Harpalus tardus*	09/04/2017	1	Bare sand on high bank
Silphidae	*Nicrophorus humator*	30/08/2018	1m 1f	Water trap on dead shrew
Silphidae	*Nicrophorus vespillo*	30/08/2018	1f	Water trap on dead shrew
Silphidae	*Nicrophorus vespilloides*	30/08/2018	5	Water trap on dead shrew
Staphylinidae	*Ontholestes murinus*	30/08/2018	1f	Water trap on dead shrew
Staphylinidae	*Philonthus carbonarius*	30/08/2018	2	Sweeping top area

Family	Species	Date	Numbers	Notes
Scarabaeidae	*Aphodius sphacelatus*	27/09/2018	1f	Netted above pond
Scarabaeidae	*Onthophagus coenobita*	30/08/2018	1f	Water trap on dead shrew
Scarabaeidae	*Onthophagus joannae*	30/08/2018	1f	Water trap on dead shrew
Cerambycidae	*Rutpela maculata*	29/06/2018	1	By railway path
Coccinelidae	*7-spot ladybird*	05/04/2018	2	Middle grass area
Coccinelidae	*Eyed ladybird*	23/06/2018	1	On Conifers
Chrysomelidae	*Agelastica alni*	16/06/2018	1	Ash wood on Alder leaf
Chrysomelidae	*Chatocnema hortensis*	27/06/2018	1	Water trap Conifers
Chrysomelidae	*Longitarsus exoletus*	22/07/2018	2m	On Common Gromwell
Oedemeridae	*Oedemera lurida*	21/05/2018	2m	Catsears top fenced area
Oedemeridae	*Oedemera nobilis*	21/05/2018	2m 4f	Catsears top fenced area
Scarabaeoidea	*Serica brunnea*	27/06/2018	1f	Water trap Conifers
Curculionidae	*Strophosoma melanogramma*	27/06/2018	1	Water trap Conifers
Ichneumonidae	-	-	-	-
Anmoloninae	*Agrypon flexiorum*	24/06/2018	1f	Top seat area
Banchidae	*Glypta mensurator*	22/07/2018	1f	On Knapweed by pond
Cryptinae	*Sphecophaga vesparum*	07/05/2018	2f	Path opposite pond
Cryptinae	*Trychosis tristator*	21/05/2018	1m	Swept middle grass area
Diplozontinae	*Syrphophilus tricinctonus*	30/08/2018	1m	Top Sallow
Pimplinae	*Ephialtes manifestor*	24/06/2018	1f	Pond Elm
Diplozontinae	*Syrphoctonus pictus*	14/05/2018	1m	Top fenced area
Braconidae	-	-	-	-
Cheloninae	*Chelonus corvulus*	16/06/2018	1m	Sweeping Middle
Cheloninae	*Microchelonus pedator*	25/07/2018	1m	Bottom water trap
Euphorinae	*Pygostylus otiorhynchi*	08/08/2018	1f	Top fenced area
Chalcidae	-	-	-	-
Chalcidae	*Haltichella rufipes*	06/08/2018	1f	From Oak top seat area
Chalcidae	*Haltichella rufipes*	27/09/2018	1m	Top Elms
Plant Bugs	-	-	-	-
Aphrophoridae	*Aphrophora alni*	07/07/2018	1f	Bottom bank water trap
Delphacidae	*Conomelus anceps*	13/08/2018	1f	Sweeping Juncus
Deltocephalinae	*Allygidius commutatus*	07/07/2018	3m	Bottom Water trap
Deltocephalinae	*Eupelix cuspidata*	24/06/2018	1m	Swept in Ash Wood
Deltocephalinae	*Mocydia crocea*	13/08/2018	1f	Sweeping grasses
Tingidae	*Dictyonata strichnocera*	25/07/2018	1f	Mid bank water trap
Rhopalidae	*Rhopalus subrufus*	25/07/2018	1f	Bottom bank water trap
Nabididae	*Narbus ericitorum*	09/04/2018	1	Amongst Grasses
Acanthosomatidae	*Acanthosoma haemorrhoidale*	14/05/2018	1	Top fenced area
Pentatomidae	*Aelia acuminata*	21/05/2018	1	Middle section
Pentatomidae	*Palomena prasina*	30/08/2018	1	Top Sallow

12. Appendix 4. Survey Diary

The season began in March, with much anticipation, to see if the many new bunds and scrapes would attract even greater numbers of species already present, and hopefully new species to the quarry. At the start of the survey I thought that I might add six to eight new species to the site, and that ten may not be achievable. How wrong can you be, and I do not think that anyone could have anticipated the 'new species' explosion which was to follow in the coming months. I think the biggest factor in this exceptional summer was the weather. Bees and wasps are highly mobile insects, and in this year of day after day of hot sunshine they will travel much further than in a year when you only get sunny days a couple of times a week.

The first day of recording in March produced the usual early emerging bumblebee species, and the mining bees *Andrena clarkella* and *Andrena bicolor*.

The first week of April saw the first new species to Marford Quarry, *Andrena apicata*, which was found below the conifers. This is a scarce species in North Wales, and this is only the second record for Denbighshire VC50.

Some time sieving grass tussocks and litter in the North seat area in the second week of April produced three species of ants including *Lasius alienus* which was new to the quarry. On the same day, three *Nomada leucopthalma* were seen around the nest burrows of its host *Andrena clarkella* in a sandy scrape next to the conifers - this 'Nomada' was a new species to Marford, but not unexpected.

During the next two weeks of April, a male *Nomada lathburiana*, and several of its host *Andrena cineraria* were found, both new to Marford Quarry. Another new find was *Nomada marshamella* in the newly created sandy bunds opposite the conifers.
It the same area, at least seven *Lasioglossum fulvicorne* females were nest digging in the new bunds. This was an unexpected species which is usually found in limestone grassland.

The most memorable day in Marford Quarry this year was in mid April. In the company of Ian Hughes, we saw that many areas of the quarry were buzzing with large numbers of *Colletes cunicularius*. This Nationally Rare species was confined to coastal areas in Wales until the last few years, when it has since colonised some inland sandy areas. It is not an exaggeration that we estimated there were more than 1000 individuals flying around on the day.

In the latter part of April, the red and black cuckoo bee *Sphecodes pellucidus* was seen in good numbers, more than thirty on one visit, and it was more numerous than its host *Andrena barbilabris*.

Seven new aculeate species were added to the Marford Quarry list in April.

In early May, a male and female of the Nationally Scarce mason bee *Osmia aurulenta* were found around the new bunds below the conifers. This usually coastal species is rarely found inland in Wales. It has an unusual breeding cycle in that empty snail shells are used as nest sites.

In mid May, I was half way up the big bank east of the conifers when a black and yellow wasp species landed on a disguarded larger can (I think it was 'Fosters').
It turned out to be a male *Odynerus spinipes*, another first for Marford Quarry. A female was found in the same area a week later. Towards the end of May, *Lasioglossum rufitarse* and *Lasioglossum villosulum* were netted from 'Catsears' growing in the middle fenced area, both were new to the Quarry.

Three new aculeate species were added to the Marford Quarry list during May.

During June, the site was swarming with aculeates, and *Cerceris arenaria* was abundant with twenty-five counted in its main nesting area opposite the conifers. It was using the small mounds of pure sand a couple of feet high, created when holes were dug to make the ground more undulating.

Philanthus triangulum (Bee Wolf) had its best year to date, with more than ninety nest holes found in three areas of the site. They were using the older, more stabilised bunds which were created a couple of years ago. It was good to record the Nationally Rare *Stelis ornatula* again this year. Marford Quarry is its only site in North Wales.

The tiny ant *Leptothorax acervorum* was found on the middle Elm, where they were probably nesting in mid June.

The yellow water traps were seemingly irresistible to some species, when one minute after filling one up, a male *Tachysphex pompiliformis* dived straight in. Three spider-hunting wasp species were attracted to a trap put out just below the conifers, of which *Anoplius infuscatus* and *Anoplius nigerrimus* were new to the site list. A male *Coelioxys inermis* was also in the same trap. An even scarcer North Wales species, *Coelioxys conoidea*, was netted at the base of the big bank. Both these species use Megachilidae (Leaf-cutter bees) as hosts.

The last week of June produced three species which I had never dreamed of seeing in the Quarry. The cuckoo bee *Nomada flavopicta* which uses bees of the '*Mellita*' genus as hosts - none of the *Mellita* species has been found in the Quarry, but they could be also present. An unfamiliar looking species netted from one of the few Weld (*Reseda luteola*) plants on the site turned out to be the Nationally Scarce Cuckoo wasp *Nysson*

trimaculatus. The real star find amongst the many must be the Nationally Rare wasp *Gorytes laticinctus*. This record is about 150 miles from its Southern England distribution, where it is scarce.

Twelve new aculeate species were added to the Marford Quarry list in June.

As the summer became even hotter, there was no let up in the appearance of new species during July. The water traps, one in the middle of the high bank and the other at the base of the bank in the quarry bottom, were most productive.

Three new spider-hunting wasps were caught in the middle trap, *Dipogon variegatus*, *Arachnospila spissa* and *Arachnospila wesmaeli*, the latter being a Nationally Scarce species. This is the first record for Denbighshire (VC50). In the bottom bank trap, *Psenulus pallipes* and *Stigmus solski* were added to the ever growing 'new species' list, both being dead-wood nesters.

I had been keeping an eye out on Weld (*Reseda luteola*) for the bee *Hylaeus signatus*, which only uses '*Reseda*' species for pollen collection. My persistence paid off when in late July I found two females on one of the few Weld plants in the Quarry. In the last week of July, *Andrena denticulata*, on Ragwort, and the cuckoo bumble bee *Bombus rupestris*, on Knapweed, were added to the ever-growing new species list.

Twelve new aculeate species were added to the Marford Quarry list in July.

The most numerous species in August was the abundant *Mellinus arvensis*, the females of which were searching over tree foliage for flies with which they provision their nests. I thought that the new species bonanza was over but imagine my surprise when looking at the top elm for late nesting dead-wood species, there in front of me was a huge *Vespa crabro* (Hornet) scraping up dead wood for nest building. This advanced the new species list to 34, which lifted the Marford Quarry list
to 170 species. In late September, I went around the site to take photos for the report. There was one last surprise new species when I found *Colletes hederae* (Ivy Bee) on the bank just above the pond - also a new species for Denbighshire (VC50).

After a memorable summer recording the bees, wasps and ants of Marford Quarry, the total species found in 2018 was 120 species, of which 35 were new species to the site. **The overall Marford Quarry aculeate list now stands at 171 species.**

The number of new species added this year leads me to believe that with more recording in the future Marford Quarry could become the best site for aculeates in the whole of Wales.

Chrysidae – Jewel Wasps

Chrysis ignita Local
One male on the middle dead elm on 1-6-18. Four around the Top Elm on 30-8-18. The host for this species are the dead wood nesting *Ancistrocerus* species.

Chrysis viridula Local New to Quarry
One female in the water trap at the base of the big bank on 7-7-18. The host for this metallic red, green, and blue wasp is *Odynerus spinipes*.

Hedychridium ardens Common
Found in small numbers in all areas of the Quarry. The host for this small cuckoo wasp is *Tachysphex pompilliformis*. The flight dates were 1 June – 25 July.

Tiphiidae
Tiphia femorata Nationally Scarce New to Quarry
One female on 22-7-18, and one male on 25-7-18. Both were in the Water Trap at the base of the bank. The host for this species is Scarabaeid beetle larvae.

Formicidae – Ants
Lasius alienus Local New to Quarry
One female found by hand searching in the sparsely vegetated area by the North seat on 8-4-18.

Lasius flavus Common
Two females found in the same area as above on 8-4-18, one female in the bottom bank water trap on 4-7-18.

Lasius mixtus Local
Two females found in the sparsely vegetated North seat area on 8-4-18.

Lasius niger/platythorax Common
Abundant all over the site.

Leptothorax acervorum Local New to Quarry
Two female workers on the fallen middle Elm on 16-6-18.

Myrmica scabrinodes Local
One female found in the middle sandy area on 8-4-18.

Myrmica rubra Common
Five females in the bottom bank water trap on 4-7-18.

Pompilidae – Spider-hunting Wasps
Anoplius infuscatus Local New to Quarry
One female in the water trap below conifers on 23-6-18.

Anoplius nigerrimus Local New to Quarry
One male netted near the quarry entrance, and one female in the water trap below the conifers, both on 23-6-18.

Arachnospila anceps Local
Two male and one female in the water trap below conifers on 23-6-18, and one female in the mid high bank water trap on 7-7-18.

Arachnospila spissa Local New to Quarry
One male in the mid high bank water trap on 22-7-18.

Arachnospila trivialis Local
One male in conifers water trap on 23-6-18, and a female in mid high bank water trap on 7-7-18.

Arachnospila wesmaeli Nationally Scarce New to Quarry
One male in the mid high bank water trap on 4-7-18.

Ceropales maculata Local
One female netted below conifers on 21-5-18.

Dipogon variegatus Local New to Quarry
Two females in the mid bank water trap on 7-7-18.

Evagetes crassicornis Local
Seven females and five males recorded between 21-5-18 and 7-7-18. This Cuckoo Pompilid uses other Pompilids as its host.

Pompilus cinereus Local
One female in the mid bank water trap on 22-7-18. This species is usually the most numerous Pompilid in the quarry.

Priocnemis exaltata Local
One male in the mid bank water trap on 4-7-18.

Vespidae – Potter Wasps, Mason Wasps, and Social Wasps
Ancistrocerus gazella **C**ommon New to Quarry
One male netted on top Elm on 24-6-18, and one netted on pond Elm on 8-8-18.

Ancistrocerus nigricornis Local
Two males netted from the pond Elm on 19-7-18.

Ancistrocerus scoticus Local New to Quarry
One male netted from an Ash trunk near the site entrance on 2-7-18.

Ancistrocerus trifasciatus Local
One male netted from the top Elm on 4-7-18.

Dolichovespula saxonica Local
Two females in the bottom bank water trap on 4-7-18.

Vespa crabro (Hornet) Local New to Quarry
One female pulping rotten wood for nest material from the top Elm on 30-8-18. One female flying in the Ash wood on 27-9-18. At least flying around foliage on 17-10-18.

Vespula germanica (German Wasp) Common
One Queen netted in the middle of the quarry on 19-4-18, and a female in the bottom bank water trap on 25-7-18.
Vespula vulgaris (Common Wasp) Common
One Queen netted in the middle of the quarry on 19-4-18. Abundant in most areas of the quarry in August and September.

Odynerus spinipes Local New to Quarry
The first quarry record was when a male was seen to land on a blue larger can on the mid high bank on 21-5-18. a female was netted in the same area on 1-6-18.

Sphecidae – Solitary Wasps
Cerceris arenaria Local
Flight period was 16-6-18 to 19-7-18 in areas of exposed sand. Twenty five counted in its main nesting area, which was in the small sand mounds created when the digger dug out shallow holes a couple of feet deep opposite the conifers. This species provisions it nests with Weevils.

Cerceris rybyensis Local

On the wing from 16-6-18 to 25-7-18. Only up to four in any visit, again nesting in the sand mounds opposite the conifers. A male nectering on Rose-bay Willow herb on 25-7-18.

Crabro peltarius Local
While standing by one of the newly constructed bunds opposite the conifers on 27-6-18, I noticed grains of sand trickling down the bank. It was some species digging a nest burrow. I plunged a collecting tube into the sand, and captured a female wasp of this species, it was the only one of the year.

Crossocerus annulipes Common
A female netted from a prostrate Birch log just outside the top fenced area on 25-7-18.

Crossocerus cetratus Local
Four females and three males recorded from Top Elm and Middle Elm between 1-6-18 and 24-6-18.

Crossocerus dimidiatus Local
2 females netted from the bank by the pond on 4-7-18, and two males and one female on the top Elm on 30-8-18.

Crossocerus megacephalus Common
One female netted from the top Elm on 16-6-18.

Crossocerus ovalis Local
Two females netted from prostrate fence posts way above pond on 22-5-18, and one female netted from Creeping Thistle flowers on 11-7-18.

Crossocerus quadrimaculatus Common
Two males netted on the newly formed bunds opposite the conifers on 22-7-18.

Crossocerus wesmaeli Local
One male netted on the bare sand area of the Quarry bottom on 19-7-18.

Ectemnius cavifrons Common
A single male netted on 29-6-18, and another male on 4-7-18 both on the pond Elm.

Ectemnius continuus Common
Abundant this year. Flying from 1-6-18 to 30-8-18. It was nesting in the mid Elm and the top Elm, in lying fence posts, and a rotting Sallow by the railway.

Gorytes laticinctus Nationally Rare New to Quarry
Only recorded in Southern England, so a complete surprise to find one in our Quarry in North Wales. A female netted by the new bunds opposite the conifers on 27-6-18.

Mellinus arvensis (Sand Digger Wasp) Common
Found in all areas of the Quarry from 19-7-18 to 27-9-18.

Nysson trimaculatus Nationally Scarce New to Quarry
A female netted from Weld close to the top fenced area on 29-6-18. Its host is *Gorytes quadrifasciatus*, a species yet to be found in the quarry.

Oxybelus uniglumis Common
Frequent in all areas of the quarry with more than 10 on some visits. recorded from 21-5-18 to 25-7-18. The flies this species uses for nest provision are carried back to the nest impaled on its sting.

Passaloecus corniger Common
One male at the top Elm on 2-7-18 was the only record.

Passaloecus singularis Common

Two males and one female at the top Elm between 23-6-18 and 19-7-18.

Pemphredon lugubris Common
The first record was one female entering the old Sallow stump opposite the bottom seat. One female on 30-8-18 and three females at the top Elm on 27-9-18.

Philanthus triangulum (Bee Wolf) Nationally Rare
Flight period recorded from 16-6-18 to 8-8-18. 55 nest diggings counted on the sandy bank where you turn left on path above pond, and twenty five nest diggings in the bund formed a couple of years ago, just past where the large gateposts used to be. Twelve nest diggings along the path from the pond back down to the railway path. Making a site total of 92 nests this year. Several males were nectering on Rose-bay Willow Herb on 25-7-18. This species catches Honey Bees to provision their nests, and there are four hives full at the top of the big bank.

Psenulus pallipes Common New to Quarry
One male in the bottom bank water trap on 19-7-18.

Stigmus solskyi Local New to Quarry
2 females in the bottom bank water trap on 27-7-18, and 3 females and 2 males netted at the top Elm on 27-9-18.

Tachysphex pompiliformis Local
Within three minutes of filling a water trap below the conifers a male splashed down into the water, two days later there were seven males and four females in the trap on 23-6-18. Up to eight in the mid bank, and bottom bank water traps between 27-6-18 and 7-7-18. This species provisions its nests with Grasshopper nymphs.

Apoidea – Solitary Bees
Colletinae
Colletes cunicularius Nationally Rare
This once very rare coastal species, has spread inland in England and Wales in recent years. The males emerge first and can be seen quartering the sandy ground for females. On 9-4-18 at least fifty were seen around the new bunds below the conifers. On 19-4-18, in the company of Ian Hughes, we estimated that around One Thousand individuals were present, in all areas of the quarry, where sand was exposed. The main nesting areas were on the new bunds below the conifers, the open sand in the quarry bottom, the sandy area on the big bank, the other side of the conifers, and the small sandy area near the North seat. The last recorded date was eight females on 21-5-18.

Colletes daviesanus Common New to Quarry
One male on Ox-eye Daisy in thr top fenced area on 16-6-18, and two males in the same area on 24-6-18.

Colletes hederae (Ivy Bee) Local New to Quarry
This species has rapidly spread North since its recent arrival in Britain. A female netted on the sandy bank, just above the pond on 27-9-18. Its only food plant is Ivy. I think that this is the first record for Denbighshire VC 50.

Hylaeus brevicornis Local
Two females on Creeping Thistle flowers on a new bund opposite the conifers on 4-7-18.

Hylaeus communis Local
One male netted from Ash close to the middle elm on 23-6-18.

Hylaeus signatus Nationally Scarce New to Quarry
This uncommon species only uses *Reseda* species as forage plants. I kept my eye on the very few Weld (*Reseda luteola*) plants hoping to find this species. My patience paid off on 4-7-18 when two females were recorded, not far outside the top fenced area.

Andreninae
Andrena apicata Nationally Scarce New to Quarry
A male netted from a sunlit Sycamore trunk below the conifers on 5-4-18.

Andrena barbilabris Local

Flight period 19-4-18 to 1-6-18. Found in all areas of the quarry, with fourteen males opposite and below the conifers on 26-4-18. This species nests in bare sand.

Andrena bicolor Common
Flight period 5-4-18 to 23-6-18. Two females on gorse flowers on 5-4-18. Small numbers in all areas of the quarry. This species is double brooded.
Andrena carantonica Common
One male on Gorse flowers by the pond on 9-4-18, and a female entering a nest hole in a new bund below the conifers on 14-5-18.

Andrena cineraria Local New to Quarry
Flight period 19-4-18 to 14-5-18 Four males and six females recorded widely across the Quarry.

Andrena clarkella Common
One of the very first species to emerge in spring. Four males netted by the horseshoe seat on 25-3-18. Three females digging nest burrows in a sandy face right next to the conifers on 8-4-18. Three females resting on bare sunlit gorse branches on 9-4-18.

Andrena denticulata Local New to Quarry
One male and one female on Ragwort at the path junction above the pond on 19-7-18. One female on Knapweed near the quarry entrance on 22-7-18.

Andrena haemorrhoa Common
One female netted in the quarry bottom on 14-5-18.

Andrena nitida Common
One female netted below the conifers on 7-5-18.

Andrena nigroaenea Common
One female on Dandelion on 19-4-18, and one female in the conifers water trap on 23-6-18.

Andrena praecox Local
One female swept from grasses above the conifers on 8-4-18.

Andrena subopaca Local
One male on a Daisy flower by the pond on 26-4-18.

Anthophorinae
Epeolus variegatus Local
One female netted in the open sandy area in the quarry bottom on 29-6-18. Its host in the quarry is *Colletes daviesanus*.

Nomada fabriciana Common
Three females on 8-4-18, and two on 7-5-18 on the new bunds below the conifers. Its host is *Andrena bicolor*.

Nomada flava Common
Flight period 26-4-18 to 14-5-18. Four females netted on the new bunds around the conifers. Its hosts are several *Andrena* species.

Nomada flavoguttata Common
Flight period 14-5-18 to 29-6-18. One male and four female netted on the new bunds around the conifers. Its hosts are several small *Andrena* species.

Nomada flavopicta Nationally Scarce New to Quarry
A totally unexpected species to find. A male netted on the bunds opposite the conifers on 29-6-18. Its host are *Mellita* species, none of which has been found in the quarry.

Nomada goodeniana Common

Flight period 19-4-18 to 1-6-18. Three males and five females recorded, all in the bunds below the conifers. Its hosts are the larger *Andrena* species.

Nomada lathburiana Nationally Rare New to Quarry
One male netted from Gorse at the middle of the high bank on 19-4-18, and two females below the conifers on 14-5-18. Its host is *Andrena cineraria*, which was also new to the quarry this year.

Nomada leucopthalma Local New to Quarry
One male, and three females, flying with *Andrena clarkella*, its host, in the new sandy dig opposite the conifers on 8-4-18.

Nomada marshamella Common New to Quarry
One male on 19-4-18, and one female on 7-5-18. Both on the new bunds opposite the conifers. Its host is *Andrena carantonica*.

Nomada panzeri Common
One female above the pond on 7-5-18. Its hosts are several of the larger *Andrena* species.

Megachilinae - *Megachile* species are leaf Cutter Bees
Coelioxys inermis Local New to Quarry
One male in the water trap below the conifers on 23-6-18. Its hosts are *Megachile* species.

Coelioxys conoidea Local New to Quarry
A female netted at the base of the big bank in the quarry bottom on 27-6-18. Its host is *Megachile maritima*.

Hoplitis claviventris Common
One female swept in the grassy area above the conifers on 29-6-18. It nests in dead stems of Ragwort and Rose.

Megachile ligniseca Common New to Quarry
Flight period 1-6-18 to 4-7-18 five males and two females were found in this period. Flowers visited were Birdsfoot trefoil and Ragword mostly in, and around the top fenced area.

Megachile maritima Local
Flight period 16-6-18 to 2-7-18. Recorded in all areas of the Quarry. At least six females visiting a nest site in the bottom enclosed area, in a long established bund on 29-6-18. Seen to visit Birdsfoot Trefoil and Ragwort flowers.

Megachile versicolor Local
Only one record, a female on Ragwort flowers in the bottom fenced area on 11-7-18.

Megachile willughbiella Common
Flight period 21-5-18 to 4-7-18. Three males recorded. One Half way up the big bank on Birdsfoot Trefoil on 21-5-18, one close to the pond on 16-6-18, and one in the top enclosure on 4-7-18.

Osmia aurulenta Nationally Scarce
This usually coastal species, is rarely recorded inland. One female netted on the new bunds below the conifers on 7-5-18, and a male in the same area on 14-5-18. This species nests in empty snail shells.

Osmia bicornis (Red Mason Bee) Common
One female below the conifers on 7-5-18, and two in the same area on 14-8-18.

Stelis ornatula Nationally Rare
This Cuckoo Bee is a genuinely rare British species. One female netted on the new bunds below the conifers on 1-6-18. Its host is *Hoplitis claviventris*.

Halictinae
Halictus rubicundus Common
One female netted by the new bunds opposite the conifers on 7-5-18.

Lasioglossum calceatum Local
One female netted opposite the conifers on 14-5-18, and one male netted at the woodland edge at the top of the big bank on 11-7-18.

Lasioglossum fulvicorne Common New to Quarry
Seven female were netted along the new sandy bund opposite the conifers where they were entering nest holes on 19-4-18, and two more females netted on 7-5-18 in the same area.

Lasioglossum leucopus Local
Flight period was 14-5-18 to 19-7-18 found in all areas of the quarry in small numbers.

Lasioglossum leucozonium Common
Only one record, a male nectering on Rose-bay Willow herb on 8-8-18.

Lasioglossum morio Common
First of the Spring was a female on Wild Strawberry on 26-4-18. Small numbers recorded in all areas up to 25-7-18.

Lasioglossum parvulum Common
One female netted from Catsear in the middle fenced area on 14-5-18, and a male netted along the Railway path on 23-6-18.

Lasioglossum rufitarse Local New to Quarry
Three females netted from catsear in the middle fenced area on 21-5-18, and a male nectering on Rose-bay Willow herb on 25-7-18.
Lasioglossum villosulum Common New to Quarry
Two females netted from Catsear in the middle fenced area on 21-5-18, and a male in the bottom bank water trap on 25-7-18.

Sphecodes crassus Nationally Scarce
One female netted from the new bunds opposite the conifers on 21-5-18. The hosts of this species are several *Lasioglossum* species.

Sphecodes ephippius Common
One female netted on the new bunds opposite the conifers on 19-4-18. Two females on 7-5-18, and two females on 21-5-18, both on new bunds below conifers. The host of this species is *Lasioglossum leucozonium*.

Sphecodes geoffrellus Common
Flight period 7-5-18 to 2-7-18. Small numbers found on the new bunds opposite, and below the conifers. The hosts are several *Lasioglossum* species.

Sphecodes gibbus Common New to Quarry
One female netted on the new bunds opposite the conifers, and another female found half way up the big bank on 11-7-18. The host of this species is *Halictus rubicundus*.

Sphecodes monilicornis Local
A female netted on the bank just above the pond on 25-7-18 was the only record. Its hosts are *Halictus*, and *Lasioglossum* species.

Sphecodes pellucidus Local
Flight period from 19-4-18 to 2-7-18. This is by far the most numerous *Sphecodes* species in the quarry with at least 30 recorded on 19-4-18, and after smaller numbers in all areas of the quarry. Its single host is *Andrena barbilabris*.

Sphecodes puncticeps Unknown
Two females netted on the new bunds opposite conifers on 7-5-18, and one female below the conifers on 14-5-18. Its host is *Lasioglossum lativentre*, a species not yet recorded from the quarry.

Apinae
Bombus hortorum Common
Scarce this year, only one female seen in the top fenced area on 16-6-18.

Bombus hypnorum (Tree Bumblebee) Common
A female on Hellebore flowers on 25-3-18, and a female on Gorse flowers on 5-4-18.

Bombus lapidarius Common
Abundant all over the quarry, flying from 5-4-18 to 27-9-18.

Bombus lucorum Common
Scarce this year, one queen on 5-4-18.

Bombus pratorum Common
Good numbers flying from 5-4-18 to 30-8-18.

Bombus pascuorum Common
The most abundant Bumblebee flying from 9-4-18 to 27-9-18. A lover of Birdsfoot trefoil.

Bombus rupestris Nationally Scarce New to Quarry
One male of this cuckoo bumblebee was found on Knapweed on the bottom path by the railway on 22-7-18. Its host is the Red-tailed Bumblebee *Bombus lapidarius*.

Bombus terrestris Common
Two Queens on 25-3-18, and three on 5-4-18.

Bombus vestalis Common
One female on Sallow on 19-4-18. Two males netted in the Ash wood on 23-6-18, and two males on 25-7-18 in the quarry bottom, one on Stemless Thistle.

Apis mellifera (Honey Bee) Common
6 females on Sallow on 25-3-18 was the first record. Numbers built up on most visits, with at least 40 on 23-6-18. The source of the Honey Bees was found when I came across 4 hives in the woodland at the top of the big bank.
One of our rarest species the Bee Wolf (*Philanthes triangulum*) will never be short of nest provisions again.

13. 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://libcat.naturalresources.wales or http://catllyfr.cyfoethnaturiol.cymru by searching 'Dataset Titles'. The metadata is held as record no 122469.