Cyfoeth Naturiol Cymru
Natural Resources Wales

The status of the Snowdon Beetle *Chrysolina cerealis* on Yr Wyddfa in 2015

World Museum Liverpool

NRW Evidence Report No. 160

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O fewn y DU mae Chwilen yr Wyddfa *Chrysolina cerealis* wedi'i chyfyngu i'r Wyddfa, er ei bod i'w chanfod hefyd yng Nghwm Idwal tan 1980. Gan mai ychydig o gofnodion a geir ar gyfer y chwilen, cafodd yr arolwg presennol ei gynnal mewn ymdrech i bennu ei statws a'i dosbarthiad. Daethpwyd o hyd i bum chwilen (pedwar larfa ac un chwilen lawndwf) ar ôl 63.5 awr o chwilio â llaw ar ac o amgylch planhigion teim (yr unig blanhigyn bwyd sydd wedi'i gofnodi ar gyfer y chwilen yn y DU) a thrwy droi cerrig ger clystyrau o deim rhwng Mehefin a Medi 2015. Fe ddaethpwyd o hyd i'r holl sbesimenau ar Glogwyn Coch ym mis Medi. Gan na ddaethpwyd o hyd i'r chwilen yng Nghwm Du'r Arddu, ei hardal draddodiadol, er gwaethaf chwilio dyfal, awgrymir yn betrus fod y chwilen yn cilio i lecynnau uwch, efallai oherwydd newid hinsawdd neu ffactorau eraill. Ni ddaethpwyd o hyd i *C. cerealis* yng Nghwm Idwal ar ôl treulio pum awr yn chwilio amdani ym mis Medi, er bod ei phlanhigyn bwyd i'w gael yno. Argymhellir y dylid parhau â'r astudiaethau yn 2016.

2. Executive Summary

The Snowdon Beetle *Chrysolina cerealis* is restricted in the UK to Snowdon(Yr Wyddfa), although it was also found in Cwm Idwal until 1980. As recent records of the beetle have been few, the current survey was undertaken in an attempt to determine its status and distribution. A total of five beetles (four larvae and one adult) was found following 63.5 hours of hand searching on and around thyme plants (the only recorded foodplant of the beetle in the UK) and stone-turning near patches of thyme from June to September 2015, with all specimens found on Clogwyn Coch in September. As no beetles were found in Cwm du'r Arddu, its traditional hotspot, despite exhaustive searches, it is tentatively suggested that the beetle is retreating to higher altitudes, perhaps as a consequence of climate change or other factors. *C. cerealis* was not found in Cwm Idwal following a five hour search in September, despite the presence of the foodplant. It is recommended that studies continue in 2016.

3. Introduction

3.1. Background information

Whilst the Snowdon Beetle *Chrysolina cerealis* is widespread in Europe, from Norway to northern Italy (Buse, 1993), it has been recorded in the UK only from the Snowdon massif (Yr Wyddfa) and Cwm Idwal, although subfossil deposits have been found in kettle holes to the west of Criccieth (Coope & Brophy, 1972). Described as a glacial relict, it is most often associated with montane habitats, although there are anomalous records of it feeding on lavender at sea level in southern France, and it was reported from France in abundance on wheat in the 1870s (Anon., 1875). At its Welsh localities, it is restricted to base-rich montane grassland where both larvae and adults feed exclusively on the flowers and leaves of wild thyme *Thymus polytrichus*. European populations are reported to utilise members of various plant families including Asteraceae, Fabaceae, and Labiatae.

It has not been recorded in Cwm Idwal since 1980, despite repeated searches (Shackshaft, 2007a&b; Strong & Moscrop, 1991). It is regarded as Endangered in the UK (Hubble, 2014) although it is more likely to be Critically Endangered given its apparent absence from Cwm Idwal. The beetle is also protected under Schedule 5 of the Wildlife & Countryside Act. Adults have been recorded from April to October, with most found between June and September (see Appendix A), and larvae have been found in August and September. It is thought to be flightless (Buse, 1993, Shackshaft, 2007b), presumably to save energy and avoid being blown away from its habitat (Lopatin, 1996).

Buse (1993) highlights the fluctuating population numbers and often contradictory nature of records since recording on Snowdon was first reported in mid-1800s. It "appeared to be plentiful in Wales" in 1856 (Anon., 1856) and it was not uncommon on a slope at 853m in 1874 (Champion, 1875). Only two adults were found after "a long and careful search" in August 1885 (Wilding, 1885), who noted that thyme "was almost as scarce as the beetle". Ellis (1934) found it difficult to find in 1886 although he recorded 17 adults in a small area after four hours of searching on 30th June 1886 (Ellis, 1887), and was pleased to see the beetle "occurring in sudden abundance" (Birch, 1902). Wood (1901) failed to find a single specimen in 1901 but Tomlin & Sopp (1901) found 12 specimens in the same year and Kidson-Taylor (1906) found it very sparingly at the roots of thyme in September 1905. Thirteen specimens in the National Museum of Wales, Cardiff collected by J. Chappell are labelled 'Snowdon July 1902', and Donisthorpe (1906) collected 24 specimens on 30th June 1906. Parry (1988) found 13 adults under stones after 90 minutes of searching in July 1978 and Shackshaft (2007a) found the remains of beetles at thirteen localities in July 2007, but no live specimens. Table 1 highlights counts in excess of 10 individuals. Remaining counts are of low numbers of adults or larvae, even during intensive searches (Buse, 1993; Evans, 1990; Shackshaft, 2007a&b; Turner, 1991; Adrian Fowles, pers.obs.).

Detailed studies of the Snowdon population, including autecological observations of captive specimens, have been undertaken by Buse (1993), Parry (1988) and Sopp (1902). Buse (1993) reported that females laid between seven and 18 eggs, mainly singly but with clutch sizes varying between one and six eggs, at the tips of grass

blades, with eggs hatching after 14 days. Larvae took 38 days to develop to 4th instar at which stage they became inactive in hollows in soil or between stones. Captive females have also been observed laying eggs on thyme leaves (Geoff Gartside, personal communication to Richard Gallon [Cofnod]). Parry (1988) observed that larvae and adults most typically hide amongst root debris and matted fibres beneath vegetation, rather than under stones, making them more difficult to find. Observations by Evans (1990) and Adrian Fowles & Dr. Mike Howe (Fowles, 1995) suggest that adults beetles are nocturnal but that observations are difficult at such times. Whilst population estimates are difficult to make, Buse (1993) suggested 1000 adults in June and July, whilst Parry (1988) and M.L. Cox (in a letter to Peter Hope Jones of the Nature Conservancy Council, dated 11th January 1989) postulated a population of 10,000 adults.

Table 1: Counts in excess of 10 specimens of *Chrysolina cerealis*.

Site	GR	Date	Abundance	Recorder	Source
Yr Wyddfa	SH6254	30 June 1886	17 adults	J.W.Ellis	Ellis (1887)
Yr Wyddfa	SH65	18-20 August 1901	12 adults	B.Tomlin & E.J.B.Sopp	Tomlin & Sopp (1901)
Yr Wyddfa	SH65	July 1902	13 adults	J.Chappell	National Museum of Wales
Yr Wyddfa	SH65	30 June 1906	24 adults	H.Donisthorpe	Donisthorpe (1906)
Clogwyn d'ur Arddu	SH6254	July 1978	13 adults	J.Parry	Parry (1988)
Clogwyn du'r Arddu	SH6055	July 2007	remains of 13 adults	M.Shackshaft	Shackshaft (2007a)

C. cerealis has been recorded from a wide area of Yr Wyddfa but there are clusters of records around four main locations – Cwm du'r Arddu; Llechog ridge in Cwm Clogwyn; the Pyg & Miners Tracks and Clogwyn y Garnedd in Cwm Glaslyn; and Cwm Glas (see Figures 1 to 4). Figure 4 illustrate the distribution of sightings in relation to areas of thyme-rich grassland mapped in 1996-98 and 2006. The most recent records are from high altitude (Table 2). Records of the beetle from Cwm Idwal are shown in Figures 5 and 6, with the latter showing areas of mapped thyme grassland which do not coincide with beetle sightings.

Table 2: Records of *Chrysolina cerealis* from 2010 to 2014.

Site	GR	Altitude	Date	Abundance	Recorder
Clogwyn y Garnedd	SH61265441	765 m	23 September 2011	1 adult	Alastair Hotchkiss
Cwm Clogwyn	SH598539	610 m	16 June 2010	2 adults	Andrew Graham
Cwm Clogwyn	SH600537	675 m	26 June 2011	1 adult	Andrew Graham

3.2. Objectives

The objective of the current survey was to determine if *C. cerealis* still occurs on Yr Wyddfa by searching areas of thyme-rich grassland which had recently supported the beetle. Any attempt to quantify status and distribution is likely to require longer-term efforts.

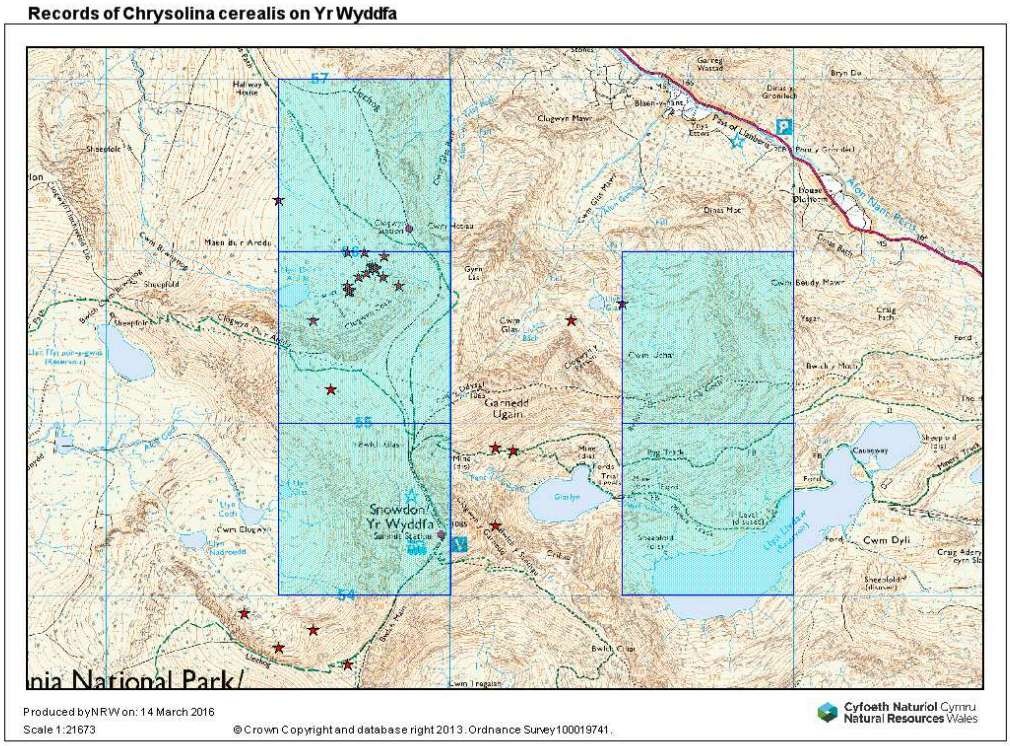

Figure 1: Records of *Chysolina cerealis* from Yr Wyddfa. Red star = records with at least a 6-figure grid reference; blue square = records with a 4-figure grid reference.

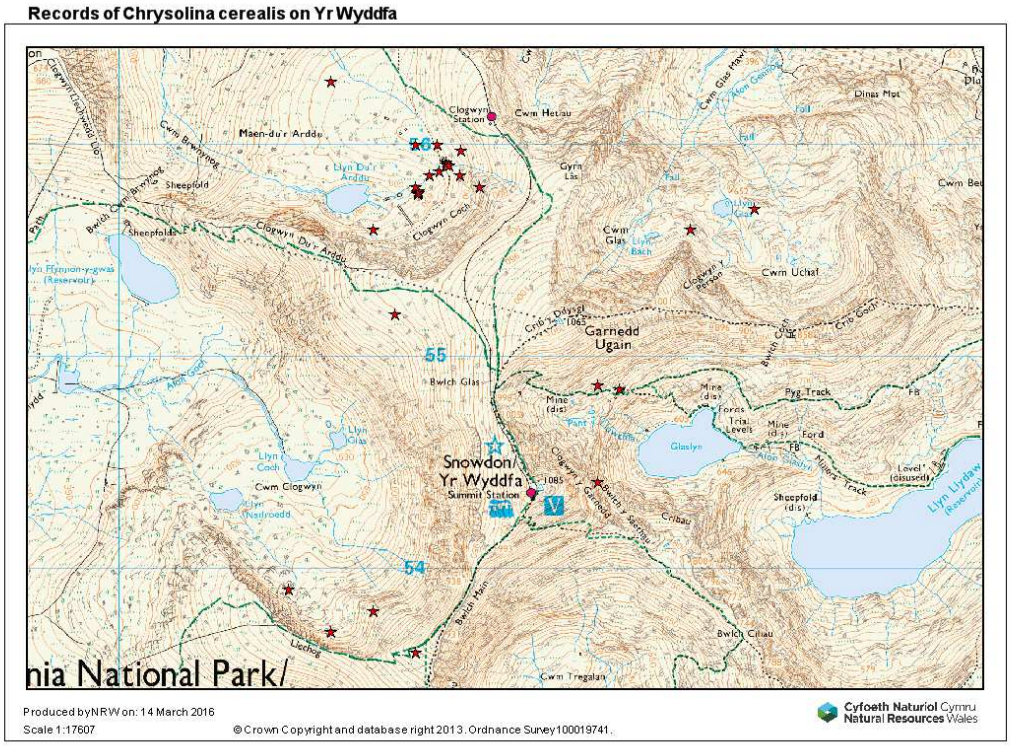

Figure 2: Records of *Chysolina cerealis* from Yr Wyddfa. Red star = records with at least a 6-figure grid reference.

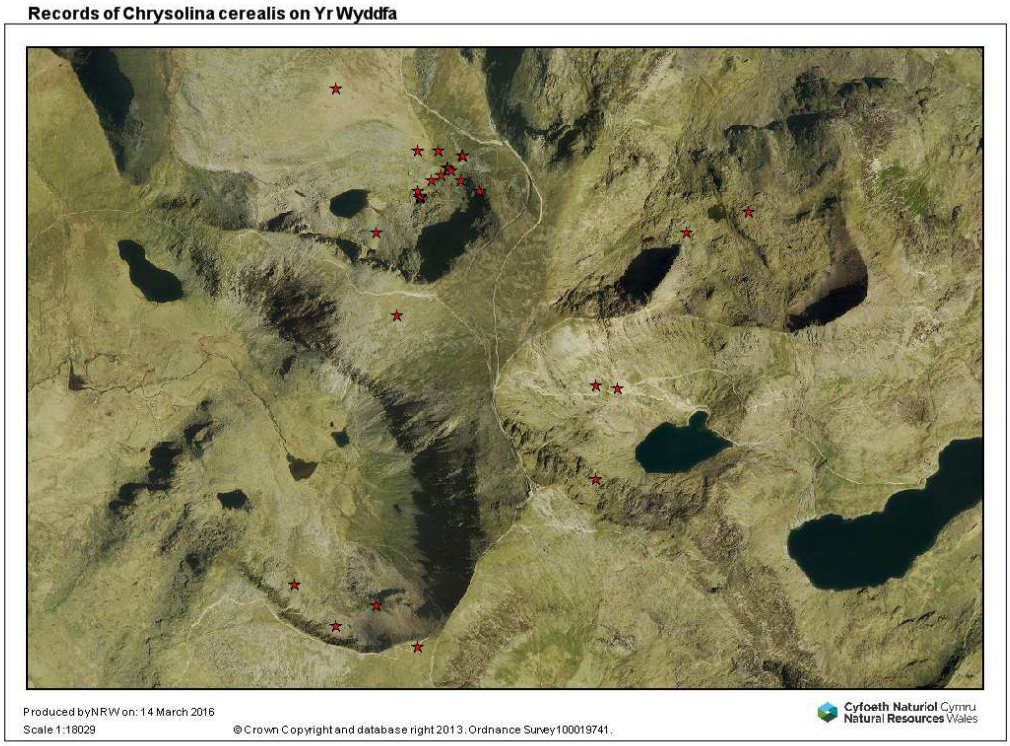

Figure 3: Records of *Chysolina cerealis* from Yr Wyddfa. Red star = records with at least a 6-figure grid reference.

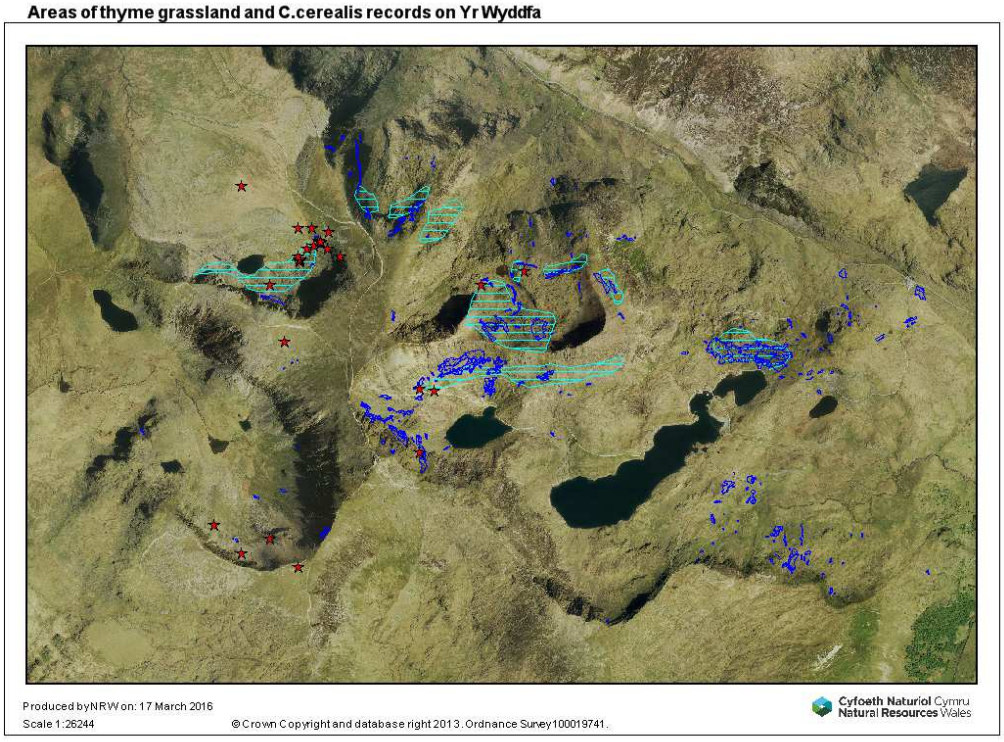

Figure 4: Records of *Chysolina cerealis* from Yr Wyddfa. Red star = records with at least a 6-figure grid reference. Dark blue = thyme grassland mapped in 1996-98 by Alex Turner. Light blue = areas of thyme mapped in 2006.

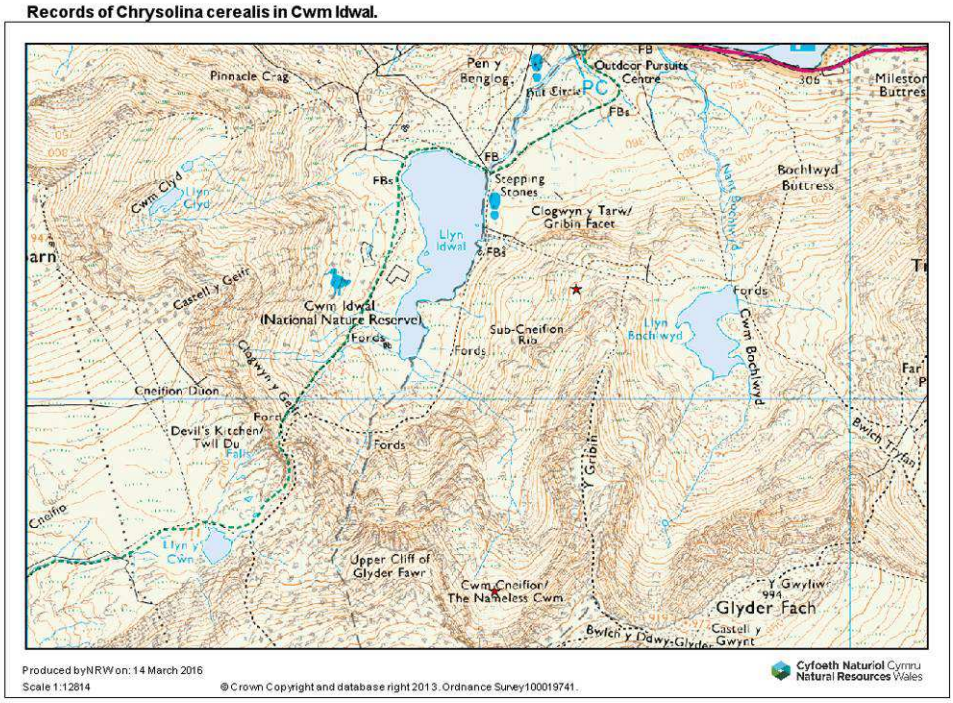

Figure 5: Records of *Chysolina cerealis* from Cwm Idwal. Red star = records with at least a 6-figure grid reference.

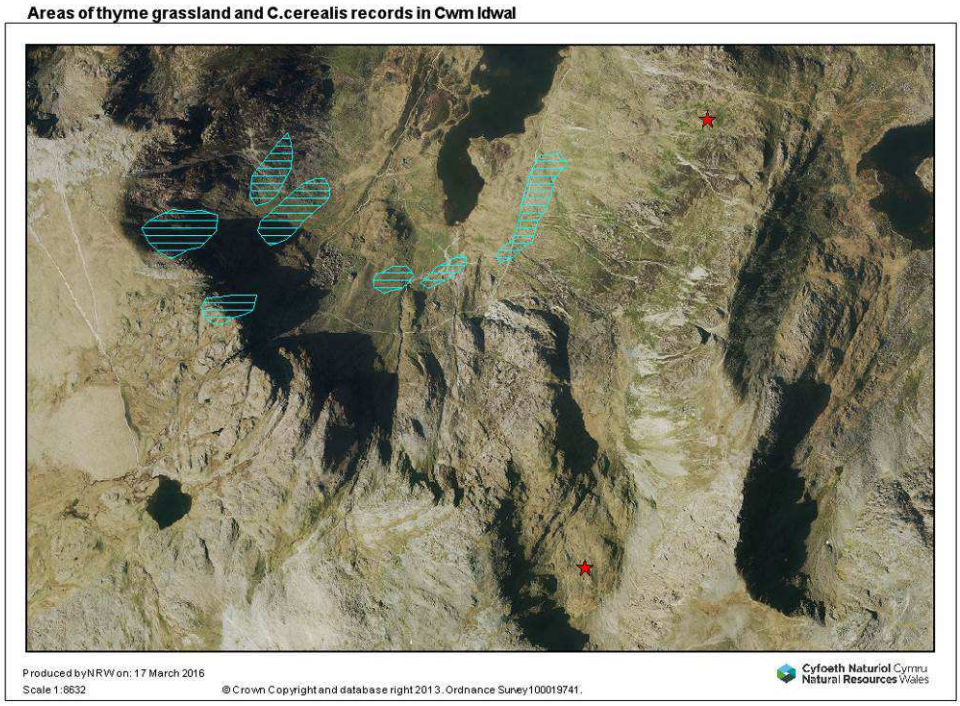

Figure 6: Records of *Chysolina cerealis* from Cwm Idwal. Red star = records with at least a 6-figure grid reference. Light blue = areas of thyme mapped in 2006.

4. Methods

Search effort in 2015 focussed on areas of thyme-rich grassland with recent records of either adults or larvae. Beetles were looked for by visual searches of the foodplant and by turning over stones within the vicinity of thyme (Figures 7 to 9). Most searches were undertaken in daylight, with an additional survey conducted at night when two hours were dedicated to searching thyme plants before sunrise in particularly inclement weather in August. The bulk of the fieldwork was carried out by World Museum Liverpool staff (Tony Hunter TH; Steve Judd SJ) but efforts were supplemented on 16th June and 17th September by staff from Natural Resources Wales (Mike Howe MAH; Alice Jewer AJ; Dafydd Parry DP; Hywel Roberts HR; Harriet Robinson HJR). A total of seven visits was made:

- 16.06.2015 (MAH, TH, DP, HJR, HR) = 20 person hours (fine, dry conditions).
- 19+20.08.2015 (TH, SJ) = 20 person hours (wet and windy conditions).
- 31.08.2015 (TH) = 3 person hours (fine, dry conditions).
- 04.09.2015 (TH, SJ) = 7.5 person hours (damp and overcast conditions).
- 17.09.2015 (MAH, TH, SJ, DP) = 13 person hours (fine and dry conditions).
- 18.09.2015 (TH, SJ) = 5 person hours in Cwm Idwal (wet and windy conditions).

Most of the current survey period was dedicated to sites on Yr Wyddfa, including Clogwyn Coch, Cwm Clogwyn, and Clogwyn y Garnedd, with five person hours spent searching suitable habitat in Cwm Idwal on 18th September.

Voucher specimens of invertebrates other than *C. cerealis* collected by World Museum Liverpool were identified by Tony Hunter, with the exception of some spiders (Chris Felton and Richard Gallon), aculeates (Carl Clee), moths (Mike Hull) and beetles (Richard Loxton).

Figure 7: Typical survey habitat.


Figures 8 & 9: Visual and stone-turning searches for *Chrysolina cerealis*.

5. Results

A total of five *C.cerealis* was recorded during the course of the 2015 survey (Table 3; Appendix B). Four records were of larvae, three of which were feeding on thyme plants and one was under a stone near patches of thyme (Figure 10). A single adult was found, again from under a stone near the food plant. All were found on Clogwyn Coch, the crags above Cwm d'ur Arddu (Figure 11). None was found in the cwm itself, the traditional location for the beetle, despite exhaustive searches.

No beetles were found in Cwm Idwal during a search on 18 September 2015, despite the presence of thyme.

Table 3: Records of *Chrysolina cerealis* from the 2015 survey.

Date collected	Abundance	Grid Reference	Altitude
4 September 2015	2 larvae	SH6085255820	795 m
4 September 2015	1 larva	SH6077155705	827 m
17 September 2015	1 adult + 1 larva	SH6068655758	729 m

Forty other species of invertebrate were recorded during searches for *C.cerealis*, (Appendix B).

Figure 10: Adult (right) and larva (left) of *Chrysolina cerealis* under a stone.

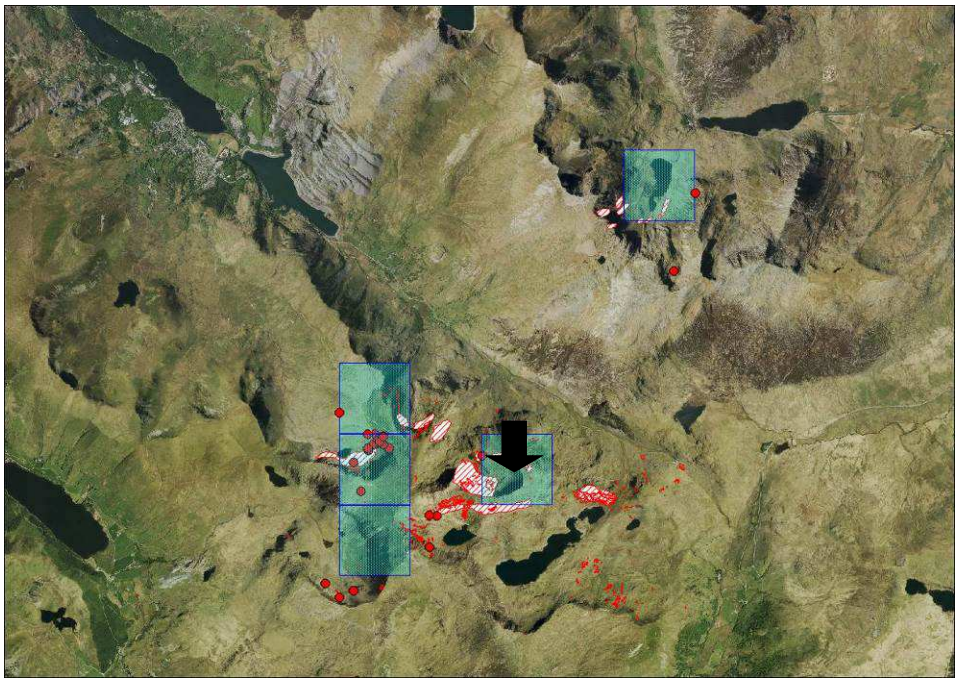

Figure 11: The location of Clogwyn Coch (black arrow), the only location for *Chrysolina cerealis* in 2015.

6. Discussion

The finding of just five beetles on Yr Wyddfa after 63.5 hours of search suggests that the population is currently very small. The lack of beetles in Cwm du'r Arddu, the traditional hotspot for *C. cerealis*, suggests that it may have been lost from this area, despite the presence of thyme. Indeed, Shackshaft (2007a) found only beetle remains within the cwm. All five beetles were at higher altitude on the crags of

Clogwyn Coch, perhaps indicating that the population is moving up the mountain. Other recent records are also from high altitude.

Whilst *C. cerealis* has always proved difficult to find throughout the history of recording the beetle on Yr Wyddfa, the largest numbers were recorded during the early 1900s, with at least 62 individuals noted between 1900 and 1910 (see Appendix A). Unfortunately, these were probably all killed and preserved in collections, as was the fashion at the time, and this may have had a long-term impact upon the population or degraded the genetic diversity. However, a study in the 1990s still managed to record at least 47 individuals (Buse, 1993), a much larger number than found during the current survey, although this could be an artefact of survey methods.

Hubble (2014) suggest that climate change may have an impact upon *C. cerealis,* with increasing temperatures and other factors having particular implications for mountain specialists with restricted ranges and relatively small populations (Parmesan, 2006). The mean air temperature in Wales is estimated to have increased by 0.7^{o} Celsius between 1914 and 2006 and it is predicted to continue rising exponentially for the foreseeable future (Anon., 2009). Long-term monitoring on Yr Wyddfa as part of the Environmental Change Network has shown an increase in temperature and rainfall, and a decline in vegetation species-richness over the 1992 to 2007 period (Lloyd *et al*., 2011). Key findings from the monitoring include:

- Spring air temperatures have risen and winters have become less severe. Soil and grass minimum temperature have also both risen since the earlier period. These changes are accompanied by a rise in annual precipitation totals since 1995. Such observed shifts are influenced by the period of observation and the variability in climate, with more recent severe winters reducing the extent of the overall temperature rise since ECN recording started in 1995.

- Levels of acidification and pollutant concentrations have decreased in response to emission controls. The recovery of Snowdon's ecosystems is taking longer and on-going pollution levels (such as nitrogen and ozone) are still likely to be having a negative impact on semi-natural habitats.

- Snowdon has undergone a significant reduction in grazing intensity over the recording period with sheep numbers on the site having fallen by around 50% from the levels recorded in 1997. This fall in sheep numbers is accompanied by the reintroduction of cattle grazing on the site and an increase in goat numbers.

- Vegetation community composition has shifted to one more indicative of acidic habitats and species richness has decreased, with grasses becoming more dominant over herbs. This may result from acidification of soils over a 40-year period. Although acidification has reduced more recently, following emission controls, recovery of vegetation appears to be lagging behind changes to inputs probably as the buffering potential of soils takes time to recover. This in turn has meant that there has been a lag in seeing changes to the plant communities on the site.

- Warmer winter and early spring weather in recent years have ensured the survival of larger numbers of new-born kid goats and there has been a population increase. As they often graze areas avoided by sheep such as cliff ledges and rocky outcrops, an increase in goat numbers may have an impact upon ledge florisitics.

Increasing temperatures and rainfall and less severe winters may be having an impact upon *C. cerealis*. Conditions which favour wetter, more acidic vegetation may have a deleterious effect on thyme which prefers free-draining, base-rich substrates (Preston *et al*., 2002). The cwm itself is also likely to flood more often and for longer periods. With beetles seemingly restricted to less accessible crags and ledges, an increasing goat population may result in the loss of these retreats through trampling, grazing out stands of thyme or accidentally ingesting eggs oviposited on grass tips. It should be noted that the author has not observed goats around Clogwyn, although sheep do graze the crags and ledges. Some light grazing is thought to be beneficial inpreventing plants being shaded out by more vigorous species (Martin *et al*., 2013).

7. Conclusions & Recommendations

Although breeding populations are still present on Yr Wyddfa, the perceived reduction in numbers could indicate some degradation of the beetle's habitat or reproductive fitness. A longer period of study, with searches adopting a variety of techniques, is required to fully understand the current status and distribution of *C. cerealis* and to identify any management issues. To determine if over-grazing is an issue, small exclosures could be erected to monitor the response of thyme. A genetic comparison between Welsh and continental beetles may identify any genetic bottleneck within the Snowdon population. Further searches in Cwm Idwal are required before considering it extinct here.

8. Acknowledgements

World Museum Liverpool wishes to thank the survey team, particularly Mike Howe, Alice Jewer, Dafydd Parry, Hywel Roberts and Harriet Robinson (all Natural Resources Wales) for help with the fieldwork, and Carl Clee, Richard Gallon, Mike Hull and Richard Loxton for help with specimen determination.

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10. Appendices

10.1. Appendix A: Records of *Chrysolina cerealis* held on the NRW Welsh Invertebrate Database, March 2016. Note that there are additional, mostly historic, records on the NBN Gateway, from data supplied by the UK Seed & Leaf Beetle Recording Scheme.

Site	Grid Ref	Date	Abundance	Recorder	Determiner
Cwm Idwal	SH6459	02/06/1830	2 adult	Unknown	Thomas Glover
Cwm Idwal	SH65	1960 - 1968	present	Rawdon Goodier	Rawdon Goodier
Cwm Idwal	SH6459	pre-1979	present	Unknown	Unknown
Cwm Idwal	SH650594	11/06/1970	2 adult	Joan Morgan	Joan Morgan
Cwm Idwal	SH647583	21/08/1980	1 larva + 2 adult	Philip King	Philip King
Cwm Idwal	SH6459	July 1991	0	NEGATIVE RESULT	Sally Strong & Caroline Moscrop
Cwm Idwal	SH6459	July 2007	0	NEGATIVE RESULT	Michael Shackshaft
Glanllynnau SSSI	SH455373	subfossil deposits	Present	Unknown	Unknown
Yr Wyddfa	SH6254	1829	1 adult	Unknown	Unknown
Yr Wyddfa	SH6254	pre-1831	present	Unknown	Unknown
Yr Wyddfa	SH6254	July 1851	1 adult	James Foxcroft	James Foxcroft
Yr Wyddfa	SH6254	1856	present	James Foxcroft	James Foxcroft
Yr Wyddfa	SH6254	1867	present	J.A. Brewer	J.A. Brewer
Yr Wyddfa	SH6254	June 1875	present	G.C. Champion	G.C. Champion
Yr Wyddfa	SH6254	02- 03/08/1885	2 adult	R. Wilding	R. Wilding
Yr Wyddfa	SH6254	30/06/1886	17 adult	John Ellis	John Ellis
Yr Wyddfa	SH6254	02/07/1886	Several adult	John Ellis	John Ellis
Yr Wyddfa	SH65	27/06/1901	0	NEGATIVE RESULT	Theodore Wood
Yr Wyddfa	SH65	18-20/08/1901	12 adult	Unknown	Unknown
Yr Wyddfa	SH65	September 1901	4 adult	Unknown	Unknown
Yr Wyddfa	SH6254	July 1902	13 adult	J. Chappell	J. Chappell
Yr Wyddfa	SH6254	June 1905	1 adult	Unknown	Unknown
Yr Wyddfa	SH6254	September 1905	present	J. Kidson-Taylor	J. Kidson-Taylor
Yr Wyddfa	SH6254	1906	1 adult	Unknown	Unknown
Yr Wyddfa	SH6254	30/06/1906	24 adult	H. Donisthorpe	H. Donisthorpe
Yr Wyddfa	SH6254	August 1906	present	E.C. Bedwell & J. Kidson-Taylor	J. Kidson-Taylor
Yr Wyddfa	SH6254	03/08/1906	2 adult	Unknown	G.W. Chaster
Yr Wyddfa	SH6254	August 1907	1 adult	John Read Tomlin	John Read Tomlin
Yr Wyddfa	SH6254	07/09/1910	4 adult	Unknown	Unknown
Yr Wyddfa	SH6254	1926	present	Unknown	Unknown
Yr Wyddfa	SH65	01/08/1943	1 adult	Unknown	Unknown
Yr Wyddfa	SH65	05/08/1943	5 adult	Unknown	Unknown
Yr Wyddfa	SH65	06/08/1943	1 adult	Unknown	Unknown
Yr Wyddfa	SH6254	04/08/1951	1 adult	A.M. Massee	A.M. Massee
Yr Wyddfa	SH65	01/08/1955	4 adult	Unknown	Unknown
Yr Wyddfa	SH6254	08/06/1957	2 adult	Unknown	Unknown
Yr Wyddfa	SH6254	1960 - 1966	present	E. Ansorge	E. Ansorge
Yr Wyddfa	SH6254	04/08/1961	1 adult	A.M. Massee	A.M. Massee
Yr Wyddfa	SH6054	09/08/1963	several adult	A.M. Massee;A.E. Gardner	A.M. Massee
Yr Wyddfa	SH6254	03/08/1967	5 adult	Unknown	Unknown
Yr Wyddfa	SH6254	23/08/1968	present	G.A. Mitchell	G.A. Mitchell
Yr Wyddfa	SH6254	02/08/1969	3 adult	Unknown	Unknown
Yr Wyddfa	SH65	15/06/1973	present	K.C. Side	K.C. Side
Yr Wyddfa	SH6254	July 1978	13 adult	John Parry	John Parry
Yr Wyddfa	SH6254	1979	present	John Parry	John Parry
Yr Wyddfa	SH6254	15/05/1992	2 adult	Alan Buse	Alan Buse
Yr Wyddfa	SH6254	16/09/1992	1 larva + 3 adult	Alan Buse	Alan Buse
Yr Wyddfa	SH604536	17/06/1999	1 adult	NEEDS CONFIRMING	Julian Ellis
Yr Wyddfa, Clogwyn Du'r Arddu	SH600563	15/06/1965	present	Colin Johnson	Colin Johnson
Yr Wyddfa, Clogwyn Du'r Arddu	SH605560	29/07/1976	1 adult	Peter Hodge	Peter Hodge
Yr Wyddfa, Clogwyn Du'r Arddu	SH602556	27/04/1989	1 adult	Liz Howe;Mike Howe	Mike Howe
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	15/05/1989	0	NEGATIVE RESULT	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	22/05/1989	3 adult	Peter Hope Jones	Peter Hope Jones
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	07/06/1989	0	NEGATIVE RESULT	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	14/06/1989	0	NEGATIVE RESULT	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	28/06/1989	0	NEGATIVE RESULT	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	03/07/1989	1 adult	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	10/07/1989	0	NEGATIVE RESULT	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH604558	11/07/1989	1 adult	Adrian Fowles	Adrian Fowles
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	17/07/1989	1 adult	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	14/08/1989	0	NEGATIVE RESULT	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	21/08/1989	1 adult	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	09/09/1989	1 adult	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	11/09/1989	0	NEGATIVE RESULT	Alan Buse

Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	25/09/1989	0	NEGATIVE RESULT	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6055	23/04/1990	1 female	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	30/04/1990	0	NEGATIVE RESULT	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	14/05/1990	1 female	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	21/05/1990	1 adult	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6055	04/06/1990	1 adult	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	11/06/1990	1 adult	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6055	14/06/1990	4 adult	David Evans	David Evans
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	18/06/1990	0	NEGATIVE RESULT	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH604558	27/06/1990	2 adult	Adrian Fowles	Adrian Fowles
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	02/07/1990	0	NEGATIVE RESULT	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6055	09/07/1990	1 adult	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6055	12/07/1990	2 adult	David Evans	David Evans
Yr Wyddfa, Clogwyn Du'r Arddu	SH6055	13/07/1990	4 adult	David Evans	David Evans
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	16/07/1990	0	NEGATIVE RESULT	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	23/07/1990	0	NEGATIVE RESULT	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	30/07/1990	0	NEGATIVE RESULT	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6055	06/08/1990	2 adult	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	20/08/1990	1 adult	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	03/09/1990	1 adult	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH603552	10/09/1990	1 larva	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH603552	17/09/1990	1 larva	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	01/10/1990	0	NEGATIVE RESULT	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH603552	12/10/1990	2 adult	Alan Buse	Alan Buse
Yr Wyddfa, Clogwyn Du'r Arddu	SH602538	13/07/1994	1 adult	Mark Jones	Mark Jones
Yr Wyddfa, Clogwyn Du'r Arddu	SH604560	18/08/1995	8 adult	Adrian Fowles	Adrian Fowles
Yr Wyddfa, Clogwyn Du'r Arddu	SH602556	18/08/1995	1 larva, 1♂ + 7♀♀	Mike Howe	Mike Howe
Yr Wyddfa, Clogwyn Du'r Arddu	SH604560	23/08/1995	2 larva + 3 adult	Adrian Fowles	Adrian Fowles
Yr Wyddfa, Clogwyn Du'r Arddu	SH607558	27/05/1997	1 adult	Gareth Higgins	Mike Howe
Yr Wyddfa, Clogwyn Du'r Arddu	SH6056	24/08/1998	1 adult	Russell Gomm	Russell Gomm
Yr Wyddfa, Clogwyn Du'r Arddu	SH6055	23/05/2007	0	NEGATIVE RESULT	Adrian Fowles
Yr Wyddfa, Clogwyn Du'r Arddu	SH6040755768	July 2007	1 adult (remains of)	Michael Shackshaft	Michael Shackshaft
Yr Wyddfa, Clogwyn Du'r Arddu	SH6040955778	July 2007	1 adult (remains of)	Michael Shackshaft	Michael Shackshaft
Yr Wyddfa, Clogwyn Du'r Arddu	SH6041155772	July 2007	1 adult (remains of)	Michael Shackshaft	Michael Shackshaft
Yr Wyddfa, Clogwyn Du'r Arddu	SH6041155780	July 2007	1 adult (remains of)	Michael Shackshaft	Michael Shackshaft
Yr Wyddfa, Clogwyn Du'r Arddu	SH6046555856	July 2007	1 adult (remains of)	Michael Shackshaft	Michael Shackshaft
Yr Wyddfa, Clogwyn Du'r Arddu	SH6051255877	July 2007	1 adult (remains of)	Michael Shackshaft	Michael Shackshaft
Yr Wyddfa, Clogwyn Du'r Arddu	SH6054355915	July 2007	1 adult (remains of)	Michael Shackshaft	Michael Shackshaft
Yr Wyddfa, Clogwyn Du'r Arddu	SH6054455910	July 2007	1 adult (remains of)	Michael Shackshaft	Michael Shackshaft
Yr Wyddfa, Clogwyn Du'r Arddu	SH6055855901	July 2007	1 adult (remains of)	Michael Shackshaft	Michael Shackshaft
Yr Wyddfa, Clogwyn Du'r Arddu	SH6055855903	July 2007	1 adult (remains of)	Michael Shackshaft	Michael Shackshaft
Yr Wyddfa, Clogwyn Du'r Arddu	SH6060755856	July 2007	1 adult (remains of)	Michael Shackshaft	Michael Shackshaft
Yr Wyddfa, Clogwyn Du'r Arddu	SH6061455974	July 2007	1 adult (remains of)	Michael Shackshaft	Michael Shackshaft
Yr Wyddfa, Clogwyn Du'r Arddu	SH6061555974	July 2007	1 adult (remains of)	Michael Shackshaft	Michael Shackshaft
Yr Wyddfa, Clogwyn Du'r Arddu	SH6055	21/08/2014	0	NEGATIVE RESULT	Adrian Fowles
Yr Wyddfa, Clogwyn y Garnedd	SH61265441	23/09/2011	1 adult	Alastair Hotchkiss	Alastair Hotchkiss
Yr Wyddfa, Crib Goch	SH6255	12/07/1945	2 adult	John Hobart	John Hobart
Yr Wyddfa, Crib Goch	SH6255	15/05/1960	1 adult	P.W. Price	P.W. Price
Yr Wyddfa, Crib Goch	SH6255	25/06/1999	2 adult	Hywel Roberts	Hywel Roberts
Yr Wyddfa, Cwm Arddu	SH604558	15/05/1980	2 adult	Philip King	Philip King
Yr Wyddfa, Cwm Arddu	SH604558	10/06/1980	4 adult	Philip King	Philip King
Yr Wyddfa, Cwm Arddu	SH604558	19/09/1980	1 larva	Philip King	Philip King
Yr Wyddfa, Cwm Arddu	SH604558	24/09/1980	1 adult	Philip King	Philip King
Yr Wyddfa, Cwm Clogwyn	SH598539	16/06/2010	2 adult	Andrew Graham	Andrew Graham
Yr Wyddfa, Cwm Clogwyn	SH600537	26/06/2011	1 adult	Andrew Graham	Andrew Graham
Yr Wyddfa, Cwm Clogwyn	SH6053	31/08/2014	0	NEGATIVE RESULT	Adrian Fowles
Yr Wyddfa, Cwm Glas Mawr	SH617556	21/08/1980	1 larva	Philip King	Philip King
Yr Wyddfa, Cwm Glas Mawr	SH620557	06/06/1985	2 adult	Nigel Brown	Nigel Brown
Yr Wyddfa, Cwm Glaslyn	SH6125954864	09/06/2007	2 adult	Brian Laney	Brian Laney
Yr Wyddfa, Cwm Glaslyn	SH6136454847	09/06/2007	1 adult	Brian Laney	Brian Laney

10.2. Appendix B: Records of invertebrates recorded during the current survey. Spiders marked * were determined by Richard Gallon.

Date collected.	Stage/Sex.	Locality.	Grid Ref.	Recorder.
Araneae: Amaurobiidae: *Coelotes atropos* (Walckenaer, 1830)				
17.09.2015	Female	Clogwyn y Garnedd	SH 61194 54499	Tony Hunter
Araneae: Linyphiidae: *Agyneta decora* (O.P.-Cambridge, 1871)				
16.05.2015	Male	Clogwyn Coch	SH 60746 55772	Tony Hunter
Araneae: Linyphiidae: *Centromerita concinna* (Thorell, 1875)				
16.05.2015	Female	Clogwyn Coch	SH 60746 55772	Tony Hunter
Araneae: Linyphiidae: *Dicymbium tibiale* (Blackwall, 1836)				
16.05.2015	Female	Clogwyn Coch	SH 60746 55772	Tony Hunter
Araneae: Linyphiidae: *Erigone atra* Blackwall, 1833				
19.08.2015	Female	Clogwyn Coch	SH 60746 55772	Tony Hunter
Araneae: Linyphiidae: *Saaristoa abnormis* (Blackwall, 1841)				
16.06.2015	Both	Clogwyn Coch	SH 60746 55772	Tony Hunter
Araneae: Linyphiidae: *Tenuiphantes mengei* (Kulczynski, 1887)				
17.09.2015	Female	Clogwyn y Garnedd	SH 61194 54499	Tony Hunter
***Araneae: Linyphiidae:** *Lepthyphantes tenuis* (Blackwall, 1852)*				
16.06.2015	Both	Clogwyn Coch	SH 60746 55772	Tony Hunter
Araneae: Linyphiidae: *Lepthyphantes zimmermanni* (Bertkau, 1890)				
19.08.2015	Male	Clogwyn Coch	SH 60746 55772	Tony Hunter
05.10.2015	Female	Clogwyn Coch	SH 60746 55772	Tony Hunter
Araneae: Linyphiidae: *Leptothrix hardyi* (Blackwall, 1850)				
16.06.2015	Male	Clogwyn Coch	SH 60746 55772	Tony Hunter
***Araneae: Linyphiidae:** *Meioneta gulosa* (L. Koch, 1869)*				
16.06.2015	Female	Clogwyn Coch	SH 60746 55772	Tony Hunter
Araneae: Linyphiidae: *Monocephalus castaneipes* (Simon,1884)				
04.09.2015	Female	Clogwyn Coch	SH 60746 55772	Steve Judd
Araneae: Linyphiidae: *Poeciloneta variegata* (Blackwall, 1841)				
16.06.2015	Female	Clogwyn Coch	SH 60746 55772	Tony Hunter
05.10.2015	Female	Clogwyn Coch	SH 60746 55772	Tony Hunter
Araneae: Linyphiidae: *Tapinopa longidens* (Wider, 1834)				
16.06.2015	Female	Clogwyn Coch	SH 60746 55772	Tony Hunter
17.09.2015	Female	Clogwyn y Garnedd	SH 61194 54499	Tony Hunter
Araneae: Linyphiidae: *Walckenaeria nudipalpis* (Westring, 1851)				
16.06.2015	Female	Clogwyn Coch	SH 60746 55772	Tony Hunter
Araneae: Lycosidae: *Pardosa lugubris* (Walckenaer, 1802)				
16.06.2015	Female	Llanberis path	SH 60273 56603	Tony Hunter
Araneae: Lycosidae: *Pardosa pullata* (Clerck, 1757)				
16.06.2015	Female	Llanberis path	SH 60273 56603	Tony Hunter
17.09.2015	Female	Clogwyn y Garnedd	SH 61194 54499	Tony Hunter
Araneae: Salticidae: *Neon reticulatus* (Blackwall, 1853)				
16.06.2015	Both	Clogwyn Coch	SH 60746 55772	Tony Hunter
17.09.2015	Female	Clogwyn y Garnedd	SH 61194 54499	Tony Hunter
Araneae: Theridiidae: *Robertus lividus* (Blackwall, 1836)				
16.06.2015	Both	Clogwyn Coch	SH 60746 55772	Tony Hunter
Chilopoda: Lithobiidae: *Lithobius melanops* Newport, 1845				
05.10.2015	Female	Clogwyn Coch	SH 60746 55772	Tony Hunter
Chilopoda: Lithobiidae: *Lithobius variegatus* Leach, 1813				

16.06.2015	Both	Clogwyn Coch	SH 60746 55772	Tony Hunter

Coleoptera: Carabiidae: *Calathus melanocephalus* (Linnaeus, 1758)

19.08.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Tony Hunter

Coleoptera: Carabiidae: *Carabus problematicus* Herbst, 1786

16.06.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Tony Hunter

Coleoptera: Carabiidae: *Clivina fossor* (Linnaeus, 1758)

19.08.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Tony Hunter

Coleoptera: Carabiidae: *Nebria rufescens* (Ström, 1768)

16.06.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Tony Hunter

Coleoptera: Carabiidae: *Notiophilus biguttatus* (Fabricius, 1779)

04.09.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Steve Judd

Coleoptera: Carabiidae: *Pterostichus aethiops* (Panzer, 1796)

16.06.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Tony Hunter

Coleoptera: Carabiidae: *Pterostichus madidus* (Fabricius, 1775)

19.08.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Tony Hunter

Coleoptera: Carabiidae: *Pterostichus niger* (Schaller, 1783)

19.08.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Tony Hunter

Coleoptera: Carabiidae: *Trechus obtusus* Erichson, 1837

19.08.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Steve Judd
19.08.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Tony Hunter

Coleoptera: Cantharidae: *Rhagonycha femoralis* (Brullé, 1832)

19.08.2015	Female	Clogwyn Coch	SH 60746 55772	Tony Hunter

Coleoptera: Chrysomelidae: *Chrysolina cerealis* (Linnaeus, 1767)

04.09.2015	Larvae	Clogwyn Coch	SH 60852 55820	Tony Hunter
04.09.2015	Larvae	Clogwyn Coch	SH 60771 55705	Tony Hunter
17.09.2015	Adult+Larvae	Clogwyn Coch	SH 60686 55758	Tony Hunter

Coleoptera: Staphylinidae: *Acidota crenata* (Fabricius, 1792)

17.09.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Tony Hunter

Coleoptera: Staphylinidae: *Othius punctulatus* (Goeze, 1777)

19.08.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Steve Judd

Coleoptera: Staphylinidae: *Quedius persimilis* Mulsant & Rey, 1876

17.09.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Tony Hunter

Homoptera: Cicadellidae: *Eupteryx atropunctata* (Goeze 1778)

18.09.2015	Unsexed	Devils Kitchen	SH 63948 58964	Tony Hunter

Homoptera: Cicadellidae: *Planaphrodes bifasciata* (Linnaeus, 1758)

03.08.2015	Unsexed	Cwm Clogwyn	SH 59834 54042	Tony Hunter
20.08.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Tony Hunter
31.08.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Tony Hunter

Hymenoptera: Formicidae: *Myrmica sulcinodis* Nylander, 1846

04.09.2015	Female	Bwlch Glas	SH 6082 5453	Tony Hunter
17.09.2015	Female	Clogwyn y Garnedd	SH 61194 54499	Tony Hunter

Hymenoptera: Ichneumonidae: *Homotherus magus* (Wesmael, 1855)

31.08.2015	Male	Cwm Clogwyn	SH 60105 54263	Tony Hunter

Lepidoptera: Noctuidae: *Cerapteryx graminis* (Linnaeus, 1758)

03.08.2015	Unsexed	Cwm Clogwyn	SH 59834 54042	Tony Hunter

Lepidoptera: Tortricidae: *Eana osseana* (Scopoli, 1763)

19.08.2015	Unsexed	Clogwyn Coch	SH 60746 55772	Steve Judd

10.3. 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 116513.

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