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Terrestrial Invertebrate Survey, Cromwell Bottom Nature Reserve, nr. Brighouse, West Yorkshire

Calderdale Council

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Executive Summary

- Calderdale Council commissioned Richard Wilson Ecology to undertake an invertebrate survey within the Brookfoot Loop section of Cromwell Bottom Local Nature Reserve (LNR) and Local Wildlife Site (LWS), (hereafter referred to as Cromwell Bottom Nature Reserve (NR)), located in the Calder Valley, near Brighouse, West Yorkshire.

- Cromwell Bottom NR has had a complex history, originating from mineral extraction and subsequently as an area utilised by the energy industry to dispose of a waste product, pulverised fuel ash (PFA). Originally known and referred to as Elland Gravel Pits, the general area comprised a series of gravel pits and sludge lagoons. These gravel pits were subsequently used to dump PFA from the now demolished Elland Powerstation which lay approximately 1 km to the west. Some of the PFA was sequentially quarried and contributed to the construction of the M62 and in turn, the re-exposed pits were infilled for landfill and capped. This complex sequence of historical disturbance led to a mosaic of wetland and drier habitats within the study site developing.

- The purpose of the commission was to inform proposed habitat intervention works to re-wet the woodland carr and remaining lagoon within the Brookfoot Loop section (the survey area) which are gradually drying out due to various factors identified in a separate hydro-ecological study.

- To inform this study, a review of existing ecological data relating to Cromwell Bottom NR has been undertaken. Cromwell Bottom NR is fortunate in that it is reasonably well studied for its fauna and flora, including its invertebrates. A summary of the historical survey work has been included as part of this work, which has included reference to a number of known rare invertebrate species that have previously been recorded here. Historical data and commentary associated with this, such as on the Invertebrate Site Register, has made reference to an outstanding invertebrate assemblage, which at the time, was considered to be of at least county and possibly national significance. These historical assemblages have been considered in the current context of vegetation communities and the 2017 invertebrate survey data.

- This report goes on to present the results of the invertebrate surveys, which were undertaken between May and August 2017, and evaluates the nature conservation significance of the assemblages recorded during this period, in the context of the proposed habitat intervention work.

- A wide range of taxa were collected, resulting in 315 species being identified. The most abundant taxa were flies (106 species), beetles (96 species) and spiders (50 species), though a wider range of groups were recorded.

- Eight species were recorded with a national nature conservation status and a further three species were scarce or uncommon in a Yorkshire context.

- The habitats within the Brookfoot Loop section of Cromwell Bottom NR support an invertebrate assemblage that is evaluated to be of **District Significance**.

- The evaluation of District Significance is believed to be partly a consequence of the hydrological inputs being less than the outputs, as identified by the hydro-ecological study, and as a result, the site is drying out. A secondary but no less important contributory factor is the increase in woodland cover to the detriment of open habitats that were once present and which were known to support a noteworthy invertebrate assemblage of some significance. Whilst the woodland carr in 2017 supports some interesting invertebrates associated with wood decay habitats, there has likely been a greater loss in species previously recorded (in the late 1970s and 1980s) that were associated with open habitat biotopes such as the dry calcareous influenced grasslands and mosaics of bare ground.

- The proposed habitat intervention works will reinstate wetland habitats with a sustainable hydrological management regime; but with careful planning, further offer the opportunity to enhance the developing woodland community and reinstate open habitats, including the potential

for dry grassland and open mosaic habitats. This would increase the structural heterogeneity of the habitats, between and within each other, which should increase Brookfoot Loop's nature conservation value for its invertebrate assemblages.

- The proposed habitat intervention works will have no likely detrimental effect on the identified invertebrate assemblages or species within the Brookfoot Loop section as recorded in 2017 providing the works are limited to the selective felling of the wooded habitats, which have started to develop a noteworthy community in its own right.

- Additional recommendations to enhance and complement the proposed habitat intervention work have been incorporated in to the report; including potentially radical works to restart seral succession by exposing PFA in carefully managed plots. Further desk study is advisable before undertaking this on a significant scale to identify if there have been any previous attempts elsewhere in the UK (or abroad?) to ensure avoidance of any detrimental effects (e.g. enabling competitor species including invasive non-natives to establish).

- Given the importance of Cromwell Bottom within the context of the Calder Valley, it is recommended that a minimum of two seasons monitoring is undertaken post-completion of the habitat intervention works to assess how invertebrate assemblages and species have responded to the work. This should be complemented by botanical surveys, including bryophytes; and include mapping habitat boundaries at an appropriate scale and following a suitable methodology to enable changes to me measured in a geospatial sense.

1 Introduction

1.1 Background

Richard Wilson Ecology was commissioned in early April 2017 by Calderdale Council (Countryside and Woodlands Service) to undertake an invertebrate survey of land within Cromwell Bottom Local Nature Reserve (LNR) and Local Wildlife Site (LWS), a dual-designated nature reserve (see Section 1.2 for more details) located within the Calder Valley, just west of Brighouse, West Yorkshire. The purpose of the survey is to inform the planned habitat intervention works to reverse the drying out of wetland features for which the nature reserve has been designated (see Section 1.3 for a description of the proposed works). The approach has broadly followed recommendations contained within a detailed hydro-ecological study completed in 2005 (MRB Ecology and Environment, 2005; section 4.5 [p. 29]).

1.2 Study Site

Cromwell Bottom LWS and LNR (centred on National Grid Reference (NGR): SE 12 22), is located within the Calder Valley, sandwiched between the River Calder which meanders west-east, and the Calder & Hebble Navigation (Canal) that also runs on a west-east axis, approximately 1.6 km west south-west of Brighouse, West Yorkshire (vice-county 63 [South-west Yorkshire]).

It has been designated as a non-statutory LWS for the diversity of wetland and transitional habitats present within the site that have developed on the former gravel pits and PFA lagoons; and for a number of scarce species it supports within the Calder Valley. It has also been designated as a LNR as it provides important access to greenspace with biodiversity value. Cromwell Bottom Wildlife Group, a local conservation group is established and maintains a website (https://cromwellbottom.wordpress.com/) which includes an updated 'sightings' page as a blog and some information on species previously recorded by visiting naturalists. For ease of reading, this report refers to the dual designated site as Cromwell Bottom Nature Reserve (NR).

[1]Cromwell Bottom NR extends for approximately 30 ha on land that has been subject to complex disturbances over the last six decades. During the 1950s and 1960s, the glacial gravels were extracted for the building industry and then subsequently infilled with coal washery tailings, pulverised fuel ash (PFA) or used as sludge lagoons during the operational period of the coal-fired Elland Powerstation (1960s to late 1980s/ early 1990s). Subsequently, the PFA was partially extracted to provide material for the construction of the M62 before some of the gravel pits were infilled with landfill and subsequently capped; or filled with water and managed for angling. However, the sludge lagoon, which is roughly central to Cromwell Bottom NR, was left *in situ* though landscaped with its mix of PFA, gravels and other materials and subsequently developed a mosaic of vegetation communities were recognised as supporting regionally important flora and fauna, which is partly considered to be a consequence of its past use.

Within a wider setting, Cromwell Bottom NR is surrounded by steep-sided wooded cloughs such as Binns Wood and Elland Park Wood to the north; and Strangstry Wood to the south. Within the valley floor, and generally following the course of the River Calder and Calder & Hebble Navigation are various transport links (e.g. Trans-Pennine railway line and the A6025 (Elland Road)) which are lined by various commercial developments. Thus, Cromwell Bottom NR forms part of a mix of landuses within a green corridor connecting Brighouse with neighbouring settlements

1.2.1 Survey Area (2017)

For the purposes of this commission, only the section of Cromwell Bottom NR known as Brookfoot Loop, centred on SE 130 224 and occupying *c.* 11 ha was surveyed as this is where the proposed habitat intervention works are being planned. Thus this report is describing the habitats and species recorded within this section only, and not the entire site.

[1] Cromwell Bottom NR is designated as an LWS and an LNR; but the extents are not contiguous. The LWS extends over a greater area, including land to the west of the LNR as illustrated on the Multi-Agency Geographic Information for the Countryside (MAGIC) website. The area conveyed is for the LWS; the LNR extends for approximately 30 ha.

The habitats within the Brookfoot Loop section as observed during summer 2017 comprise birch/ willow carr woodland and tall ruderal vegetation, largely comprising dense stands of bramble (*Rubus fruticosus* agg.) on the outer edges. Only two small areas of grassland occur within this section, both in the north-west and close to the boundary with the Calder and Hebble Navigation. A single body of open water remains (Lagoon 1), which is fringed by invading common reed (*Phragmitis communis*) and New Zealand pygmy-weed (*Crassula helmsii*) forming dense continuous carpets at ground level. The northern edge of Lagoon 1 has had invading willow (*Salix* sp.) cleared and the arisings left *in situ*. Approximately 100 m east of Lagoon 1 is a relatively small open area of *Sphagnum*-bog which is rapidly becoming encroached by the surrounding dense carr woodland (e.g. Pixie Wood) to the extent that ground conditions are no more than damp at best.

1.3 Proposed Habitat Intervention Work

The proposed habitat intervention work is aimed at re-wetting the habitats within the Brookfoot Loop section of Cromwell Bottom NR. A number of options have been considered but the current favoured option is to:

- excavate material from the northern third of Lagoon 1 to deepen the waterbody and retain open water year round;
- create a number of islands, primarily aimed for ground-nesting birds (assumed to be common terns (*Sterna hirundo*));
- pump water from the River Calder through an existing linear depression to the west of the lagoon currently under closed canopy birch/ willow carr;
- thin/ remove areas of dense birch/ willow carr woodland; and
- remove invading birch from the *Sphagnum*-bog.

1.4 Survey Limitations

The surveys commenced in early May 2017 and extended until the end of August 2017 such that the late spring and summer faunas were sampled. The lack of early spring and autumn visits, whilst likely to have reduced the total species list, is not thought to have significantly suppressed the evaluation. A broad taxonomic coverage has been achieved by including a wide coverage of the guilds such as pollinators, detritivores and predators, and utilising a range of survey methods such as pitfall trapping, sieving leaf-litter and sweeping, such that a diverse range of species, including scarcer inhabitants stad a realistic chance of being recorded.

Weather conditions during the spring and summer of 2017 were mixed across the UK. Whilst spring (March to May) was generally considered to be warm and dry (see Meteorological Office [2] website), the summer (June to August) was the ninth wettest since 1910 (see Meteorological Office [3] website); with June 2017 particularly so. A prolonged unseasonably cool and wet period commenced from mid-July (see Meteorological Office [4] website) further reducing the season's favourability for invertebrates.

Nevertheless, survey visits were timed to coincide with reasonable to optimal weather, i.e. avoiding days where overcast, cool and/ or rain were forecast. Despite best efforts, given that the summer of 2017 proved to be one of the wettest on record, this will have inevitably influenced invertebrate populations and behaviour. This has been taken in to account when evaluating the results of the survey.

One of the methods used was pitfall trapping (see Section 2.2 and Table 3 for details). The pitfall traps set within the edge of the reedbed in Lagoon 1 were removed in late June 2017 due to emerging amphibians and the risk to excessive capture of unwanted bycatch. This may have reduced the data collected from the northern fringe of the reedbed and this is discussed in more detail in Section 3.5.

[2] See https://www.metoffice.gov.uk/climate/uk/summaries/2017/spring; last accessed on 25th September 2017.
[3] See https://www.metoffice.gov.uk/climate/uk/summaries/2017/summer; last accessed on 25th September 2017.
[4] See https://www.metoffice.gov.uk/climate/uk/summaries/2017/july; last accessed on 25th September 2017

The survey of the *Sphagnum*-bog commenced following an extension to the initial commission in late June 2017 and as such, species active in late spring and early summer (i.e. May and June) and restricted to this habitat will have been missed. Any implications arising from this are also discussed in Section 3.5.

2 Methodology

2.1 Desk Study

Calderdale Council passed on historical records of invertebrate known from Cromwell Bottom NR held by West Yorkshire Ecology Service (WYES), the biological record centre; in addition to a number of documents relevant to informing the study. This included:

- a detailed study of Cromwell Bottom NR's history and ecology based on detailed botanical surveys supported and supplemented with faunal surveys completed in 1990, and included appendices citing data collected during the late 1970s and 1980s (NEAP Environmental Consultancy (NEAP), 1991);
- Cromwell Bottom NR's Management Plan (Calderdale Council, 2000);
- Cromwell Bottom NR's Hydroecological Assessment (MRB Ecology and Environment, 2005), which considers the various options and inputs for the potential habitat intervention and re-wetting of the Brookfoot Loop section; and
- draft proposals (in plan form) for the re-wetting of the Brookfoot Loop section.

Additional information has been obtained through desk-based internet searches (e.g. Multi-Agency Geographic Information for the Countryside Website; the NBN Atlas (https://nbnatlas.org/) where licence agreements permit commercial use; liaison with Yorkshire Naturalists' Union invertebrate recorders and national specialists; and Natural England to obtain information held by them in the archive from the Invertebrate Site Register which included Cromwell Bottom NR (as Elland Gravel Pits).

This information was reviewed to identify if there were any noteworthy invertebrate taxa associated with the vegetation communities likely to be subject to the intervention works; for example if their ecological requirements are restricted to the transitional zone between wetland and dry habitats. This level of detail would be useful in considering the finer detail of the proposed works such as informing more precisely the layout and specific locations of the more permanent interventions, or temporary effects such as the sighting of site compound(s) or storage areas.

2.2 Field Survey

The primary objective of the field work element was to survey the Brookfoot Loop section to inform the proposed habitat intervention works. It is therefore not intended to provide an exhaustive list of invertebrate taxa present. Furthermore, given that the surveys were constrained to one section of Cromwell Bottom NR, it would be inaccurate to assess the nature conservation value of the invertebrate assemblages recorded as if they pertained to the whole study site. Potentially important grasslands, scrub, and mosaics between the two may occur within the Tag Loop and North Bank Loop sections of Cromwell Bottom NR, but these were not surveyed in 2017. Consequently, any evaluation as to the nature conservation significance of assemblages recorded is necessarily restricted to the Brookfoot Loop section only.

In achieving this, the surveys followed the methodologies described in Drake *et al*. (2007) using a variety of techniques. This included sweeping vegetation and aerial netting for flying invertebrates using a light-weight butterfly net as well as a more heavy duty sweep-net. This was complemented by vacuum sampling (using a commercially available modified garden blow-vac) and direct observation. Pitfall traps were set in three locations throughout the study site to collect ground-dwelling (epigeic) invertebrates. Each pitfall trap consisted of a plastic drinking cup with the aperture set flush with, or slightly below, the surface and approximately one-third filled with a preservative, in this instance, monoproyplene glycol, diluted to 50 % with tap water. Chicken wire was pegged down over the top to minimise unwanted bycatch and each was individually marked with a red flag to aid relocating through the season. Details on the locations are provided in Table 3.

Specimens collected were either identified in the field or retained for subsequent microscopic identification. Surveys paid particular attention to those groups most likely to include species of nature conservation interest, typically Diptera (flies), aculeate Hymenoptera (solitary bees, wasps and allies), Araneae (spiders) and Coleoptera (beetles). However, a wide range of invertebrate orders were recorded.

2.3 Evaluation Methodologies

There is currently no standard frame of reference to evaluate the nature conservation value of invertebrate assemblages for the purposes of Ecological Impact Assessment (EcIA). There are various methods available but these have been designed for specific purposes. Reliance is also placed on professional judgement of the surveyor and associates. Each methodology has its advantages and disadvantages, so for the purposes of this study, more than one approach is used to draw a conclusion, which also incorporates professional judgement. A summary of evaluation methods applied for this project are described below.

Since April 2017, the Invertebrate Species-habitat Information System (ISIS) developed by Derek Lott and referenced in Drake *et al*., (2007) has been updated and advanced by [5]Pantheon (Webb *et al*., 2017). This incorporates ISIS but takes the analysis further by attaching associated habitats and resources, habitat fidelity scores and other ecological information against each species. This is based on approximately 11,000 invertebrate species out of an estimated 37,000 species known from the UK. The taxa primarily used for this analysis are Coleoptera, Diptera, Hemiptera, Lepidoptera, aculeate Hymenoptera and Araneae; hence the focus on these groups for survey. In addition to ecological information, species with a nature conservation status are highlighted, based on the series of [6]Species Status Reviews being undertaken. All reasonable effort has been made to ensure that the most recent publications at the time of this report's writing has been completed including amending any discrepancies. However, there is no guarantee that all have been captured. Ultimately, reliance has been placed on Pantheon to be correct.

As for the original ISIS, some caution has also to be applied as strictly speaking, survey effort would normally require standardisation such as timed sweeps in order to provide data that can be compared between subsequent visits. Nevertheless, interrogating the data using Pantheon, with professional judgment and reference to other contextual information can inform which invertebrate assemblages recorded are of particular importance within a site, such as those associated with wetlands, wood decay, floristically rich habitats or a combination. A positive aspect of this approach is that attention is given to assemblages rather than solely relying on the national status of individual species, though the latter can also be indicative, especially as a proportion of the total species recorded.

2.4 Personnel

The invertebrate survey (field visits) were undertaken by Richard Wilson CEnv MCIEEM MSc; an experienced field entomologist. He is a [7]recognised arachnid (spiders and harvestmen) specialist and in addition to identifying this group, all fauna readily identified in the field including some of the Diptera (flies), Coleoptera (beetles), the Lepidoptera (butterflies and moths), Odonata (dragonflies and damselflies), the majority of the Hemiptera caught (bugs, including the Auchenorrhyncha (plant-hoppers etc.)) and a number of other minor groups (e.g. Isopoda (woodlice)) were covered by him. Richard was assisted by Steven Falk FRES who also identified the Diptera and aculeate Hymenoptera (bees, wasps and allies); and Bob Marsh, the Yorkshire Naturalists' Union (YNU) beetle recorder who identified specimens of Coleoptera.

[5] More information on Pantheon is available here: http://www.brc.ac.uk/pantheon/about/pantheon.
[6] Species Status Reviews are research documents authored by taxonomic specialists and assessing current nature conservation status for species against internationally accepted criteria (International Union for the Conservation of Nature); and national criteria with respect to Great Britain.
[7] Richard is the YNU's spider recorder, the Yorkshire, County Durham and Northumberland recorder for the national spider recording scheme; and sits on the conservation committee of the British Arachnological Society.

3 Results and Interpretation

3.1 Desk Study

3.2 Previous Surveys

Given the study site's nature conservation designation and long-standing recognised importance for biodiversity within the Calder Valley (Key, 1986), various ecological surveys have been undertaken by amateur naturalists from at least the 1970s onwards. WYES has passed on, via Calderdale Council, invertebrate records held by them from their database (see Table 1). Whilst most of WYES's historical data relating to Cromwell Bottom NR dates from a period between 1996 and 2001, there are important records dating back to the late 1970s and early 1980s which are assumed to relate to Mike Denton's work on behalf of the Halifax Scientific Society and which informed the then Nature Conservancy Council's [8]Invertebrate Site Register (ISR). Table 1 provides a summary of the data split by taxonomic group. Further interrogation is described in Table 7 (Section 3.4).

Table 1: Summary of **h**istorical invertebrate taxa recorded from Cromwell Bottom NR (including Elland Gravel Pits) (from WYES database).

Taxonomic Group	Number of Species	Selected Noteworthy Records
Lepidoptera (butterflies and moths)	271	3 species with a nature conservation status (SoPI (s.41) status) and a further 15 species which are SoPI (Research Only). One species now extinct in the UK. White-letter hairstreak (*Satyrium w-album*) [EN; SoPI (s.41)] Small heath (*Coenonympha pamphilus*) [NT; SoPI (s.41)] Wall brown (*Lasiommata megera*) [NT; SoPI (s.41)] [9]Large tortoiseshell (*Nymphalis polychloros*) [RE]
Coleoptera (beetles)	260	29 species with a nature conservation status (see Table 11; Appendix B). Most significant records, based on IUCN status: *Bembidion nigricorne* [NT; Nationally Scarce] *Acupalpus flavicollis* [NT; Nationally Rare] *Philorhizus sigma* [EN; Nationally Rare]
Diptera (flies)	36	1 species with a nature conservation status. *Cheilosia mutabilis* [Nationally Scarce]
Arachnida (spiders and harvestmen)	23	None
Odonata (dragonflies & damselflies)	12	None
Hymenoptera (bees, wasps & allies)	8	None
Hemiptera (bugs)	3	None
Other invertebrate taxa	8	None
Other Insect Orders	5	None
Key *UK Biodiversity Action Plan:* **SoPI (s.41):** Species of Principal Importance (section 41 species) *IUCN Categories:* **RE:** Regionally Extinct; **EN:** Endangered; **NT:** Near Threatened		

[8] More information on the ISR is available here: http://jncc.defra.gov.uk/page-2102; last accessed on the 29th September 2017.
[9] The validity of this record is open to question. It is given as being recorded on the 21st August 1996; and the record submitted by the Halifax Scientific Society. This is presumably a typographic error for the small tortoiseshell (*Aglais urticae*) and it is assumed the incorrect vernacular name was entered in to the database and not the scientific one. Large tortoiseshell are occasionally reported as migrants, or deliberate introductions but became extinct as a breeding species in the 1950s/ 1960s.

In addition to the WYES's data set, a series of forays were undertaken between late May and mid-September 1990 and reported in an unpublished document held by Calderdale Council describing in detail the ecology and history of the Cromwell Bottom Area (NEAP, 1991). These forays include a modest list of 68 species of invertebrate; of which just under half (33 spp.) are hoverflies (Diptera, Syrphidae). The majority of these species were relatively widespread but this did include one species of Nationally Scarce hoverfly (*Cheilosia mutabilis*) (given as RDB 3 in NEAP (1991) but this pre-dated the most recent revision (Ball and Morris, 2014) and two species of butterfly (small heath and wall brown) that are now considered to be Near Threatened and listed as Species of Principle Importance (SoPI).

An appendix within NEAP (1991) sheds more light on what were considered to be noteworthy beetles which were recorded in the late 1970s and early 1980s. One species of ground beetle included, *Acupalpus luteatus*, is now considered a misidentification for the widespread *A. dubius*. However, the other seven species comprise a single rove beetle (Staphylinidae): *Oxypoda procerula*; four species of ground beetle (Carabidae): *Broscus cephalotes*, *Anisodactylis binotatus*, *Philorhizus* (= *Dromius*) *sigma* and *Stenolophus mixtus*; and the leaf beetles *Bruchidius* (= *Bruchus*) *cisti* and *Aphthona lutescens*. Of these, *B. cephalotes* is unusual in that it is generally considered a coastal species though there are occasional records inland (Luff, 2007). Two records of this beetle were collected in May 1979, which were considered to be significant for Yorkshire (Mike Denton, personal communication); and Marsh (2009) states that there are 10 records from VC 63 and thus remains a significant record. A single specimen of *P. sigma* was collected in October 1980 from the North Tag Loop section of Cromwell Bottom NR (approximately at SE 122 220); i.e. outwith the current study area (MRB Ecology and Environment, 2005). Luff (2007) describes this as a very scarce species associated with marshes, fenland and at the margins of standing freshwater. In Yorkshire, it is only known from Askham Bog, Thorne Moor and Throxenby Mere (Marsh, 2009).

An element of the 2017 surveys was to establish if any of these nature conservation species were present within the Brookfoot Loop; and thus inform the proposed habitat intervention works. The presence or possible absence of these species may, subject to circumstances, help place some context to the assemblages present within the Brookfoot Loop section. However, for the most part, it has not been established with any accuracy where the historical records going back to the late 1970s were taken so this lack of detail has constrained to some extent the ability to contextualise these records.

3.3 Field Survey

Six survey visits were completed between early May and mid-August 2017 (see Table 2). Site visits were coincided with at least reasonable, and ideally, optimal weather conditions for invertebrate survey though the first early May visit was colder than forecast and therefore focussed on scoping the site, installing pitfall traps and sieving leaf-litter which is less weather dependent. To compensate, an additional supplementary visit on the 11th May was completed during improved weather conditions whereby more active collecting methods were deployed such as aerial netting and vacuum sampling.

Table 2: Weather conditions for survey visits.

Date	Weather	Notes
8th May 2017	**Cloud:** 8/8; **Temperature:** 9.2°C; **Wind Speed:** 8.7 kph (26.3 kph) SE.	Cold south-east wind, overcast and damp following a period of unseasonably cool weather with few sunny days. Installed pitfall traps
11th May 2017	**Cloud:** 0/8; **Temperature:** 15.8°C; **Wind Speed:** 0.4 kph (5.6 kph)	Active survey in warmer weather
3rd June 2017	**Cloud:** 4/8; **Temperature:** 25.0°C; **Wind Speed:** 0.3 kph (3.1 kph).	Servicing pitfall traps and active collecting
22nd June 2017	**Cloud:** 8/8; **Temperature:** 17.5°C increasing to 24°C; **Wind Speed:** 5.1 kph (20.0 kph) W.	Servicing pitfall traps and active collecting. Removed pitfalls from reedbed area. Installed pitfalls in *Sphagnum*-bog.
13th July 2017	**Cloud:** 4/8; **Temperature:** 22.4°C; **Wind Speed:** 0.8 kph (7.8 kph) W.	Servicing pitfall traps and active collecting
16th August 2017	**Cloud:** 6/8; **Temperature:** 17.7°C; **Wind Speed:** 0.4 kph (4.8 kph) W.	Closing pitfall traps and active collecting

Static traps were left *in situ* for varying lengths of time in a range of habitats where it was considered informative to the proposed habitat intervention work. Details are provided in Table 3.

Table 3: Location and description of static traps.

Trap	Grid Reference	Notes
Reedbed pitfall traps	SE 1298 2240	Five pitfall traps set as a transect on northern edge of reed swamp within damp ground conditions (in May). Pitfall traps set from 8th May until 22nd June 2017.
Carr woodland pitfall traps	SE 1284 2232	Five pitfall traps set as a transect within the birch/ willow carr at western edge of Lagoon 1 within leaf-litter/ limited ground cover (adjacent to proposed route to transfer water from River Calder to lagoon). Pitfall traps set from 8th May until 16th August 2017.
Sphagnum-bog	SE 1329 2264	Five pitfall traps set as a transect within a mosaic of *Sphagnum* and *Polytrichium* mosses and scattered birch. Pitfall traps set from 22nd June until 16th August 2017.

A total of 315 species were recorded across all survey visits. A wide variety of invertebrate groups were recorded as summarised in Table 4, including the target groups cited in Drake *et al.* (2007) for the broad habitats present within the survey area. Species recorded during 2017 are listed in Table 10 (Appendix A); and historical records are provided in Table 11 (Appendix B).

Table 4: Distribution of main taxonomic groups studied. Red numbers in parentheses equate to species with a nature conservation status (excluding Research Only – see text for explanation).

Taxonomic Group	Number of Species
Lepidoptera (Butterflies & moths)	18 (1) species
Coleoptera (Beetles)	96 (5) species
Diptera (Flies)	106 (1) species
Hymenoptera (Bees, wasps, ants etc.)	13 (0) species
Araneae (Spiders)	50 (1) species

Eight species have a formal nature conservation status (NCS), representing *c*. 2.5 % of the total number of species recorded and a further four species (*c*. 1 %) are considered to be of significance in Yorkshire (Bob Marsh, personal communication); see Table 5 for details.

Table 5: Species recorded with an NCS (nationally and within Yorkshire).

Species	Status	Ecology
†*Porrhomma errans* (Arachnida, Linyphiidae)	Nationally Scarce	A rarely recorded species whose ecology is inadequately known. Most records relate to grassland with some element of bare ground. A single male was collected in a pitfall trap set in the reedbed on the northern edge of Lagoon 1 between the 8th May and 3rd June 2017. This represents the first modern record for VC 63; and only the fifth record for Yorkshire as a whole in the last 25 years.
†*Dacrila fallax* (Coleoptera, Staphylinidae)	Nationally Scarce	A scarce species associated with wetland leaf-litter. The Cromwell Bottom NR specimen represents the 10th record for Yorkshire (Bob Marsh, personal communication).
†*Agelastica alni* (Coleoptera, Chrysomelidae)	Data Deficient	A species of leaf-beetle which was previously considered to be extinct in the UK. However, since the mid-2000s, it has reappeared, starting from a core area in the Greater Manchester area and subsequently spreading eastwards and in to Yorkshire by 2012. It is assumed to have been accidently imported with nursery stock of alder (*Alnus* sp.), its foodplant, and it is now reasonably widespread in the

Species	Status	Ecology
		north-west England and in to north Wales (Buckland and Buckland, 2014; Hubble, 2014). This leaf-beetle continues to be recorded in new squares all over the southern half of Yorkshire and represents a spectacular spread; even potentially becoming a pest as it can defoliate alder trees when a heavy infestation occurs. It probably no longer merits a nature conservation status. An individual was collected on shrubs, presumably alder, on the edge of the carr woodland on the 8th May 2017
Notaris scirpi (Coleoptera, Erirhinidae)	Nationally Scarce (Nb)	A wetland species associated with lesser pond-sedge (*Carex acutiformis*) and bulrush (*Typha latifolia*) that is widely distributed in England and Wales (Hyman and Parsons, 1992). Two individuals were collected in a pitfall trap set in the reedbed on the northern edge of Lagoon 1 between the 8th May and 3rd June 2017.
Grypus equiseti (Coleoptera, Erirhinidae)	Nationally Scarce (Nb)	A wetland species associated with horsetails, particularly field (*Equisetum arvense*) and marsh (*E. palustre*), within which the larvae develop. Habitats within which it has been recorded include willow carr (Hyman and Parsons, 1992). Recorded in a pitfall trap from the willow/ birch carr woodland between the 8th May and 3rd June 2017; where there is a scattering of horsetail plants.
†*Glocianus punctiger* (Coleoptera, Curculionidae)	Nationally Scarce (Nb)	A species of weevil that is associated with free-draining areas and phytophagous on dandelions (*Taraxacum* agg.). Although the host plants are widespread and abundant, the weevil is much more restricted, typically being found in grasslands, waste places, at the sides of roads and tracks, in woods and in open and rough ground generally, occurring very locally throughout England and Wales (Hyman and Parsons, 1992; Morris, 2008). In Yorkshire, it is particularly scarce, being known from only two other locations in Yorkshire: Thorne Moors (1984) and Cali Heath Yorkshire Wildlife Trust Reserve (2007) (Bob Marsh, personal communication). An individual was vacuum sampled from the remnant dry grassland in the north-west corner of the Brookfoot Loop section, opposite Freeman's Bridge (SE 1276 2236) on the 13th July 2017.
†*Parasyrphus nigritarsis* (Diptera, Syrphidae)	Nationally Scarce	A hoverfly associated with wet woodland, particularly sallows (*Salix* sp.); alder and docks (*Rumex* sp.) as its larvae are predaceous on leaf-beetle larvae associated with these plants. The adults are frequently observed and recorded from umbellifers associated with woodland edge or wider rides on the edge of wetlands that support these plants. It is a north-western species that is widely distributed but remains scarce (Ball and Morris, 2014). This record represents the first for VC 63 (Grayson, 2015). A single individual was swept from the path-side vegetation in May 2017.
White-letter hairstreak (*Satyrium w-album*) (Lepidoptera, Lycaenidae)	Endangered; SoPI	The white-letter hairstreak is a widespread species in England but dependent on various elm (*Ulmus* sp.); of which wych elm (*Ulmus glabra*) may be preferentially selected, particularly in the north. It has suffered a substantial decline in both occupancy (at the 1 km^2 scale) and abundance of 45 % and 96 % respectively over the long-term; and 41 % and 77 % in the short term (Fox *et*

Species	Status	Ecology
		al., 2015). The butterfly is scarce within the Calder Valley; WYER holding only three records from 2004 in the wider area but within 500 m; and a single record from the Brookfoot Loop section of Cromwell Bottom on the 18th June 2006 (though this is supposedly of a single egg which if so, is questionable). Records of this species are continuing to decline throughout Yorkshire, including for the most recent year available (2016) (Beaumont *et al.* 2017). A single adult was observed nectaring on creeping thistle (*Cirsium arvense*) on the 13th July 2017; which must be considered a significant record in a local context.
†*Philhygra gyllenhalli* (Coleoptera, Staphylinidae)	Uncommon in Yorkshire	A very uncommon rove beetle with only 25 records in Yorkshire, including previous records for Cromwell Bottom NR. It is a species associated with ground litter in wetlands (Bob Marsh, personal communication).
†*Polydrusus pilosus* (Coleoptera, Curculionidae)	Scarce in Yorkshire	A scarce weevil with only 18 records for Yorkshire, though widely distributed in Great Britain. An arboreal, species recorded from both deciduous and coniferous trees; the larvae are root feeders in herbaceous plants with the adults occurring on tree foliage (Bob Marsh, personal communication).
†*Campiglossa malaris* (Diptera, Tephritidae)	Scarce in Yorkshire	This picture-winged fly was first recorded in Britain in 1974 from chalk hills around Folkestone. Since then it has been recorded from several other locations in Kent. In the last ten years or so, however, it has spread much more rapidly throughout southern and central England and is now reasonably frequent south of a line between the Wash and the Severn estuaries. The larval foodplant is thought to be hoary ragwort (*Senecio erucifolius*) (Clemons, 2015). North of this line, it remains scarce (based on data available up to the end of August 2015). Clemons (2015) includes for two records in VC 63 based on specimens collected in June and July 2012 and reported by Grayson (2014). A single individual was swept from grassland with ragwort noted in July 2017. The specimen is retained in Steven Falk's collection.
Blackneck (*Lygephila pastinum*) Lepidoptera, Erebidae	Uncommon	The larvae feed on tufted vetch (*Vicia cracca*) in damp situations. It is more frequent in the south of England, becoming scattered further north. Within Yorkshire, it is most frequent in VC 63 but is still considered to be relatively uncommon.
Key: †New for Cromwell Bottom NR		

One species of moth, shaded broad-bar (*Scotopteryx chenopodiata*), was recorded and which is listed as a SoPI (Research Only). This is a widespread species in the UK, including Yorkshire, and feeds on vetches (*Vicia* spp.) and clovers (*Trifolium* spp.) and has been identified as potentially declining. The Research Only element of SoPI allows for Government funding to be released (if available) and has no other interpretation on its nature conservation status.

3.4 Invertebrate Assemblage Analysis

A total of 7 stenotopic species (i.e. those with a restricted habitat requirement, referred to as *Species Assemblage Types* (SAT) in Pantheon) representing approximately 2 % of the total invertebrate fauna has been recorded within the Brookfoot Loop section of Cromwell Bottom NR. SATs are of greater significance as they include stenotopic species (those with a restricted habitat requirement) and are

considered to have an intrinsic nature conservation value. These species are generally only recorded on sites that are of nature conservation value. Five of these are associated with wood decay habitats; and two are associated with the wetland habitats; one each in reedbed litter and the leaf-litter in the woodland carr (see Table 6).

Table 6: Stenotopic species recorded within the Brookfoot Loop section, Cromwell Bottom NR in 2017.

Species	Habitat
Myathropa florea (Diptera, Syrphidae)	A211: heartwood decay
Anaspis maculata (Coleoptera, Scraptiidae)	A212: bark & sapwood decay
Anaspis rufilabris (Coleoptera, Scraptiidae)	A212: bark & sapwood decay
Grammoptera ruficornis (Coleoptera,Cerambycidae)	A212: bark & sapwood decay
Malachius bipustulatus (Coleoptera, Malachiidae)	A212: bark & sapwood decay
Bembidion clarki (Coleoptera, Carabidae)	W221: undisturbed fluctuating marsh
Dacrila fallax (Coleoptera, Staphylinidae)	W313: moss and tussock fen

The hoverfly (Syrphidae), *Myathropa florea*, and the two false-flower beetles (Scraptiidae), *Anaspis maculata* and *A. rufilabris*, whilst widespread, are dependent on a range of different wood decay habitats. For example, *A. maculata* is associated with small girth branchwood whereas *A.rufilabris* is associated with larger girth material; thus implying that there is age diversity to the wood decay habitat (Alexander, 2002). The false-flower beetles are frequently associated with hawthorn (*Crataegus monogyna*) blossom, suggesting there is a requirement for the presence of this species within the scrub.

The 2017 surveys re-recorded three species with a nature conservation status previously recorded at Cromwell Bottom NR; the white-letter hairstreak butterfly and two species of weevils: *Grypus equiseti* and *Notaris scirpi*. However, as stated in Section 3.2 and reiterated here, there is limited further interrogation possible with a high level of confidence due the differences between the 2017 results and the historical data, largely due to:

- the different survey efforts involved. Historical data was collected over many years; whereas the 2017 data is a result of six visits in one season; and

- historical data covered the whole of Cromwell Bottom, whereas the 2017 data is restricted to the Brookfoot Loop. Furthermore, historical data is often conveyed at a 'whole site' resolution, i.e. not compartmentalised.

Whilst only three NCS species were re-recorded in 2017 (see Table 5), it is considered that the recorded absence of the 30 species with an NCS previously recorded within Cromwell Bottom NR may be an artefact of survey effort and not genuine absence from the entire nature reserve. This said, some indication of continued presence, focussing on some of the rarer species, can be obtained from their known ecological requirements.

The ground beetle *P. sigma* is likely to be the rarest species of invertebrate to have been recorded at Cromwell Bottom NR. A single specimen was collected from the North Tag Loop section of Cromwell Bottom in October 1980 (then known as Elland Gravel Pits) (MRB Ecology and Environment, 2005) adjacent to the River Calder. It is a rare species in Yorkshire, known from three other sites (Marsh, 2009) and is similarly rare on a national scale; with modern (i.e. post-1980 records) from one site each in Nottinghamshire and West Sussex in addition to the Yorkshire locations (Telfer, 2016). It is a species associated with wet grasslands, foraging in the canopy, i.e. above ground in the field layer (Telfer, *op. cit.*) associated with marshes, fenland or the margins of standing freshwater (Luff, 2017). Within the Brookfoot Loop section, there is negligible habitat that could be described as wet grassland. The only potential area is a small glade surrounded by dense scrub towards the western end (centred approximately on SE 1273 2233) but no specimens were recorded here, despite sweeping the grassland. Potential patchy habitat may exist adjacent to the River Calder within the Brookfoot Loop but there are extensive stands of bramble and this location is probably very suboptimal. It is therefore likely that if the species ever occurred within the Brookfoot Loop section, it is no longer present.

Similarly, *B. cephalotes* is a noteworthy inland record for Yorkshire (Marsh, 2009) and nationally (Luff, 1998). It is primarily a coastal species associated with sand dunes or the strandline but has been recorded inland where there is a sandy substrate (Luff, 2007). Within Yorkshire, it has been recorded in various coastal locations in the Spurn and Bridlington area; and inland in the vicinity of the Humberhead Peatlands NNR (Marsh, 2009). Two specimens were collected in May 1979 by Mike Denton from open vegetated habitat with bare ground. No appropriate habitat would appear to be present within the Brookfoot Loop section and it is therefore concluded that it is not likely to be present within the survey area.

By considering habitat availability as a surrogate for species survey within the context of this analysis, an approximate idea of the potential for the remaining species presence within the Brookfoot Loop can be hypothesised. Table 7 allocates species with a nature conservation status (excluding SoPI: Research Only) to broad biotopes and the habitats associated with them. It is evident from the broad biotope that invertebrate species with an NCS were historically predominantly associated with open habitats (e.g. grasslands) and wetland habitats within Cromwell Bottom NR. Approximately 15 % of the NCS species associated with Cromwell Bottom NR were associated with short swards and bare ground; and just under 30 % were associated with marshland and peatland vegetation.

Table 7: Distribution of species with an NCS historically recorded from Cromwell Bottom NR.

Broad biotope (No. of NCS)	Habitat	No. of species	Species with conservation status	[10]Conservation status
Open habitats ([11]11 species)	Short sward & bare ground	28	5	SoPI (x 2) Near Threatened (x 3) Nationally Scarce (Nb) (x 1) Nationally Scarce (x 2)
	Tall sward & scrub	184	6	Nationally Scarce (Nb) (x 2) Nationally Scarce (x 4)
	Upland	4	1	Nationally Scarce (Nb) (x 1)
Tree-associated (5 species)	Arboreal	92	1	SoPI; Endangered (x 1)
	Decaying wood	17	4	Nationally Scarce (Nb) (x 3) Notable (x 1)
	Shaded woodland floor	23		-
	Wet woodland	4		-
Wetland (18 species)	Lake	3		-
	Marshland	54	6	Nationally Scarce (Nb) (x 3) Nationally Scarce (x 3)
	Peatland	39	4	Near Threatened (x 1) Nationally Scarce (Nb) (x 3) Nationally Rare
	Running water	15	8	Near Threatened (x 1) Nationally Rare (x 1) Nationally Scarce (Nb) (x 2) Nationally Scarce (x 4) Notable (x 1)
	Wet woodland	4		-

Within Brookfoot Loop, there is only a remnant area of what could reasonably be described as 'short sward and bare ground' (note this excludes bare ground associated with footpaths), which is restricted

[10] Some species, such as white-letter hairstreak, have more than one designation (e.g. SoPI and Near Threatened), hence why the number of species and conservation status may not equate.
[11] Number of NCS recorded in the broad biotope (Column 1) won't necessarily equal the numbers conveyed in Column 4 due to some species associated with more than one habitat within a biotope.

to the small patch of dry grassland opposite Freeman's Bridge (SE 1276 2236). Similarly, there is a small area of tall sward and scrub associated with this dry grassland on the opposite side of the footpath, where *G. punctiger* was collected (see Table 5). When compared to the Phase 1 habitat map illustrated in NEAP (1991), the majority of these open habitats have been lost. Therefore, it is considered likely that the invertebrate assemblages, and in particular, the NCS and stenotopic species associated with the open habitat biotope have largely been lost from Brookfoot Loop. Whether these are present elsewhere within Cromwell Bottom NR in the absence of survey is not possible to say.

Marshland and peatland habitats are more prevalent within Brookfoot Loop; associated with Lagoon 1's margins (predominantly reedbed) and the *Sphagnum*-bog towards the far eastern end of the survey area. However, as evidenced during the course of the season, the surface water within Lagoon 1 rapidly receded such that by mid-summer, the lagoon was virtually dry and had dried out by mid-August 2017. Consequently, the reedbed margins, particularly within the area where willows had been recently coppiced, the leaf-litter and ground conditions were dry by late spring. Similarly, the *Sphagnum*-bog, although retaining a hummock structure, was dry under foot from June 2017 onwards. This, within a context of a relatively wet summer (refer back to Section 1.4) suggests that at least within the Brookfoot Loop section, Cromwell Bottom's hydrological input is insufficient to maintain the water levels at or just below the ground surface, and thus maintain humidity and ground conditions necessary to maintain the wetland habitats. Therefore, whilst marshland and peatland vegetation remain present within the Brookfoot Loop section of Cromwell Bottom NR, the invertebrate assemblages associated with them that are less tolerant to drier conditions could be expected to have declined, or have been lost entirely.

Evidence for an actual decline is difficult to tease out from the data, as there is an imbalance in both survey methods and duration; the historical data pertaining to many years of intermittent recording. Nevertheless, given the intensity of the surveys undertaken during 2017, which included pitfall trapping, the number of wetland species with a NCS recorded in wetland biotopes was three species (see Table 8) compared to 18 species historically. Whilst it cannot be said (based on the datasets) that there has been a six-fold decline in wetland species with a NCS, taking the evidence together, it is considered probable that there has been a genuine decline.

Table 8: [12]Distribution of species with an NCS recorded from the Brookfoot Loop section of Cromwell Bottom NR in 2017 (excluding SoPI (Research Only).

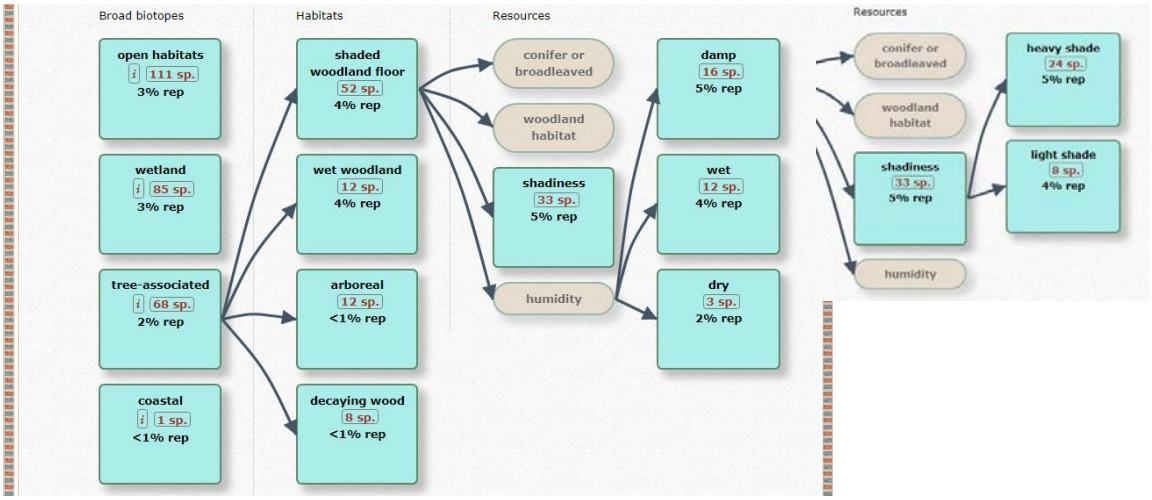
Broad biotope	Habitat	No. of species	Species with conservation status	Conservation status
Coastal	Brackish pools & ditches	1		
Open habitats (2 species)	Short sward & bare ground	12	2	Nationally Scarce (x 1) Nationally Scarce (Nb) (x 1)
	Tall sward & scrub	96	1	
	Upland	3		
Tree-associated (3 species)	Arboreal	12	3	Nationally Rare; Data Deficient Nationally Scarce SoPI; Endangered
	Decaying wood	8		
	Shaded woodland floor	50		
	Wet woodland	12		
Wetland (3 species)	Marshland	35	2	Nationally Scarce (Nb) (x 2)
	Peatland	43	2	Notable (x 1) Nationally Scarce (Nb) (x1)
	Running water	8	1	Nationally Scarce (Nb) (x 1)
	Wet woodland	12		

[12] Note, numbers won't tally due to overlap of species associated with different habitats within the same biotope.

This perceived decline in invertebrate assemblages associated with wetland habitats is also reflected in the woodland carr vegetation and open habitats.

For example, [13]Figure 1 shows that of the 68 species of tree-associated invertebrates (i.e. associated with woodlands/ wood pasture), 52 species are associated with the shaded woodland floor (partly a reflection of the pitfall trapping); of which 16 species are associated with damp shaded woodland (representing 5 % of the total invertebrate assemblage in England associated with damp shaded woodland floors); 12 species with wet shaded woodland and 3 species associated with dry shaded woodland. Furthermore, over a third (*c*. 35.3 %) of tree-associated invertebrate species are associated with heavy shade. This implies that a woodland invertebrate community is developing as shade tolerant species are a significant element of the fauna, and that there is a slight lean towards drier woodland conditions (19 species are associated with damp or dry woodland versus 12 species with wet woodland); though two NCS species recorded in 2017 (*P. nigritarsis* and *A. alni*) are associated with wet woodland. The analysis suggests that this woodland is becoming an important habitat feature within the Brookfoot Loop section given the predominance of tree-associated stenotopic species (see Table 6) associated with this biotope.

Figure 1: Pantheon analysis of tree-associated invertebrates from material collected in 2017



3.5 Evaluation

In conclusion, the invertebrate surveys undertaken during 2017 have identified assemblages that are indicating the habitats are drying out; supporting the hydro-ecological work completed by MRB Ecology and Environment (2005).

Historically, the invertebrate communities considered to be outstanding, representing an extraordinary assemblage (Key, 1986; Mike Denton, personal communication) had a higher proportion of open habitat species than evidenced in 2017, and though not possible to be certain, based on the scarcity of some species such as *P. sigma*, and general habitat descriptions given in NEAP (1991), Cromwell Bottom NR was likely to have been of *at least* County Significance for its invertebrate assemblages if formally evaluated, if not regionally or nationally.

Whilst the analysis obtained from Pantheon is useful (see Table 9), a degree of professional judgement is necessary given that strictly speaking, it only differentiates between sites that are in favourable condition expected for SSSIs. Furthermore, as the survey did not strictly comply with methods described in Drake *et al*. (2007), such as timed sweeps, a degree of caution and professional judgement is likewise necessary to accommodate for any bias (detracting or enhancing) within the analysis. Approaching or exceeding the threshold for 'favourable condition' is not, necessarily, solely indicative that the assemblages are of national significance as other factors need to be taken in to account such as site context and availability of similar habitat in the wider landscape. Nevertheless, Pantheon remains a useful guide when assessing the nature conservation value of the survey area for terrestrial invertebrates. Finally, the influence of weather and curtailment of pitfall trapping (refer back to Section 1.4) needs to be accounted for.

[13] Note that Figure 1 is a screen grab from Pantheon and illustrates the analysis for shaded woodland floor habitats. On-line, each 'blue box' can be interrogated.

Table 9: Invertebrate assemblage assessment (Brookfoot Loop section) from 2017 survey data.

Broad biotope	Habitat	SAT	No. of species	[14]FC Threshold	Proportion to Threshold	Species with NCS
Tree-associated	Decaying wood	A212: bark & sapwood decay	4	7	57 %	
		A211: heartwood decay	1	6	17 %	
Wetland	Marshland	W221: Undisturbed fluctuating marsh	1	3	33 %	
	Peatland	W313: Moss & tussock fen	1	5	20 %	1
Key: FC = Favourable conservation status						

Based on the number of stenotopic species recorded and the thresholds published in Drake *et al*. (2007), none of the invertebrate assemblages have reached or passed the thresholds considered to represent 'favourable conservation status' (FC) if the survey area was being monitored as if it were a SSSI. Indeed, the Proportion to Threshold (PtT) for each of the SATs have fallen short (range of between 17 % and 57 % of the thresholds) such that the nature conservation significance of the stenotopic invertebrate assemblages recorded in the Brookfoot Loop section of Cromwell Bottom NR falls significantly short of the national threshold.

The weather conditions in 2017 were unsettled with prolonged periods of cool temperatures and wet periods which may have suppressed some faunas, particularly pollinators. However, despite this weather, ground conditions remained dry, emphasising the precarious state of the survey area's hydrological regime, which may be reflected in the wetland stenotopic PtT scores. Thus, whilst warmer and sunnier conditions will likely have increased species diversity, this is not the same as increasing the proportion of stenotopic species present, particularly the wetland fauna within the Brookfoot Loop section and for which Cromwell Bottom NR was designated. Therefore, it is not thought likely that the weather conditions experienced in 2017 will have been a factor in evaluating the survey area's value for its invertebrate fauna. Likewise, whilst pitfall trapping was curtailed, this is not thought to have influenced the evaluation.

Given the relatively low PtTs for wetland biotopes and no stenotopic species for open habitat biotopes, the Brookfoot Loop section is evaluated to be of **District significance** for its invertebrate assemblages.

[14] Thresholds taken from Drake *et al*. (2007) ISIS spreadsheet (version 17th December 2007) supplied by Natural England.

4 Conclusions

4.1 Proposed Habitat Intervention Works

The invertebrate survey in 2017 has identified 315 species of which a small proportion (*c*. 3.5 %) are currently assigned a NCS, or are scarce Yorkshire species. Only two wetland stenotopic species have been recorded, despite survey effort focusing on woodland carr and reedbed leaf-litter. This, in combination with other evidence discussed in Section 3.4 and Section 3.5 is testament to the habitats drying out within Brookfoot Loop. The invertebrate work therefore supports and underpins the hydro-ecological study completed by MRB Ecology and Environment (2005).

In summary therefore, the proposed works will likely benefit the invertebrate assemblages present by reversing the trend towards drier habitat communities. This will at least slow down or reverse the declining fortunes of species associated with wetland biotopes, including stenotopic species associated with marshland and peatland habitats. This is likely to have greatest benefit to those assemblages associated with the *Sphagnum*-bog.

Nevertheless, the survey work undertaken during 2017 has identified that the developing woodland biotope is beginning to support invertebrates associated with wood decay. Re-wetting the woodland carr by pumping water from the River Calder through a natural channel will increase humidity and thus benefit wood decay communities too (see Section 4.2 for further commentary).

Importantly, the proposed work includes removing the invading birch trees within the *Sphagnum*-bog and this should be completed as a matter of priority, i.e. before winter 2018/ 2019 if at all possible. The 'do nothing' approach will inevitably result in a rapid eventual loss of this habitat and the invertebrate assemblages associated with it.

In conclusion therefore, the proposed habitat intervention work will likely benefit the invertebrate assemblages present within the Brookfoot Loop section of Cromwell Bottom NR and will have no foreseeable negative effects on any of the stenotopic species. This will likely result in a cessation of the decline in the invertebrate interest in the Brookfoot Loop section, which when compared to historic data and evaluating the likely nature conservation significance of past assemblages (estimated to have been of at least County and quite likely regional/ national significance), is a key nature conservation objective. Further work by way of enhancement (see Section 4.2) will offer potential opportunities to increase Brookfoot Loop's significance for invertebrate assemblages, with an optimistic, but not necessarily an unrealistic expectation of re-establishing the nature reserve as a site of county significance for its invertebrate faunas.

4.2 Proposed Habitat Enhancement

In addition to the proposed habitat intervention work conveyed by Calderdale Council, additional measures are proposed that will complement and enhance the Brookfoot Loop section.

In addition to removal (felling) of birch/ willow carr to make way for the necessary re-wetting, it is recommended that away from the permissive footpaths, individual trees are ring-barked to create standing dead wood. Priority should be given to birch and willow trees as these are the dominant species present. In a few locations, consideration should also be given to create artificially wind-blown trees (as if in a storm) such that the root bowel is exposed vertically and a shallow depression is exposed adjacent. These two approaches, supplementing stacked log-piles, will not only create an age structure of living trees, but also wood decay habitat. The exposed root bowels will provide niche habitat for various invertebrate faunas, including, if areas are selected carefully, solitary aculeate hymenoptera. The best areas for this group would be where a root bowel (exposed buried surface) is facing south or west and adjacent to open habitat biotopes, affording clear flight and sight lines.

There is almost no open habitat biotope, and particularly dry grassland communities with areas of bare ground, within the Brookfoot Loop section. Historically, this was a significant feature within this section of Cromwell Bottom NR (and Elland Gravel Pits before) and supported a range of invertebrate species

that were acknowledged to significantly contribute to the site's outstanding assemblage as described on the ISR (Key, 1986).

It is proposed that consideration should be given to re-establish open habitat biotopes within the Brookfoot Loop by removing the surface vegetation and re-exposing the PFA that remains *in situ*. This is a radical approach and may be novel; so caution is advised. In the first instance, a desk study should be undertaken to establish if similar approaches have been undertaken elsewhere. PFA has a complex chemistry and whilst initially is generally saline and alkaline, rainfall and weathering leaches the substrate such that salinity and pH reduces; the former rapidly (Shaw, 2009), thus enabling colonisation by plant communities. Field experiments in PFA colonisation has been undertaken and based on a paper describing a study of natural successional changes on an abandoned PFA lagoon in southern England, there would appear to be little vertical mixing of the humic surface horizon (Shaw, 1992). How PFA changes (if it does) below a certain depth is therefore worth investigating and it is recommended that Dr. Peter Shaw is [15]contacted for further insight before any detailed proposals are formulated.

However, it is proposed to investigate whether removing the humic layer and the immediate PFA horizon below this will allow natural recolonisation of open habitat biotope, with the possibility of recreating a vegetation community similar to the Open Mosaic Habitat on Previously Developed Land. Questions that need to be answered (in my opinion) would be:

- Does buried PFA retain its chemical properties from initial deposition?
- Would the progress of succession reasonably be expected to follow a similar transgression observed elsewhere (e.g. Shaw, 1992); i.e. from bare ground, through to halophytic (salt-tolerant) species and eventually a patchy, short, perennial vegetation reflecting the reduction in pH towards a calcicolous community?
- Should the re-exposed surface be left to colonise naturally, or inoculated with a suitable species mix; or both?

In answering these questions, consideration should be given to creating plots of sufficient size to recreate a flower-rich patchy sward with plenty of bare ground and varied topography. Within this open habitat biotope, scattered dead wood (logs) should be strewn across the surface as artificial refugia as well as wood decay habitat. Consideration should also be given to create bare shallow scrapes that could allow ephemeral waterbodies to evolve over time.

4.3 Monitoring

Given the nature conservation significance of Cromwell Bottom NR, it is recommended that a monitoring programme is undertaken post-completion of the habitat intervention work. This should include an appropriately designed invertebrate survey which should be completed over two seasons, though not necessarily consecutive years. Supporting this work, a sufficiently detailed habitat mapping exercise should be completed concurrently with the invertebrate monitoring. Ideally, and specifically for the botanical element, this should be completed in the summer immediately prior to the habitat intervention work commencing (assuming this will commence after the winter of 2017/ 2018) to provide an accurate baseline of existing habitat extents and relationships.

[15] Peter's contact details are available here: https://pure.roehampton.ac.uk/portal/en/persons/peter-shaw(3d0345c1-d4f8-43ec-ac67-bf263d0cd421).html/

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A. Appendix A: Species List

Table 10: Species recorded at Cromwell Bottom NR (2017).

Class	Order	Family	Taxon	Vernacular	Conservation Status	Woodland Edge (Paths)	Birch/ Willow Carr	Reedbed	Sphagnum Bog
Arachnida	Araneae	Theridiidae	*Phylloneta sisyphia*			1			
Arachnida	Araneae	Theridiidae	*Neottiura bimaculata*			1			
Arachnida	Araneae	Theridiidae	*Enoplognatha ovata*						2
Arachnida	Araneae	Theridiidae	*Theonoe minutissima*						4
Arachnida	Araneae	Linyphiidae	*Dicymbium nigrum*				1	1	
Arachnida	Araneae	Linyphiidae	*Gnathonarium dentatum*					5	1
Arachnida	Araneae	Linyphiidae	*Gongylidium rufipes*			1			
Arachnida	Araneae	Linyphiidae	*Hypomma bituberculatum*					4	
Arachnida	Araneae	Linyphiidae	*Maso sundevalli*						1
Arachnida	Araneae	Linyphiidae	*Pocadicnemis pumila*			1			
Arachnida	Araneae	Linyphiidae	*Oedothorax gibbosus*					3	2
Arachnida	Araneae	Linyphiidae	*Oedothorax fuscus*				1	1	
Arachnida	Araneae	Linyphiidae	*Pelecopsis parallela*			1			1
Arachnida	Araneae	Linyphiidae	*Silometopus elegans*					5	4
Arachnida	Araneae	Linyphiidae	*Cnephalocotes obscurus*			1			5
Arachnida	Araneae	Linyphiidae	*Tiso vagans*			1			
Arachnida	Araneae	Linyphiidae	*Diplocephalus cristatus*			1			1
Arachnida	Araneae	Linyphiidae	*Diplocephalus permixtus*						2
Arachnida	Araneae	Linyphiidae	*Diplocephalus picinus*				1		
Arachnida	Araneae	Linyphiidae	*Erigone promiscua*					1	
Arachnida	Araneae	Linyphiidae	*Porrhomma pygmaeum*			2		7	4

Class	Order	Family	Taxon	Vernacular	Conservation Status	Woodland Edge (Paths)	Birch/ Willow Carr	Reedbed	Sphagnum Bog
Arachnida	Araneae	Linyphiidae	*Porrhomma errans*		Nationally Scarce			1	
Arachnida	Araneae	Linyphiidae	*Meioneta saxatilis*			1			
Arachnida	Araneae	Linyphiidae	*Microneta viaria*					1	
Arachnida	Araneae	Linyphiidae	*Tallusia experta*						1
Arachnida	Araneae	Linyphiidae	*Bathyphantes approximatus*					1	
Arachnida	Araneae	Linyphiidae	*Bathyphantes gracilis*					3	3
Arachnida	Araneae	Linyphiidae	*Tenuiphantes zimmermanni*					1	
Arachnida	Araneae	Linyphiidae	*Tenuiphantes mengei*						1
Arachnida	Araneae	Linyphiidae	*Tenuiphantes flavipes*				1		
Arachnida	Araneae	Linyphiidae	*Palliduphantes ericaeus*						1
Arachnida	Araneae	Linyphiidae	*Microlinyphia pusilla*						1
Arachnida	Araneae	Tetragnathidae	*Tetragnatha extensa*					2	
Arachnida	Araneae	Tetragnathidae	*Tetragnatha montana*				1	2	1
Arachnida	Araneae	Tetragnathidae	*Metellina mengei*			2	2		
Arachnida	Araneae	Araneidae	*Araneus diadematus*	Garden Spider		2			
Arachnida	Araneae	Araneidae	*Larinioides cornutus*			1			
Arachnida	Araneae	Araneidae	*Araniella cucurbitina*				1		
Arachnida	Araneae	Araneidae	*Araniella opisthographa*			1			
Arachnida	Araneae	Lycosidae	*Pardosa pullata*			1		2	7
Arachnida	Araneae	Lycosidae	*Pardosa prativaga*					1	
Arachnida	Araneae	Lycosidae	*Pardosa amentata*					3	2
Arachnida	Araneae	Lycosidae	*Trochosa terricola*					1	1
Arachnida	Araneae	Lycosidae	*Pirata piraticus*					4	7

Class	Order	Family	Taxon	Vernacular	Conservation Status	Woodland Edge (Paths)	Birch/ Willow Carr	Reedbed	Sphagnum Bog
Arachnida	Araneae	Pisauridae	*Pisaura mirabilis*			2			
Arachnida	Araneae	Hahniidae	*Antistea elegans*					1	3
Arachnida	Araneae	Dictynidae	*Dictyna uncinata*			1			
Arachnida	Araneae	Clubionidae	*Clubiona reclusa*					1	
Arachnida	Araneae	Clubionidae	*Clubiona phragmitis*					1	
Arachnida	Araneae	Salticidae	*Neon reticulatus*						4
Arachnida	Opiliones	Nemastomatidae	*Nemastoma bimaculatum*					1	
Arachnida	Opiliones	Phalangiidae	*Rilaena triangularis*			1			
Arachnida	Opiliones	Leiobunidae	*Leiobunum blackwalli*					1	
Chilopoda	Lithobiomorpha	Lithobiidae	*Lithobius variegatus*					1	
Gastropoda	Stylommatophora	Helicidae	*Arianta arbustorum*	Copse Snail		1			
Gastropoda	Stylommatophora	Helicidae	*Helix aspersa*	Garden Snail		1			
Insecta	Coleoptera	Dytiscidae	*Ilybius fuliginosus*					1	
Insecta	Coleoptera	Carabidae	*Carabus nemoralis*				3		
Insecta	Coleoptera	Carabidae	*Leistus fulvibarbis*				1		
Insecta	Coleoptera	Carabidae	*Leistus ferrugineus*					1	
Insecta	Coleoptera	Carabidae	*Nebria brevicollis*				3		
Insecta	Coleoptera	Carabidae	*Loricera pilicornis*				2		
Insecta	Coleoptera	Carabidae	*Elaphrus cupreus*					1	
Insecta	Coleoptera	Carabidae	*Bembidion guttula*						2
Insecta	Coleoptera	Carabidae	*Bembidion tetracolum*				2	1	
Insecta	Coleoptera	Carabidae	*Bembidion assimile*				1	3	2
Insecta	Coleoptera	Carabidae	*Bembidion clarkii*				1		

Class	Order	Family	Taxon	Vernacular	Conservation Status	Woodland Edge (Paths)	Birch/ Willow Carr	Reedbed	Sphagnum Bog
Insecta	Coleoptera	Carabidae	*Pterostichus madidus*						1
Insecta	Coleoptera	Carabidae	*Pterostichus niger*				3		2
Insecta	Coleoptera	Carabidae	*Pterostichus minor*				1	1	2
Insecta	Coleoptera	Carabidae	*Pterostichus nigrita*				3	1	1
Insecta	Coleoptera	Carabidae	*Pterostichus diligens*					1	3
Insecta	Coleoptera	Carabidae	*Oxypselaphus obscurus*				4	1	
Insecta	Coleoptera	Carabidae	*Agonum fuliginosum*					3	3
Insecta	Coleoptera	Carabidae	*Agonum gracile*					1	
Insecta	Coleoptera	Carabidae	*Agonum thoreyi*						1
Insecta	Coleoptera	Carabidae	*Platynus assimilis*				4		
Insecta	Coleoptera	Carabidae	*Bradycellus verbasci*						1
Insecta	Coleoptera	Carabidae	*Trichocellus placidus*					2	2
Insecta	Coleoptera	Carabidae	*Acupalpus dubius*						4
Insecta	Coleoptera	Carabidae	*Dromius linearis*			1			
Insecta	Coleoptera	Helophoridae	*Helophorus brevipalpis*				1		
Insecta	Coleoptera	Hydrophilidae	*Anacaena limbata*					1	
Insecta	Coleoptera	Hydrophilidae	*Cercyon pygmaeus*					1	
Insecta	Coleoptera	Ptiliidae	*Acrotrichis sitkaensis*					1	
Insecta	Coleoptera	Silphidae	*Nicrophorus vespilloides*						1
Insecta	Coleoptera	Staphylinidae	*Lesteva sicula*					1	
Insecta	Coleoptera	Staphylinidae	*Proteinus ovalis*					1	
Insecta	Coleoptera	Staphylinidae	*Rybaxis longicornis*					1	2
Insecta	Coleoptera	Staphylinidae	*Tachyporus chrysomelinus*					1	2

Class	Order	Family	Taxon	Vernacular	Conservation Status	Woodland Edge (Paths)	Birch/ Willow Carr	Reedbed	Sphagnum Bog
Insecta	Coleoptera	Staphylinidae	*Tachyporus nitidulus*			1			
Insecta	Coleoptera	Staphylinidae	*Tachinus marginellus*				1		
Insecta	Coleoptera	Staphylinidae	*Tachinus signatus*				1		
Insecta	Coleoptera	Staphylinidae	*Mycetoporus splendidus*					1	
Insecta	Coleoptera	Staphylinidae	*Habrocerus capillaricornis*				1		
Insecta	Coleoptera	Staphylinidae	*Oxypoda elongatula*					1	
Insecta	Coleoptera	Staphylinidae	*Ocyusa maura*					1	
Insecta	Coleoptera	Staphylinidae	*Dacrila fallax*		Nationally Scarce			1	
Insecta	Coleoptera	Staphylinidae	*Philhygra gyllenhali*		Uncommon in Yorkshire			1	
Insecta	Coleoptera	Staphylinidae	*Mocyta fungi*			1		1	
Insecta	Coleoptera	Staphylinidae	*Atheta graminicola*					1	1
Insecta	Coleoptera	Staphylinidae	*Carpelimus rivularis*				1		
Insecta	Coleoptera	Staphylinidae	*Oxytelus laqueatus*			1			
Insecta	Coleoptera	Staphylinidae	*Stenus bimaculatus*				1		
Insecta	Coleoptera	Staphylinidae	*Stenus juno*				1		2
Insecta	Coleoptera	Staphylinidae	*Stenus bifoveolatus*						3
Insecta	Coleoptera	Staphylinidae	*Stenus nitidiusculus*						1
Insecta	Coleoptera	Staphylinidae	*Stenus impressus*						2
Insecta	Coleoptera	Staphylinidae	*Lathrobium brunnipes*					1	
Insecta	Coleoptera	Staphylinidae	*Lathrobium elongatum*					1	
Insecta	Coleoptera	Staphylinidae	*Philonthus decorus*				1		
Insecta	Coleoptera	Staphylinidae	*Quedius curtipennis*						1
Insecta	Coleoptera	Scirtidae	*Microcara testacea*					1	

Class	Order	Family	Taxon	Vernacular	Conservation Status	Woodland Edge (Paths)	Birch/ Willow Carr	Reedbed	Sphagnum Bog
Insecta	Coleoptera	Scirtidae	*Cyphon ochraceus*					2	3
Insecta	Coleoptera	Scirtidae	*Cyphon padi*			1		1	
Insecta	Coleoptera	Scirtidae	*Cyphon variabilis*			1			
Insecta	Coleoptera	Throscidae	*Trixagus dermestoides*						1
Insecta	Coleoptera	Elateridae	*Hypnoidus riparius*				2		
Insecta	Coleoptera	Elateridae	*Aplotarsus incanus*			1			
Insecta	Coleoptera	Elateridae	*Agriotes acuminatus*			1			
Insecta	Coleoptera	Cantharidae	*Cantharis nigra*			1			
Insecta	Coleoptera	Cantharidae	*Rhagonycha femoralis*			2			
Insecta	Coleoptera	Cantharidae	*Rhagonycha fulva*			2			
Insecta	Coleoptera	Malachiidae	*Malachius bipustulatus*	Malachite Beetle		1			
Insecta	Coleoptera	Coccinellidae	*Psyllobora vigintiduopunctata*	22-spot Ladybird		1			
Insecta	Coleoptera	Coccinellidae	*Propylea quattuordecimpunctata*	14-spot Ladybird		2			
Insecta	Coleoptera	Coccinellidae	*Harmonia axyridis*	Harlequin Ladybird		1		1	
Insecta	Coleoptera	Coccinellidae	*Coccinella septempunctata*	7-spot Ladybird		1			
Insecta	Coleoptera	Oedemeridae	*Oedemera lurida*			1		1	
Insecta	Coleoptera	Scraptiidae	*Anaspis maculata*			1			
Insecta	Coleoptera	Scraptiidae	*Anaspis rufilabris*			1			
Insecta	Coleoptera	Cerambycidae	*Grammoptera ruficornis*				1		
Insecta	Coleoptera	Chrysomelidae	*Hydrothassa marginella*				1		
Insecta	Coleoptera	Chrysomelidae	*Galerucella lineola*	Brown Willow Beetle				1	
Insecta	Coleoptera	Chrysomelidae	*Agelastica alni*		DD		1		
Insecta	Coleoptera	Chrysomelidae	*Longitarsus melanocephalus*			1			

Class	Order	Family	Taxon	Vernacular	Conservation Status	Woodland Edge (Paths)	Birch/ Willow Carr	Reedbed	Sphagnum Bog
Insecta	Coleoptera	Chrysomelidae	*Crepidodera fulvicornis*			1	2	2	2
Insecta	Coleoptera	Apionidae	*Protapion apricans*			1			1
Insecta	Coleoptera	Apionidae	*Protapion fulvipes*	White Clover Seed Weevil		1			
Insecta	Coleoptera	Apionidae	*Eutrichapion viciae*			1			
Insecta	Coleoptera	Erirhinidae	*Notaris scirpi*		Nationally Scarce (Nb)			1	
Insecta	Coleoptera	Erirhinidae	*Grypus equiseti*	Horsetail Weevil	Nationally Scarce (Nb)		1		
Insecta	Coleoptera	Curculionidae	*Otiorhynchus sulcatus*	Vine Weevil		1			
Insecta	Coleoptera	Curculionidae	*Polydrusus cervinus*			1			
Insecta	Coleoptera	Curculionidae	*Polydrusus pilosus*		Scarce in Yorkshire		1		
Insecta	Coleoptera	Curculionidae	*Sciaphilus asperatus*	Strawberry Root Weevil			1		
Insecta	Coleoptera	Curculionidae	*Sitona lepidus*			2			
Insecta	Coleoptera	Curculionidae	*Sitona lineatus*					1	
Insecta	Coleoptera	Curculionidae	*Hypera nigrirostris*			1			
Insecta	Coleoptera	Curculionidae	*Glocianus punctiger*		Nationally Scarce (Nb)	1			
Insecta	Coleoptera	Curculionidae	*Nedyus quadrimaculatus*	Small Nettle Weevil			1		
Insecta	Coleoptera	Curculionidae	*Archarius salicivorus*	Willow Gall Weevil				1	
Insecta	Dermaptera	Forficulidae	*Forficula auricularia*	Common Earwig		1			
Insecta	Diptera	Tipulidae	*Tipula varipennis*					1	
Insecta	Diptera	Tipulidae	*Tipula oleracea*				1		
Insecta	Diptera	Pediciidae	*Tricyphona immaculata*					1	
Insecta	Diptera	Limoniidae	*Molophilus appendiculatus*				1		
Insecta	Diptera	Limoniidae	*Molophilus griseus*				1	1	
Insecta	Diptera	Limoniidae	*Austrolimnophila ochracea*				1		

Class	Order	Family	Taxon	Vernacular	Conservation Status	Woodland Edge (Paths)	Birch/ Willow Carr	Reedbed	Sphagnum Bog
Insecta	Diptera	Limoniidae	*Epiphragma ocellare*				1		
Insecta	Diptera	Limoniidae	*Phylidorea ferruginea*					1	
Insecta	Diptera	Limoniidae	*Pilaria discicollis*			1			
Insecta	Diptera	Limoniidae	*Dicranomyia modesta*				1	1	
Insecta	Diptera	Limoniidae	*Metalimnobia quadrinotata*				1		
Insecta	Diptera	Limoniidae	*Rhipidia maculata*					1	
Insecta	Diptera	Rhagionidae	*Chrysopilus cristatus*			1			
Insecta	Diptera	Rhagionidae	*Rhagio lineola*						1
Insecta	Diptera	Rhagionidae	*Rhagio tringarius*						1
Insecta	Diptera	Stratiomyidae	*Chloromyia formosa*			1			
Insecta	Diptera	Asilidae	*Leptogaster cylindrica*			3	1		
Insecta	Diptera	Asilidae	*Dioctria rufipes*			1			
Insecta	Diptera	Hybotidae	*Ocydromia glabricula*				1		
Insecta	Diptera	Empididae	*Empis tessellata*			2			
Insecta	Diptera	Empididae	*Empis trigramma*			1			
Insecta	Diptera	Empididae	*Hilara maura*			1	1		
Insecta	Diptera	Empididae	*Phyllodromia melanocephala*				1		
Insecta	Diptera	Dolichopodidae	*Argyra leucocephala*				1		
Insecta	Diptera	Dolichopodidae	*Hercostomus metallicus*				1		
Insecta	Diptera	Dolichopodidae	*Poecilobothrus nobilitatus*			1			
Insecta	Diptera	Syrphidae	*Melanostoma mellinum*			1	1		
Insecta	Diptera	Syrphidae	*Melanostoma scalare*			1			
Insecta	Diptera	Syrphidae	*Platycheirus clypeatus*			1			

Class	Order	Family	Taxon	Vernacular	Conservation Status	Woodland Edge (Paths)	Birch/ Willow Carr	Reedbed	Sphagnum Bog
Insecta	Diptera	Syrphidae	*Platycheirus fulviventris*			2			
Insecta	Diptera	Syrphidae	*Platycheirus tarsalis*			1			
Insecta	Diptera	Syrphidae	*Chrysotoxum festivum*			1			
Insecta	Diptera	Syrphidae	*Epistrophe grossulariae*			1			
Insecta	Diptera	Syrphidae	*Episyrphus balteatus*			2			
Insecta	Diptera	Syrphidae	*Leucozona laternaria*			1			
Insecta	Diptera	Syrphidae	*Parasyrphus nigritarsis*		Nationally Scarce	1			
Insecta	Diptera	Syrphidae	*Sphaerophoria interrupta*			2	1		
Insecta	Diptera	Syrphidae	*Sphaerophoria scripta*			1			
Insecta	Diptera	Syrphidae	*Syrphus ribesii*			2			
Insecta	Diptera	Syrphidae	*Cheilosia bergenstammi*			1			
Insecta	Diptera	Syrphidae	*Cheilosia illustrata*			2			
Insecta	Diptera	Syrphidae	*Eristalis horticola*			1			
Insecta	Diptera	Syrphidae	*Eristalis nemorum*			1			
Insecta	Diptera	Syrphidae	*Eristalis pertinax*			2			
Insecta	Diptera	Syrphidae	*Eristalis tenax*			1			
Insecta	Diptera	Syrphidae	*Helophilus pendulus*			1			
Insecta	Diptera	Syrphidae	*Myathropa florea*			2			
Insecta	Diptera	Syrphidae	*Parhelophilus frutetorum*			1			
Insecta	Diptera	Syrphidae	*Volucella bombylans*			1			
Insecta	Diptera	Syrphidae	*Volucella pellucens*			1			
Insecta	Diptera	Syrphidae	*Syritta pipiens*			1			
Insecta	Diptera	Pipunculidae	*Verrallia aucta*			1			

Class	Order	Family	Taxon	Vernacular	Conservation Status	Woodland Edge (Paths)	Birch/ Willow Carr	Reedbed	Sphagnum Bog
Insecta	Diptera	Pipunculidae	*Pipunculus campestris*			1			
Insecta	Diptera	Micropezidae	*Neria cibaria*				1		
Insecta	Diptera	Conopidae	*Conops quadrifasciatus*			1			
Insecta	Diptera	Conopidae	*Sicus ferrugineus*			2			
Insecta	Diptera	Tephritidae	*Noeeta pupillata*			1			
Insecta	Diptera	Tephritidae	*Campiglossa malaris*		New for Yorkshire	1			
Insecta	Diptera	Tephritidae	*Xyphosia miliaria*			2			
Insecta	Diptera	Lauxaniidae	*Calliopum aeneum*			1			
Insecta	Diptera	Lauxaniidae	*Meiosimyza decipiens*			1	1		
Insecta	Diptera	Lauxaniidae	*Meiosimyza rorida*				1		
Insecta	Diptera	Lauxaniidae	*Minettia rivosa*			2			
Insecta	Diptera	Lauxaniidae	*Sapromyza sordida*			1			
Insecta	Diptera	Lauxaniidae	*Tricholauxania praeusta*			1	1		
Insecta	Diptera	Sciomyzidae	*Tetanocera ferruginea*			1			
Insecta	Diptera	Heleomyzidae	*Heteromyza rotundicornis*				1		
Insecta	Diptera	Scathophagidae	*Scathophaga furcata*				1		
Insecta	Diptera	Scathophagidae	*Scathophaga stercoraria*			2			
Insecta	Diptera	Anthomyiidae	*Botanophila striolata*			1			
Insecta	Diptera	Anthomyiidae	*Hylemyza partita*			1			
Insecta	Diptera	Anthomyiidae	*Lasiomma strigilatum*			1			
Insecta	Diptera	Anthomyiidae	*Delia florilega*			1			
Insecta	Diptera	Anthomyiidae	*Hydrophoria ruralis*			1	1		
Insecta	Diptera	Anthomyiidae	*Hydrophoria silvicola*				1		

Class	Order	Family	Taxon	Vernacular	Conservation Status	Woodland Edge (Paths)	Birch/ Willow Carr	Reedbed	Sphagnum Bog
Insecta	Diptera	Anthomyiidae	*Phorbia bartaki*			1			
Insecta	Diptera	Anthomyiidae	*Pegoplata infirma*			1			
Insecta	Diptera	Anthomyiidae	*Alliopsis billbergi*			1			
Insecta	Diptera	Anthomyiidae	*Paradelia intersecta*				1		
Insecta	Diptera	Anthomyiidae	*Pegomya bicolor*				1		
Insecta	Diptera	Fanniidae	*Fannia serena*			1			
Insecta	Diptera	Muscidae	*Coenosia agromyzina*				1		
Insecta	Diptera	Muscidae	*Azelia nebulosa*				1		
Insecta	Diptera	Muscidae	*Hydrotaea armipes*				1		
Insecta	Diptera	Muscidae	*Hydrotaea dentipes*				1		
Insecta	Diptera	Muscidae	*Thricops semicinereus*				1		
Insecta	Diptera	Muscidae	*Morellia simplex*				1		
Insecta	Diptera	Muscidae	*Muscina assimilis*						1
Insecta	Diptera	Muscidae	*Mydaea humeralis*				1		
Insecta	Diptera	Muscidae	*Helina allotalla*						1
Insecta	Diptera	Muscidae	*Helina impuncta*			1			
Insecta	Diptera	Muscidae	*Helina reversio*			1			
Insecta	Diptera	Muscidae	*Helina setiventris*			1			
Insecta	Diptera	Muscidae	*Phaonia angelicae*			1			
Insecta	Diptera	Muscidae	*Phaonia errans*			1			
Insecta	Diptera	Muscidae	*Phaonia perdita*				1		
Insecta	Diptera	Calliphoridae	*Calliphora vicina*			1			
Insecta	Diptera	Calliphoridae	*Protocalliphora azurea*			1			

Class	Order	Family	Taxon	Vernacular	Conservation Status	Woodland Edge (Paths)	Birch/ Willow Carr	Reedbed	Sphagnum Bog
Insecta	Diptera	Calliphoridae	*Lucilia caesar*			2			
Insecta	Diptera	Calliphoridae	*Lucilia sericata*			1			
Insecta	Diptera	Calliphoridae	*Pollenia griseotomentosa*			1			
Insecta	Diptera	Calliphoridae	*Pollenia pediculata*			2			
Insecta	Diptera	Calliphoridae	*Pollenia rudis*			1			
Insecta	Diptera	Sarcophagidae	*Sarcophaga subvicina*			1			1
Insecta	Diptera	Tachinidae	*Lydella grisescens*			1			
Insecta	Diptera	Tachinidae	*Exorista rustica*			1			
Insecta	Hemiptera, Auchenorrhyncha	Aphrophoridae	*Aphrophora alni*			2			
Insecta	Hemiptera, Auchenorrhyncha	Cicadellidae	*Paluda adumbrata*			1			
Insecta	Hemiptera, Auchenorrhyncha	Cixiidae	*Cixius nervosus*						2
Insecta	Hemiptera, Heteroptera	Miridae	*Deraeocoris ruber*			1			
Insecta	Hemiptera, Heteroptera	Miridae	*Grypocoris stysi*			1			
Insecta	Hemiptera, Heteroptera	Miridae	*Leptopterna dolabrata*			1			
Insecta	Hemiptera, Heteroptera	Nabidae	*Nabis ericetorum*			1			
Insecta	Hemiptera, Heteroptera	Nabidae	*Nabis flavomarginatus*			1			
Insecta	Hemiptera, Heteroptera	Pentatomidae	*Dolycoris baccarum*	Hairy Shieldbug		2			
Insecta	Hemiptera, Heteroptera	Pentatomidae	*Palomena prasina*	Common Green Shieldbug		1			
Insecta	Hymenoptera	Formicidae	*Formica fusca*	an ant		1			
Insecta	Hymenoptera	Formicidae	*Myrmica ruginodis*	an ant		1			
Insecta	Hymenoptera	Vespidae	*Vespula vulgaris*	Common Wasp		1			
Insecta	Hymenoptera	Andrenidae	*Andrena clarkella*	a mining bee		1	1		
Insecta	Hymenoptera	Apidae	*Apis mellifera*	Honey Bee		2	1		1

Class	Order	Family	Taxon	Vernacular	Conservation Status	Woodland Edge (Paths)	Birch/ Willow Carr	Reedbed	Sphagnum Bog
Insecta	Hymenoptera	Apidae	*Bombus hypnorum*	a bumblebee		4			
Insecta	Hymenoptera	Apidae	*Bombus lapidarius*	Large Red Tailed Bumble Bee		2			
Insecta	Hymenoptera	Apidae	*Bombus lucorum* agg.	White-tailed Bumble Bee		1			
Insecta	Hymenoptera	Apidae	*Bombus pascuorum*	Common Carder Bee		5			
Insecta	Hymenoptera	Apidae	*Bombus pratorum*	Early Bumble Bee		2			
Insecta	Hymenoptera	Apidae	*Bombus terrestris*	Buff-tailed Bumble Bee		2			1
Insecta	Hymenoptera	Anthophoridae	*Nomada marshamella*	Marsham's Nomad Bee		1			
Insecta	Hymenoptera	Halictidae	*Sphecodes ephippius*	a cuckoo bee		1			
Insecta	Lepidoptera	Hesperiidae	*Thymelicus sylvestris*	Small Skipper		1			
Insecta	Lepidoptera	Hesperiidae	*Ochlodes sylvanus*	Large Skipper		2			
Insecta	Lepidoptera	Pieridae	*Anthocharis cardamines*	Orange-tip		1			
Insecta	Lepidoptera	Pieridae	*Pieris brassicae*	Large White		1			
Insecta	Lepidoptera	Pieridae	*Pieris rapae*	Small White		1			
Insecta	Lepidoptera	Pieridae	*Pieris napi*	Green-veined White		2			
Insecta	Lepidoptera	Nymphalidae	*Pararge aegeria*	Speckled Wood		2			
Insecta	Lepidoptera	Nymphalidae	*Aphantopus hyperantus*	Ringlet		2			
Insecta	Lepidoptera	Nymphalidae	*Maniola jurtina*	Meadow Brown		2			
Insecta	Lepidoptera	Nymphalidae	*Pyronia tithonus*	Gatekeeper		2			
Insecta	Lepidoptera	Nymphalidae	*Vanessa atalanta*	Red Admiral		2			
Insecta	Lepidoptera	Nymphalidae	*Aglais io*	Peacock		1			
Insecta	Lepidoptera	Nymphalidae	*Aglais urticae*	Small Tortoiseshell		1			
Insecta	Lepidoptera	Nymphalidae	*Polygonia c-album*	Comma		1			
Insecta	Lepidoptera	Lycaenidae	*Satyrium w-album*	White-letter Hairstreak	Endangered; SoPI (s.41)	1			

Class	Order	Family	Taxon	Vernacular	Conservation Status	Woodland Edge (Paths)	Birch/ Willow Carr	Reedbed	Sphagnum Bog
Insecta	Lepidoptera	Choreutidae	*Anthophila fabriciana*			2			
Insecta	Lepidoptera	Tortricidae	*Ancylis badiana*			1			
Insecta	Lepidoptera	Pyralidae	*Chrysoteuchia culmella*	Garden Grass-veneer		1			
Insecta	Lepidoptera	Geometridae	*Scotopteryx chenopodiata*	Shaded Broad-bar	SoPI (s.41 - research)	1			
Insecta	Lepidoptera	Noctuidae	*Autographa gamma*	Silver Y		1			
Insecta	Lepidoptera	Noctuidae	*Lygephila pastinum*	Blackneck		1			
Insecta	Lepidoptera	Noctuidae	*Rivula sericealis*	Straw Dot		2			
Insecta	Megaloptera	Sialidae	*Sialis lutaria*			1			
Insecta	Neuroptera	Hemerobiidae	*Micromus variegatus*			1			
Insecta	Odonata	Coenagriidae	*Ischnura elegans*	Blue-tailed Damselfly		2			
Insecta	Odonata	Coenagriidae	*Enallagma cyathigerum*	Common Blue Damselfly		3			
Insecta	Odonata	Coenagriidae	*Coenagrion puella*	Azure Damselfly		2			
Insecta	Odonata	Aeshnidae	*Aeshna grandis*	Brown Hawker		1			
Insecta	Odonata	Libellulidae	*Libellula quadrimaculata*	Four-spotted Chaser		1			
Insecta	Orthoptera	Tetrigidae	*Tetrix subulata*	Slender Ground Hopper		1			
Insecta	Orthoptera	Acrididae	*Chorthippus parallelus*	Meadow Grasshopper		1			
Malacostraca	Isopoda	Trichoniscidae	*Trichoniscus pusillus*	a common pygmy woodlouse				1	
Malacostraca	Isopoda	Oniscidae	*Oniscus asellus*	Common Shiny Woodlouse				1	
			315			175	71	72	56

B. **Appendix B:** WYES Dataset (provided in April 2017)

Table 11: Species Recorded in Cromwell Bottom Nature Reserve (including Elland Gravel Pits) between 1979 and 2011

Class	Order	Family	Species	Nature Conservation Status
Arachnida	Araneae	Araneidae	*Araniella cucurbitina sensu stricto*	
Arachnida	Araneae	Araneidae	*Larinioides cornutus*	
Arachnida	Araneae	Clubionidae	*Clubiona lutescens*	
Arachnida	Araneae	Clubionidae	*Clubiona stagnatilis*	
Arachnida	Araneae	Dictynidae	*Dictyna uncinata*	
Arachnida	Araneae	Linyphiidae	*Agyneta decora*	
Arachnida	Araneae	Linyphiidae	*Bathyphantes approximatus*	
Arachnida	Araneae	Linyphiidae	*Diplocephalus picinus*	
Arachnida	Araneae	Linyphiidae	*Erigone atra*	
Arachnida	Araneae	Linyphiidae	*Gnathonarium dentatum*	
Arachnida	Araneae	Linyphiidae	*Gongylidium rufipes*	
Arachnida	Araneae	Linyphiidae	*Linyphia triangularis*	
Arachnida	Araneae	Linyphiidae	*Oedothorax agrestis*	
Arachnida	Araneae	Linyphiidae	*Poeciloneta variegata*	
Arachnida	Araneae	Linyphiidae	*Porrhomma pygmaeum*	
Arachnida	Araneae	Linyphiidae	*Tenuiphantes tenuis*	
Arachnida	Araneae	Lycosidae	*Arctosa perita*	
Arachnida	Araneae	Lycosidae	*Pardosa amentata*	
Arachnida	Araneae	Lycosidae	*Pardosa pullata*	
Arachnida	Araneae	Philodromidae	*Tibellus oblongus*	
Arachnida	Araneae	Tetragnathidae	*Tetragnatha extensa*	
Arachnida	Araneae	Thomisidae	*Xysticus cristatus*	
Arachnida	Opiliones	Nemastomatidae	*Nemastoma bimaculatum*	

Class	Order	Family	Species	Nature Conservation Status
Gasteropoda	Pulmonata	Helicidae	*Cepaea (Cepaea) hortensis*	
Gasteropoda	Pulmonata	Helicidae	*Cepaea (Cepaea) nemoralis*	
Gasteropoda	Pulmonata	Helicidae	*Cornu aspersum*	
Insecta	Coleoptera	Anobiidae	*Ptinus tectus*	
Insecta	Coleoptera	Anthicidae	*Omonadus floralis*	
Insecta	Coleoptera	Apionidae	*Apion frumentarium*	
Insecta	Coleoptera	Apionidae	*Ceratapion (Ceratapion) carduorum*	
Insecta	Coleoptera	Apionidae	*Eutrichapion (Eutrichapion) ervi*	
Insecta	Coleoptera	Apionidae	*Ischnopterapion (Ischnopterapion) loti*	
Insecta	Coleoptera	Apionidae	*Omphalapion hookerorum*	
Insecta	Coleoptera	Apionidae	*Perapion (Perapion) violaceum*	
Insecta	Coleoptera	Apionidae	*Protapion assimile*	
Insecta	Coleoptera	Apionidae	*Protapion ononidis*	
Insecta	Coleoptera	Apionidae	*Protopirapion atratulum*	
Insecta	Coleoptera	Attelabidae	*Attelabus nitens*	
Insecta	Coleoptera	Byrrhidae	*Cytilus sericeus*	
Insecta	Coleoptera	Byrrhidae	*Simplocaria semistriata*	
Insecta	Coleoptera	Byturidae	*Byturus tomentosus*	
Insecta	Coleoptera	Cantharidae	*Cantharis nigra*	
Insecta	Coleoptera	Cantharidae	*Cantharis nigricans*	
Insecta	Coleoptera	Cantharidae	*Cantharis pallida*	
Insecta	Coleoptera	Cantharidae	*Cantharis pellucida*	
Insecta	Coleoptera	Cantharidae	*Cantharis rufa*	
Insecta	Coleoptera	Cantharidae	*Rhagonycha fulva*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Coleoptera	Cantharidae	*Rhagonycha limbata*	
Insecta	Coleoptera	Carabidae	*Acupalpus dubius*	
Insecta	Coleoptera	Carabidae	*Acupalpus flavicollis*	NR;NT
Insecta	Coleoptera	Carabidae	*Agonum (Agonum) marginatum*	
Insecta	Coleoptera	Carabidae	*Agonum (Agonum) muelleri*	
Insecta	Coleoptera	Carabidae	*Agonum (Europhilus) gracile*	
Insecta	Coleoptera	Carabidae	*Agonum (Europhilus) thoreyi*	
Insecta	Coleoptera	Carabidae	*Amara (Amara) aenea*	
Insecta	Coleoptera	Carabidae	*Amara (Amara) communis*	
Insecta	Coleoptera	Carabidae	*Amara (Amara) familiaris*	
Insecta	Coleoptera	Carabidae	*Amara (Amara) lunicollis*	
Insecta	Coleoptera	Carabidae	*Amara (Bradytus) apricaria*	
Insecta	Coleoptera	Carabidae	*Anchomenus dorsalis*	
Insecta	Coleoptera	Carabidae	*Anisodactylus binotatus*	
Insecta	Coleoptera	Carabidae	*Anthracus consputus*	NS
Insecta	Coleoptera	Carabidae	*Bembidion (Bembidion) quadrimaculatum*	
Insecta	Coleoptera	Carabidae	*Bembidion (Bembidionetolitzkya) geniculatum*	NS
Insecta	Coleoptera	Carabidae	*Bembidion (Diplocampa) assimile*	
Insecta	Coleoptera	Carabidae	*Bembidion (Diplocampa) clarkii*	
Insecta	Coleoptera	Carabidae	*Bembidion (Diplocampa) fumigatum*	NS
Insecta	Coleoptera	Carabidae	*Bembidion (Eupetedromus) dentellum*	
Insecta	Coleoptera	Carabidae	*Bembidion (Metallina) lampros*	
Insecta	Coleoptera	Carabidae	*Bembidion (Metallina) properans*	
Insecta	Coleoptera	Carabidae	*Bembidion (Neja) nigricorne*	NS;NT

Class	Order	Family	Species	Nature Conservation Status
Insecta	Coleoptera	Carabidae	*Bembidion (Notaphus) obliquum*	NS
Insecta	Coleoptera	Carabidae	*Bembidion (Ocydromus) femoratum*	
Insecta	Coleoptera	Carabidae	*Bembidion (Ocydromus) monticola*	NS
Insecta	Coleoptera	Carabidae	*Bembidion (Ocydromus) stephensii*	NS
Insecta	Coleoptera	Carabidae	*Bembidion (Philochthus) lunulatum*	
Insecta	Coleoptera	Carabidae	*Bembidion (Semicampa) gilvipes*	
Insecta	Coleoptera	Carabidae	*Blemus discus*	NS
Insecta	Coleoptera	Carabidae	*Bradycellus harpalinus*	
Insecta	Coleoptera	Carabidae	*Bradycellus ruficollis*	
Insecta	Coleoptera	Carabidae	*Bradycellus sharpi*	
Insecta	Coleoptera	Carabidae	*Bradycellus verbasci*	
Insecta	Coleoptera	Carabidae	*Broscus cephalotes*	
Insecta	Coleoptera	Carabidae	*Calathus (Amphigynus) rotundicollis*	
Insecta	Coleoptera	Carabidae	*Calodromius spilotus*	
Insecta	Coleoptera	Carabidae	*Carabus (Archicarabus) nemoralis*	
Insecta	Coleoptera	Carabidae	*Clivina collaris*	
Insecta	Coleoptera	Carabidae	*Curtonotus aulicus*	
Insecta	Coleoptera	Carabidae	*Elaphrus (Elaphrus) cupreus*	
Insecta	Coleoptera	Carabidae	*Elaphrus (Trichelaphrus) riparius*	
Insecta	Coleoptera	Carabidae	*Leistus (Leistophorus) fulvibarbis*	
Insecta	Coleoptera	Carabidae	*Leistus (Leistus) ferrugineus*	
Insecta	Coleoptera	Carabidae	*Nebria (Nebria) brevicollis*	
Insecta	Coleoptera	Carabidae	*Notiophilus palustris*	
Insecta	Coleoptera	Carabidae	*Notiophilus quadripunctatus*	NS

Class	Order	Family	Species	Nature Conservation Status
Insecta	Coleoptera	Carabidae	*Ocys harpaloides*	
Insecta	Coleoptera	Carabidae	*Oxypselaphus obscurus*	
Insecta	Coleoptera	Carabidae	*Paradromius linearis*	
Insecta	Coleoptera	Carabidae	*Paranchus albipes*	
Insecta	Coleoptera	Carabidae	*Patrobus atrorufus*	
Insecta	Coleoptera	Carabidae	*Philorhizus melanocephalus*	
Insecta	Coleoptera	Carabidae	*Philorhizus sigma*	EN;NR
Insecta	Coleoptera	Carabidae	*Pterostichus (Argutor) diligens*	
Insecta	Coleoptera	Carabidae	*Pterostichus (Omaseus) melanarius*	
Insecta	Coleoptera	Carabidae	*Pterostichus (Pseudomaseus) minor*	
Insecta	Coleoptera	Carabidae	*Pterostichus (Pseudomaseus) nigrita*	
Insecta	Coleoptera	Carabidae	*Stenolophus mixtus*	
Insecta	Coleoptera	Carabidae	*Stomis pumicatus*	
Insecta	Coleoptera	Carabidae	*Synuchus vivalis*	
Insecta	Coleoptera	Carabidae	*Trechus (Trechus) obtusus*	
Insecta	Coleoptera	Carabidae	*Trichocellus cognatus*	
Insecta	Coleoptera	Cerylonidae	*Cerylon ferrugineum*	
Insecta	Coleoptera	Chrysomelidae	*Altica lythri*	
Insecta	Coleoptera	Chrysomelidae	*Altica oleracea*	
Insecta	Coleoptera	Chrysomelidae	*Altica palustris*	
Insecta	Coleoptera	Chrysomelidae	*Aphthona lutescens*	
Insecta	Coleoptera	Chrysomelidae	*Bruchidius cisti*	
Insecta	Coleoptera	Chrysomelidae	*Bruchus loti*	
Insecta	Coleoptera	Chrysomelidae	*Cassida flaveola*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Coleoptera	Chrysomelidae	*Cassida rubiginosa*	
Insecta	Coleoptera	Chrysomelidae	*Cassida vibex*	
Insecta	Coleoptera	Chrysomelidae	*Chaetocnema concinna s.l.*	
Insecta	Coleoptera	Chrysomelidae	*Donacia semicuprea*	
Insecta	Coleoptera	Chrysomelidae	*Galerucella lineola*	
Insecta	Coleoptera	Chrysomelidae	*Gastrophysa polygoni*	
Insecta	Coleoptera	Chrysomelidae	*Hippuriphila modeeri*	
Insecta	Coleoptera	Chrysomelidae	*Longitarsus jacobaeae*	
Insecta	Coleoptera	Chrysomelidae	*Longitarsus suturellus*	
Insecta	Coleoptera	Chrysomelidae	*Mantura rustica*	NS
Insecta	Coleoptera	Chrysomelidae	*Neocrepidodera ferruginea*	
Insecta	Coleoptera	Chrysomelidae	*Neocrepidodera transversa*	
Insecta	Coleoptera	Chrysomelidae	*Phaedon armoraciae*	
Insecta	Coleoptera	Chrysomelidae	*Phratora vulgatissima*	
Insecta	Coleoptera	Chrysomelidae	*Phyllotreta undulata*	
Insecta	Coleoptera	Chrysomelidae	*Psylliodes affinis*	
Insecta	Coleoptera	Chrysomelidae	*Psylliodes chalcomera*	NS
Insecta	Coleoptera	Chrysomelidae	*Psylliodes chrysocephala*	
Insecta	Coleoptera	Chrysomelidae	*Psylliodes cuprea*	NS
Insecta	Coleoptera	Chrysomelidae	*Psylliodes picina*	
Insecta	Coleoptera	Coccinellidae	*Adalia bipunctata*	
Insecta	Coleoptera	Coccinellidae	*Anisosticta novemdecimpunctata*	
Insecta	Coleoptera	Coccinellidae	*Calvia quattuordecimguttata*	
Insecta	Coleoptera	Coccinellidae	*Chilocorus renipustulatus*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Coleoptera	Coccinellidae	*Coccidula rufa*	
Insecta	Coleoptera	Coccinellidae	*Coccinella septempunctata*	
Insecta	Coleoptera	Coccinellidae	*Halyzia sedecimguttata*	
Insecta	Coleoptera	Coccinellidae	*Propylea quattuordecimpunctata*	
Insecta	Coleoptera	Coccinellidae	*Psyllobora vigintiduopunctata*	
Insecta	Coleoptera	Coccinellidae	*Rhyzobius litura*	
Insecta	Coleoptera	Cryptophagidae	*Cryptophagus dentatus*	
Insecta	Coleoptera	Cryptophagidae	*Ephistemus globulus*	
Insecta	Coleoptera	Cryptophagidae	*Telmatophilus caricis*	
Insecta	Coleoptera	Cryptophagidae	*Telmatophilus typhae*	
Insecta	Coleoptera	Curculionidae	*Andrion regensteinense*	
Insecta	Coleoptera	Curculionidae	*Anthonomus (Anthonomus) rubi*	
Insecta	Coleoptera	Curculionidae	*Archarius salicivorus*	
Insecta	Coleoptera	Curculionidae	*Barynotus squamosus*	Nb
Insecta	Coleoptera	Curculionidae	*Barypeithes (Exomias) pellucidus*	
Insecta	Coleoptera	Curculionidae	*Dorytomus dejeani*	
Insecta	Coleoptera	Curculionidae	*Dorytomus rufatus*	
Insecta	Coleoptera	Curculionidae	*Hadroplontus litura*	
Insecta	Coleoptera	Curculionidae	*Hypera (Hypera) nigrirostris*	
Insecta	Coleoptera	Curculionidae	*Limnobaris dolorosa*	
Insecta	Coleoptera	Curculionidae	*Liophloeus tessulatus*	
Insecta	Coleoptera	Curculionidae	*Magdalis (Odontomagdalis) armigera*	
Insecta	Coleoptera	Curculionidae	*Mecinus pascuorum*	
Insecta	Coleoptera	Curculionidae	*Neliocarus sus*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Coleoptera	Curculionidae	*Phyllobius (Dieletus) argentatus*	
Insecta	Coleoptera	Curculionidae	*Phyllobius (Metaphyllobius) pomaceus*	
Insecta	Coleoptera	Curculionidae	*Phyllobius (Nemoicus) oblongus*	
Insecta	Coleoptera	Curculionidae	*Phyllobius (Parnemoicus) roboretanus*	
Insecta	Coleoptera	Curculionidae	*Phyllobius (Phyllobius) pyri*	
Insecta	Coleoptera	Curculionidae	*Phyllobius (Pterygorrhynchus) maculicornis*	
Insecta	Coleoptera	Curculionidae	*Polydrusus (Polydrusus) tereticollis*	
Insecta	Coleoptera	Curculionidae	*Rhinoncus castor*	
Insecta	Coleoptera	Curculionidae	*Rhinusa antirrhini*	
Insecta	Coleoptera	Curculionidae	*Sciaphilus asperatus*	
Insecta	Coleoptera	Curculionidae	*Scolytus mali*	Nb
Insecta	Coleoptera	Curculionidae	*Scolytus scolytus*	
Insecta	Coleoptera	Curculionidae	*Sitona humeralis*	
Insecta	Coleoptera	Curculionidae	*Sitona lineatus*	
Insecta	Coleoptera	Curculionidae	*Sitona puncticollis*	
Insecta	Coleoptera	Curculionidae	*Sitona suturalis*	
Insecta	Coleoptera	Curculionidae	*Tychius picirostris*	
Insecta	Coleoptera	Curculionidae	*Zacladus geranii*	
Insecta	Coleoptera	Dytiscidae	*Agabus (Gaurodytes) bipustulatus*	
Insecta	Coleoptera	Dytiscidae	*Agabus (Gaurodytes) nebulosus*	
Insecta	Coleoptera	Dytiscidae	*Colymbetes fuscus*	
Insecta	Coleoptera	Dytiscidae	*Dytiscus marginalis*	
Insecta	Coleoptera	Dytiscidae	*Hydroporus erythrocephalus*	
Insecta	Coleoptera	Dytiscidae	*Hydroporus planus*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Coleoptera	Dytiscidae	*Hydroporus pubescens*	
Insecta	Coleoptera	Dytiscidae	*Hydroporus striola*	
Insecta	Coleoptera	Dytiscidae	*Hydroporus tessellatus*	
Insecta	Coleoptera	Dytiscidae	*Ilybius fuliginosus*	
Insecta	Coleoptera	Dytiscidae	*Laccophilus minutus*	
Insecta	Coleoptera	Elateridae	*Aplotarsus incanus*	
Insecta	Coleoptera	Elateridae	*Athous (Athous) haemorrhoidalis*	
Insecta	Coleoptera	Elateridae	*Hemicrepidius hirtus*	
Insecta	Coleoptera	Elateridae	*Melanotus villosus*	
Insecta	Coleoptera	Erirhinidae	*Grypus equiseti*	Nb
Insecta	Coleoptera	Erirhinidae	*Notaris scirpi*	Nb
Insecta	Coleoptera	Erirhinidae	*Tournotaris bimaculatus*	Nb
Insecta	Coleoptera	Eucnemidae	*Melasis buprestoides*	Nb
Insecta	Coleoptera	Gyrinidae	*Gyrinus marinus*	
Insecta	Coleoptera	Haliplidae	*Haliplus (Haliplinus) fluviatilis*	
Insecta	Coleoptera	Haliplidae	*Haliplus (Haliplinus) immaculatus*	
Insecta	Coleoptera	Haliplidae	*Haliplus (Haliplinus) ruficollis*	
Insecta	Coleoptera	Haliplidae	*Haliplus (Haliplus) obliquus*	
Insecta	Coleoptera	Haliplidae	*Haliplus (Neohaliplus) lineatocollis*	
Insecta	Coleoptera	Hydrophilidae	*Anacaena lutescens*	
Insecta	Coleoptera	Hydrophilidae	*Cercyon (Cercyon) convexiusculus*	
Insecta	Coleoptera	Hydrophilidae	*Cercyon (Cercyon) obsoletus*	
Insecta	Coleoptera	Hydrophilidae	*Helophorus (Helophorus) flavipes*	
Insecta	Coleoptera	Hydrophilidae	*Helophorus (Helophorus) longitarsis*	NS

Class	Order	Family	Species	Nature Conservation Status
Insecta	Coleoptera	Hydrophilidae	*Hydrobius fuscipes*	
Insecta	Coleoptera	Hydrophilidae	*Laccobius sinuatus*	
Insecta	Coleoptera	Kateretidae	*Brachypterolus pulicarius sensu auct. partim not (L., 1758)*	
Insecta	Coleoptera	Kateretidae	*Kateretes rufilabris*	
Insecta	Coleoptera	Latridiidae	*Corticaria impressa*	
Insecta	Coleoptera	Latridiidae	*Corticaria punctulata*	
Insecta	Coleoptera	Latridiidae	*Cortinicara gibbosa*	
Insecta	Coleoptera	Latridiidae	*Enicmus fungicola*	Notable
Insecta	Coleoptera	Latridiidae	*Latridius minutus*	
Insecta	Coleoptera	Leiodidae	*Agathidium (Neoceble) varians*	
Insecta	Coleoptera	Leiodidae	*Catops grandicollis*	
Insecta	Coleoptera	Leiodidae	*Nargus (Nargus) velox*	
Insecta	Coleoptera	Leiodidae	*Ptomaphagus subvillosus*	
Insecta	Coleoptera	Monotomidae	*Rhizophagus (Eurhizophagus) depressus*	
Insecta	Coleoptera	Monotomidae	*Rhizophagus (Rhizophagus) dispar*	
Insecta	Coleoptera	Monotomidae	*Rhizophagus (Rhizophagus) nitidulus*	Nb
Insecta	Coleoptera	Nitidulidae	*Carpophilus hemipterus*	
Insecta	Coleoptera	Nitidulidae	*Soronia grisea*	
Insecta	Coleoptera	Nitidulidae	*Soronia punctatissima*	
Insecta	Coleoptera	Silphidae	*Nicrophorus vespilloides*	
Insecta	Coleoptera	Staphylinidae	*Atheta aquatilis*	Notable
Insecta	Coleoptera	Staphylinidae	*Atrecus affinis*	
Insecta	Coleoptera	Staphylinidae	*Bisnius cephalotes*	
Insecta	Coleoptera	Staphylinidae	*Bryaxis puncticollis*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Coleoptera	Staphylinidae	*Carpelimus elongatulus*	
Insecta	Coleoptera	Staphylinidae	*Gabrius bishopi*	Nb
Insecta	Coleoptera	Staphylinidae	*Gabrius breviventer*	
Insecta	Coleoptera	Staphylinidae	*Gabrius nigritulus*	
Insecta	Coleoptera	Staphylinidae	*Gabrius piliger*	
Insecta	Coleoptera	Staphylinidae	*Habrocerus capillaricornis*	
Insecta	Coleoptera	Staphylinidae	*Lathrobium (Lathrobium) fulvipenne*	
Insecta	Coleoptera	Staphylinidae	*Leptacinus batychrus*	
Insecta	Coleoptera	Staphylinidae	*Leptacinus pusillus*	
Insecta	Coleoptera	Staphylinidae	*Lesteva sicula subsp. heeri*	
Insecta	Coleoptera	Staphylinidae	*Lordithon exoletus*	
Insecta	Coleoptera	Staphylinidae	*Mycetoporus clavicornis*	
Insecta	Coleoptera	Staphylinidae	*Mycetoporus splendidus*	
Insecta	Coleoptera	Staphylinidae	*Ocypus (Pseudocypus) fuscatus*	Nb
Insecta	Coleoptera	Staphylinidae	*Omalium excavatum*	
Insecta	Coleoptera	Staphylinidae	*Omalium italicum*	
Insecta	Coleoptera	Staphylinidae	*Omalium oxyacanthae*	
Insecta	Coleoptera	Staphylinidae	*Oxypoda procerula*	
Insecta	Coleoptera	Staphylinidae	*Philonthus cognatus*	
Insecta	Coleoptera	Staphylinidae	*Philonthus tenuicornis*	
Insecta	Coleoptera	Staphylinidae	*Philonthus umbratilis*	
Insecta	Coleoptera	Staphylinidae	*Platystethus (Platystethus) arenarius*	
Insecta	Coleoptera	Staphylinidae	*Quedius (Quedius) levicollis*	
Insecta	Coleoptera	Staphylinidae	*Quedius (Raphirus) boops*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Coleoptera	Staphylinidae	*Quedius (Raphirus) maurorufus*	
Insecta	Coleoptera	Staphylinidae	*Quedius (Raphirus) persimilis*	
Insecta	Coleoptera	Staphylinidae	*Rugilus orbiculatus*	
Insecta	Coleoptera	Staphylinidae	*Siagonium quadricorne*	
Insecta	Coleoptera	Staphylinidae	*Stenus (Hypostenus) fulvicornis*	
Insecta	Coleoptera	Staphylinidae	*Stenus (Metatesnus) nitidiusculus*	
Insecta	Coleoptera	Staphylinidae	*Stenus (Metatesnus) niveus*	Nb
Insecta	Coleoptera	Staphylinidae	*Stenus (Metatesnus) pallitarsis*	
Insecta	Coleoptera	Staphylinidae	*Stenus (Metatesnus) picipennis*	
Insecta	Coleoptera	Staphylinidae	*Stenus (Stenus) biguttatus*	
Insecta	Coleoptera	Staphylinidae	*Stenus (Stenus) europaeus*	Nb
Insecta	Coleoptera	Staphylinidae	*Stenus (Stenus) juno*	
Insecta	Coleoptera	Staphylinidae	*Stenus (Stenus) nanus*	
Insecta	Coleoptera	Staphylinidae	*Stenus (Stenus) nitens*	
Insecta	Coleoptera	Staphylinidae	*Stenus (Stenus) pusillus*	Nb
Insecta	Coleoptera	Staphylinidae	*Stenus (Tesnus) crassus*	
Insecta	Coleoptera	Staphylinidae	*Syntomium aeneum*	
Insecta	Coleoptera	Staphylinidae	*Tachinus corticinus*	
Insecta	Coleoptera	Staphylinidae	*Tachinus pallipes*	
Insecta	Coleoptera	Staphylinidae	*Tachyporus nitidulus*	
Insecta	Coleoptera	Staphylinidae	*Tachyporus pusillus*	
Insecta	Coleoptera	Staphylinidae	*Tasgius (Rayacheila) globulifer*	
Insecta	Coleoptera	Throscidae	*Trixagus carinifrons*	
Insecta	Diptera	Conopidae	*Conops quadrifasciatus*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Diptera	Limoniidae	*Limnophila dispar*	
Insecta	Diptera	Sciaridae	*Sciara hemerobioides*	
Insecta	Diptera	Stratiomyidae	*Nemotelus nigrinus*	
Insecta	Diptera	Syrphidae	*Cheilosia albitarsis*	
Insecta	Diptera	Syrphidae	*Cheilosia illustrata*	
Insecta	Diptera	Syrphidae	*Cheilosia mutabilis*	NS
Insecta	Diptera	Syrphidae	*Chrysogaster hirtella*	
Insecta	Diptera	Syrphidae	*Chrysotoxum bicinctum*	
Insecta	Diptera	Syrphidae	*Dasysyrphus tricinctus*	
Insecta	Diptera	Syrphidae	*Dasysyrphus venustus*	
Insecta	Diptera	Syrphidae	*Epistrophe grossulariae*	
Insecta	Diptera	Syrphidae	*Episyrphus balteatus*	
Insecta	Diptera	Syrphidae	*Eristalis arbustorum*	
Insecta	Diptera	Syrphidae	*Eristalis horticola*	
Insecta	Diptera	Syrphidae	*Eristalis intricarius*	
Insecta	Diptera	Syrphidae	*Eristalis pertinax*	
Insecta	Diptera	Syrphidae	*Eristalis tenax*	
Insecta	Diptera	Syrphidae	*Helophilus pendulus*	
Insecta	Diptera	Syrphidae	*Melanostoma mellinum*	
Insecta	Diptera	Syrphidae	*Metasyrphus latifasciatus*	
Insecta	Diptera	Syrphidae	*Neoascia tenur*	
Insecta	Diptera	Syrphidae	*Platycheirus angustatus*	
Insecta	Diptera	Syrphidae	*Platycheirus clypeatus*	
Insecta	Diptera	Syrphidae	*Platycheirus fulviventris*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Diptera	Syrphidae	*Platycheirus granditarsus*	
Insecta	Diptera	Syrphidae	*Platycheirus peltatus*	
Insecta	Diptera	Syrphidae	*Platycheirus scutatus*	
Insecta	Diptera	Syrphidae	*Rhingia campestris*	
Insecta	Diptera	Syrphidae	*Sphaerophoria scripta*	
Insecta	Diptera	Syrphidae	*Syritta pipiens*	
Insecta	Diptera	Syrphidae	*Syrphus ribesii*	
Insecta	Diptera	Syrphidae	*Syrphus torvus*	
Insecta	Diptera	Syrphidae	*Syrphus vitripennis*	
Insecta	Diptera	Syrphidae	*Volucella pellucens*	
Insecta	Diptera	Syrphidae	*Xylota segnis*	
Insecta	Glomerida	Glomeridae	*Glomeris marginata*	
Insecta	Hemiptera	Cercopidae	*Cercopis vulnerata*	
Insecta	Hemiptera	Miridae	*Plagiognathus albipennis*	
Insecta	Hemiptera	Nepidae	*Nepa cinerea*	
Insecta	Hygrophila	Lymnaeidae	*Lymnaea stagnalis*	
Insecta	Hygrophila	Lymnaeidae	*Radix peregra*	
Insecta	Hygrophila	Lymnaeidae	*Radix peregra*	
Insecta	Hymenoptera	Apidae	*Bombus (Bombus) terrestris*	
Insecta	Hymenoptera	Apidae	*Bombus (Melanobombus) lapidarius*	
Insecta	Hymenoptera	Apidae	*Bombus (Pyrobombus) pratorum*	
Insecta	Hymenoptera	Apidae	*Nomada ruficornis*	
Insecta	Hymenoptera	Cynipidae	*Cynips quercusfolii*	
Insecta	Hymenoptera	Cynipidae	*Diplolepis rosae*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Hymenoptera	Tenthredinidae	*Pontania proxima*	
Insecta	Hymenoptera	Vespidae	*Vespula (Paravespula) vulgaris*	
Insecta	Julida	Julidae	*Cylindroiulus punctatus*	
Insecta	Julida	Julidae	*Tachypodoiulus niger*	
Insecta	Lepidoptera	Adelidae	*Nematopogon swammerdamella*	
Insecta	Lepidoptera	Argyresthiidae	*Argyresthia goedartella*	
Insecta	Lepidoptera	Blastobasidae	*Blastobasis adustella*	
Insecta	Lepidoptera	Chimabachidae	*Diurnea fagella*	
Insecta	Lepidoptera	Choreutidae	*Anthophila fabriciana*	
Insecta	Lepidoptera	Coleophoridae	*Coleophora alticolella*	
Insecta	Lepidoptera	Coleophoridae	*Coleophora caespititiella*	
Insecta	Lepidoptera	Coleophoridae	*Coleophora mayrella*	
Insecta	Lepidoptera	Coleophoridae	*Coleophora serratella*	
Insecta	Lepidoptera	Coleophoridae	*Coleophora trifolii*	
Insecta	Lepidoptera	Crambidae	*Acentria ephemerella*	
Insecta	Lepidoptera	Crambidae	*Agriphila straminella*	
Insecta	Lepidoptera	Crambidae	*Agriphila tristella*	
Insecta	Lepidoptera	Crambidae	*Anania hortulata*	
Insecta	Lepidoptera	Crambidae	*Cataclysta lemnata*	
Insecta	Lepidoptera	Crambidae	*Chrysoteuchia culmella*	
Insecta	Lepidoptera	Crambidae	*Crambus lathoniellus*	
Insecta	Lepidoptera	Crambidae	*Donacaula forficella*	
Insecta	Lepidoptera	Crambidae	*Elophila nymphaeata*	
Insecta	Lepidoptera	Crambidae	*Eudonia mercurella*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Lepidoptera	Crambidae	*Nomophila noctuella*	
Insecta	Lepidoptera	Crambidae	*Nymphula nitidulata*	
Insecta	Lepidoptera	Crambidae	*Pleuroptya ruralis*	
Insecta	Lepidoptera	Crambidae	*Scoparia ambigualis*	
Insecta	Lepidoptera	Crambidae	*Scoparia pyralella*	
Insecta	Lepidoptera	Crambidae	*Scoparia subfusca*	
Insecta	Lepidoptera	Crambidae	*Udea ferrugalis*	
Insecta	Lepidoptera	Crambidae	*Udea lutealis*	
Insecta	Lepidoptera	Depressariidae	*Agonopterix angelicella*	
Insecta	Lepidoptera	Depressariidae	*Agonopterix heracliana*	
Insecta	Lepidoptera	Drepanidae	*Drepana falcataria*	
Insecta	Lepidoptera	Drepanidae	*Habrosyne pyritoides*	
Insecta	Lepidoptera	Drepanidae	*Tethea ocularis*	
Insecta	Lepidoptera	Drepanidae	*Thyatira batis*	
Insecta	Lepidoptera	Drepanidae	*Watsonalla binaria*	Section 41 Priority Species - research only
Insecta	Lepidoptera	Elachistidae	*Elachista albifrontella*	
Insecta	Lepidoptera	Elachistidae	*Elachista argentella*	
Insecta	Lepidoptera	Elachistidae	*Elachista canapennella*	
Insecta	Lepidoptera	Elachistidae	*Elachista maculicerusella*	
Insecta	Lepidoptera	Elachistidae	*Elachista rufocinerea*	
Insecta	Lepidoptera	Erebidae	*Calliteara pudibunda*	
Insecta	Lepidoptera	Erebidae	*Eilema lurideola*	
Insecta	Lepidoptera	Erebidae	*Euclidia mi*	
Insecta	Lepidoptera	Erebidae	*Herminia grisealis*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Lepidoptera	Erebidae	*Hypena proboscidalis*	
Insecta	Lepidoptera	Erebidae	*Lygephila pastinum*	
Insecta	Lepidoptera	Erebidae	*Rivula sericealis*	
Insecta	Lepidoptera	Erebidae	*Scoliopteryx libatrix*	
Insecta	Lepidoptera	Erebidae	*Spilosoma lubricipeda*	Section 41 Priority Species - research only
Insecta	Lepidoptera	Erebidae	*Spilosoma lutea*	
Insecta	Lepidoptera	Erebidae	*Tyria jacobaeae*	Section 41 Priority Species - research only
Insecta	Lepidoptera	Eriocraniidae	*Dyseriocrania subpurpurella*	
Insecta	Lepidoptera	Geometridae	*Aethalura punctulata*	
Insecta	Lepidoptera	Geometridae	*Agriopis leucophaearia*	
Insecta	Lepidoptera	Geometridae	*Agriopis marginaria*	
Insecta	Lepidoptera	Geometridae	*Alcis repandata*	
Insecta	Lepidoptera	Geometridae	*Alsophila aescularia*	
Insecta	Lepidoptera	Geometridae	*Archiearis parthenias*	
Insecta	Lepidoptera	Geometridae	*Biston betularia*	
Insecta	Lepidoptera	Geometridae	*Biston betularia form carbonaria*	
Insecta	Lepidoptera	Geometridae	*Cabera exanthemata*	
Insecta	Lepidoptera	Geometridae	*Cabera pusaria*	
Insecta	Lepidoptera	Geometridae	*Campaea margaritaria*	
Insecta	Lepidoptera	Geometridae	*Camptogramma bilineata*	
Insecta	Lepidoptera	Geometridae	*Chiasmia clathrata*	Section 41 Priority Species - research only
Insecta	Lepidoptera	Geometridae	*Chloroclystis v-ata*	
Insecta	Lepidoptera	Geometridae	*Cidaria fulvata*	
Insecta	Lepidoptera	Geometridae	*Colostygia pectinataria*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Lepidoptera	Geometridae	*Crocallis elinguaria*	
Insecta	Lepidoptera	Geometridae	*Dysstroma truncata*	
Insecta	Lepidoptera	Geometridae	*Ecliptopera silaceata*	
Insecta	Lepidoptera	Geometridae	*Ectropis crepuscularia*	
Insecta	Lepidoptera	Geometridae	*Electrophaes corylata*	
Insecta	Lepidoptera	Geometridae	*Ematurga atomaria*	
Insecta	Lepidoptera	Geometridae	*Ennomos alniaria*	
Insecta	Lepidoptera	Geometridae	*Epirrhoe alternata*	
Insecta	Lepidoptera	Geometridae	*Eulithis mellinata*	Section 41 Priority Species - research only
Insecta	Lepidoptera	Geometridae	*Eupithecia abbreviata*	
Insecta	Lepidoptera	Geometridae	*Eupithecia assimilata*	
Insecta	Lepidoptera	Geometridae	*Eupithecia dodoneata*	
Insecta	Lepidoptera	Geometridae	*Eupithecia succenturiata*	
Insecta	Lepidoptera	Geometridae	*Eupithecia tenuiata*	
Insecta	Lepidoptera	Geometridae	*Eupithecia vulgata*	
Insecta	Lepidoptera	Geometridae	*Geometra papilionaria*	
Insecta	Lepidoptera	Geometridae	*Hydrelia flammeolaria*	
Insecta	Lepidoptera	Geometridae	*Idaea aversata*	
Insecta	Lepidoptera	Geometridae	*Idaea biselata*	
Insecta	Lepidoptera	Geometridae	*Lomaspilis marginata*	
Insecta	Lepidoptera	Geometridae	*Lomographa temerata*	
Insecta	Lepidoptera	Geometridae	*Odezia atrata*	
Insecta	Lepidoptera	Geometridae	*Opisthograptis luteolata*	
Insecta	Lepidoptera	Geometridae	*Ourapteryx sambucaria*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Lepidoptera	Geometridae	*Pelurga comitata*	Section 41 Priority Species - research only
Insecta	Lepidoptera	Geometridae	*Peribatodes rhomboidaria*	
Insecta	Lepidoptera	Geometridae	*Perizoma alchemillata*	
Insecta	Lepidoptera	Geometridae	*Perizoma didymata*	
Insecta	Lepidoptera	Geometridae	*Perizoma flavofasciata*	
Insecta	Lepidoptera	Geometridae	*Phigalia pilosaria*	
Insecta	Lepidoptera	Geometridae	*Scopula floslactata*	
Insecta	Lepidoptera	Geometridae	*Scotopteryx chenopodiata*	Section 41 Priority Species - research only
Insecta	Lepidoptera	Geometridae	*Selenia dentaria*	
Insecta	Lepidoptera	Geometridae	*Selenia tetralunaria*	
Insecta	Lepidoptera	Geometridae	*Trichopteryx carpinata*	
Insecta	Lepidoptera	Geometridae	*Xanthorhoe designata*	
Insecta	Lepidoptera	Geometridae	*Xanthorhoe ferrugata*	Section 41 Priority Species - research only
Insecta	Lepidoptera	Geometridae	*Xanthorhoe fluctuata*	
Insecta	Lepidoptera	Geometridae	*Xanthorhoe montanata*	
Insecta	Lepidoptera	Geometridae	*Xanthorhoe spadicearia*	
Insecta	Lepidoptera	Glyphipterigidae	*Glyphipterix simpliciella*	
Insecta	Lepidoptera	Gracillariidae	*Caloptilia rufipennella*	
Insecta	Lepidoptera	Gracillariidae	*Phyllonorycter geniculella*	
Insecta	Lepidoptera	Gracillariidae	*Phyllonorycter nicellii*	
Insecta	Lepidoptera	Gracillariidae	*Phyllonorycter oxyacanthae*	
Insecta	Lepidoptera	Gracillariidae	*Phyllonorycter ulmifoliella*	
Insecta	Lepidoptera	Hepialidae	*Hepialus humuli*	Section 41 Priority Species - research only
Insecta	Lepidoptera	Hepialidae	*Korscheltellus fusconebulosa*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Lepidoptera	Hepialidae	*Phymatopus hecta*	
Insecta	Lepidoptera	Hepialidae	*Triodia sylvina*	
Insecta	Lepidoptera	Hesperiidae	*Ochlodes sylvanus*	
Insecta	Lepidoptera	Hesperiidae	*Thymelicus sylvestris*	
Insecta	Lepidoptera	Lycaenidae	*Celastrina argiolus*	
Insecta	Lepidoptera	Lycaenidae	*Favonius quercus*	
Insecta	Lepidoptera	Lycaenidae	*Lycaena phlaeas*	
Insecta	Lepidoptera	Lycaenidae	*Polyommatus icarus*	
Insecta	Lepidoptera	Lycaenidae	*Satyrium w-album*	EN;Legal Protection;Section 41 Priority Species
Insecta	Lepidoptera	Lyonetiidae	*Leucoptera spartifoliella*	
Insecta	Lepidoptera	Lyonetiidae	*Lyonetia clerkella*	
Insecta	Lepidoptera	Momphidae	*Mompha raschkiella*	
Insecta	Lepidoptera	Nepticulidae	*Stigmella aurella*	
Insecta	Lepidoptera	Nepticulidae	*Stigmella salicis*	
Insecta	Lepidoptera	Nepticulidae	*Stigmella speciosa*	
Insecta	Lepidoptera	Noctuidae	*Abrostola tripartita*	
Insecta	Lepidoptera	Noctuidae	*Acronicta leporina*	
Insecta	Lepidoptera	Noctuidae	*Acronicta psi*	Section 41 Priority Species - research only
Insecta	Lepidoptera	Noctuidae	*Acronicta rumicis*	Section 41 Priority Species - research only
Insecta	Lepidoptera	Noctuidae	*Agrochola lota*	
Insecta	Lepidoptera	Noctuidae	*Agrotis exclamationis*	
Insecta	Lepidoptera	Noctuidae	*Agrotis puta*	
Insecta	Lepidoptera	Noctuidae	*Anorthoa munda*	
Insecta	Lepidoptera	Noctuidae	*Antitype chi*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Lepidoptera	Noctuidae	*Apamea crenata*	
Insecta	Lepidoptera	Noctuidae	*Apamea lithoxylaea*	
Insecta	Lepidoptera	Noctuidae	*Apamea monoglypha*	
Insecta	Lepidoptera	Noctuidae	*Apamea remissa*	
Insecta	Lepidoptera	Noctuidae	*Apamea scolopacina*	
Insecta	Lepidoptera	Noctuidae	*Apamea sordens*	
Insecta	Lepidoptera	Noctuidae	*Apamea unanimis*	
Insecta	Lepidoptera	Noctuidae	*Autographa gamma*	
Insecta	Lepidoptera	Noctuidae	*Autographa pulchrina*	
Insecta	Lepidoptera	Noctuidae	*Axylia putris*	
Insecta	Lepidoptera	Noctuidae	*Bryophila domestica*	
Insecta	Lepidoptera	Noctuidae	*Caradrina morpheus*	Section 41 Priority Species - research only
Insecta	Lepidoptera	Noctuidae	*Celaena leucostigma*	Section 41 Priority Species - research only
Insecta	Lepidoptera	Noctuidae	*Cerapteryx graminis*	
Insecta	Lepidoptera	Noctuidae	*Cirrhia icteritia*	
Insecta	Lepidoptera	Noctuidae	*Conistra vaccinii*	
Insecta	Lepidoptera	Noctuidae	*Cosmia trapezina*	
Insecta	Lepidoptera	Noctuidae	*Denticucullus pygmina*	
Insecta	Lepidoptera	Noctuidae	*Diachrysia chrysitis*	
Insecta	Lepidoptera	Noctuidae	*Diarsia mendica*	
Insecta	Lepidoptera	Noctuidae	*Diarsia rubi*	Section 41 Priority Species - research only
Insecta	Lepidoptera	Noctuidae	*Eremobia ochroleuca*	
Insecta	Lepidoptera	Noctuidae	*Eugnorisma glareosa*	Section 41 Priority Species - research only
Insecta	Lepidoptera	Noctuidae	*Euplexia lucipara*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Lepidoptera	Noctuidae	*Eupsilia transversa*	
Insecta	Lepidoptera	Noctuidae	*Ipimorpha subtusa*	
Insecta	Lepidoptera	Noctuidae	*Lacanobia oleracea*	
Insecta	Lepidoptera	Noctuidae	*Lacanobia thalassina*	
Insecta	Lepidoptera	Noctuidae	*Lateroligia ophiogramma*	
Insecta	Lepidoptera	Noctuidae	*Leucania comma*	
Insecta	Lepidoptera	Noctuidae	*Luperina testacea*	
Insecta	Lepidoptera	Noctuidae	*Lycophotia porphyrea*	
Insecta	Lepidoptera	Noctuidae	*Mesapamea secalis*	
Insecta	Lepidoptera	Noctuidae	*Mormo maura*	
Insecta	Lepidoptera	Noctuidae	*Mythimna ferrago*	
Insecta	Lepidoptera	Noctuidae	*Mythimna impura*	
Insecta	Lepidoptera	Noctuidae	*Mythimna pallens*	
Insecta	Lepidoptera	Noctuidae	*Mythimna straminea*	
Insecta	Lepidoptera	Noctuidae	*Noctua comes*	
Insecta	Lepidoptera	Noctuidae	*Noctua fimbriata*	
Insecta	Lepidoptera	Noctuidae	*Noctua interjecta*	
Insecta	Lepidoptera	Noctuidae	*Noctua janthe*	
Insecta	Lepidoptera	Noctuidae	*Noctua pronuba*	
Insecta	Lepidoptera	Noctuidae	*Nonagria typhae*	
Insecta	Lepidoptera	Noctuidae	*Ochropleura plecta*	
Insecta	Lepidoptera	Noctuidae	*Oligia fasciuncula*	
Insecta	Lepidoptera	Noctuidae	*Omphaloscelis lunosa*	
Insecta	Lepidoptera	Noctuidae	*Orthosia cerasi*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Lepidoptera	Noctuidae	*Orthosia cruda*	
Insecta	Lepidoptera	Noctuidae	*Orthosia gothica*	
Insecta	Lepidoptera	Noctuidae	*Orthosia incerta*	
Insecta	Lepidoptera	Noctuidae	*Phlogophora meticulosa*	
Insecta	Lepidoptera	Noctuidae	*Plusia festucae*	
Insecta	Lepidoptera	Noctuidae	*Tiliacea aurago*	
Insecta	Lepidoptera	Noctuidae	*Xanthia togata*	
Insecta	Lepidoptera	Noctuidae	*Xestia baja*	
Insecta	Lepidoptera	Noctuidae	*Xestia sexstrigata*	
Insecta	Lepidoptera	Noctuidae	*Xestia xanthographa*	
Insecta	Lepidoptera	Nolidae	*Pseudoips prasinana*	
Insecta	Lepidoptera	Notodontidae	*Furcula furcula*	
Insecta	Lepidoptera	Notodontidae	*Notodonta dromedarius*	
Insecta	Lepidoptera	Notodontidae	*Notodonta ziczac*	
Insecta	Lepidoptera	Notodontidae	*Phalera bucephala*	
Insecta	Lepidoptera	Notodontidae	*Pheosia gnoma*	
Insecta	Lepidoptera	Notodontidae	*Pheosia tremula*	
Insecta	Lepidoptera	Nymphalidae	*Aglais io*	
Insecta	Lepidoptera	Nymphalidae	*Aglais urticae*	
Insecta	Lepidoptera	Nymphalidae	*Aphantopus hyperantus*	
Insecta	Lepidoptera	Nymphalidae	*Coenonympha pamphilus*	NT;Section 41 Priority Species
Insecta	Lepidoptera	Nymphalidae	*Lasiommata megera*	NT;Section 41 Priority Species
Insecta	Lepidoptera	Nymphalidae	*Maniola jurtina*	
Insecta	Lepidoptera	Nymphalidae	*Nymphalis polychloros*	Extinct;Legal Protection;RE

Class	Order	Family	Species	Nature Conservation Status
Insecta	Lepidoptera	Nymphalidae	*Pararge aegeria*	
Insecta	Lepidoptera	Nymphalidae	*Polygonia c-album*	
Insecta	Lepidoptera	Nymphalidae	*Pyronia tithonus*	
Insecta	Lepidoptera	Nymphalidae	*Vanessa atalanta*	
Insecta	Lepidoptera	Nymphalidae	*Vanessa cardui*	
Insecta	Lepidoptera	Pieridae	*Anthocharis cardamines*	
Insecta	Lepidoptera	Pieridae	*Colias croceus*	
Insecta	Lepidoptera	Pieridae	*Gonepteryx rhamni*	
Insecta	Lepidoptera	Pieridae	*Pieris brassicae*	
Insecta	Lepidoptera	Pieridae	*Pieris napi*	
Insecta	Lepidoptera	Pieridae	*Pieris rapae*	
Insecta	Lepidoptera	Pterophoridae	*Emmelina monodactyla*	
Insecta	Lepidoptera	Pterophoridae	*Platyptilia gonodactyla*	
Insecta	Lepidoptera	Pyralidae	*Acrobasis advenella*	
Insecta	Lepidoptera	Pyralidae	*Myelois circumvoluta*	
Insecta	Lepidoptera	Sphingidae	*Deilephila elpenor*	
Insecta	Lepidoptera	Sphingidae	*Deilephila porcellus*	
Insecta	Lepidoptera	Sphingidae	*Laothoe populi*	
Insecta	Lepidoptera	Sphingidae	*Mimas tiliae*	
Insecta	Lepidoptera	Tineidae	*Tinea trinotella*	
Insecta	Lepidoptera	Tortricidae	*Acleris emargana*	
Insecta	Lepidoptera	Tortricidae	*Agapeta hamana*	
Insecta	Lepidoptera	Tortricidae	*Ancylis badiana*	
Insecta	Lepidoptera	Tortricidae	*Aphelia paleana*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Lepidoptera	Tortricidae	*Apotomis betuletana*	
Insecta	Lepidoptera	Tortricidae	*Cacoecimorpha pronubana*	
Insecta	Lepidoptera	Tortricidae	*Celypha lacunana*	
Insecta	Lepidoptera	Tortricidae	*Clepsis consimilana*	
Insecta	Lepidoptera	Tortricidae	*Clepsis spectrana*	
Insecta	Lepidoptera	Tortricidae	*Cochylis atricapitana*	
Insecta	Lepidoptera	Tortricidae	*Cydia pomonella*	
Insecta	Lepidoptera	Tortricidae	*Cydia splendana*	
Insecta	Lepidoptera	Tortricidae	*Epiblema foenella*	
Insecta	Lepidoptera	Tortricidae	*Epinotia nisella*	
Insecta	Lepidoptera	Tortricidae	*Epinotia ramella*	
Insecta	Lepidoptera	Tortricidae	*Eucosma cana*	
Insecta	Lepidoptera	Tortricidae	*Grapholita lunulana*	
Insecta	Lepidoptera	Tortricidae	*Gynnidomorpha alismana*	
Insecta	Lepidoptera	Tortricidae	*Gypsonoma dealbana*	
Insecta	Lepidoptera	Tortricidae	*Gypsonoma sociana*	
Insecta	Lepidoptera	Tortricidae	*Hedya nubiferana*	
Insecta	Lepidoptera	Tortricidae	*Notocelia cynosbatella*	
Insecta	Lepidoptera	Tortricidae	*Notocelia uddmanniana*	
Insecta	Lepidoptera	Tortricidae	*Pandemis cerasana*	
Insecta	Lepidoptera	Yponomeutidae	*Yponomeuta evonymella*	
Insecta	Lepidoptera	Yponomeutidae	*Yponomeuta padella*	
Insecta	Lepidoptera	Zygaenidae	*Zygaena filipendulae*	
Insecta	Lepidoptera	Zygaenidae	*Zygaena lonicerae*	

Class	Order	Family	Species	Nature Conservation Status
Insecta	Megaloptera	Sialidae	*Sialis lutaria*	
Insecta	Neuroptera	Chrysopidae	*Chrysoperla carnea group*	
Insecta	Odonata	Aeshnidae	*Aeshna grandis*	
Insecta	Odonata	Aeshnidae	*Aeshna juncea*	
Insecta	Odonata	Aeshnidae	*Aeshna mixta*	
Insecta	Odonata	Coenagrionidae	*Coenagrion puella*	
Insecta	Odonata	Coenagrionidae	*Enallagma cyathigerum*	
Insecta	Odonata	Coenagrionidae	*Ischnura elegans*	
Insecta	Odonata	Coenagrionidae	*Pyrrhosoma nymphula*	
Insecta	Odonata	Lestidae	*Lestes sponsa*	
Insecta	Odonata	Libellulidae	*Libellula depressa*	
Insecta	Odonata	Libellulidae	*Libellula quadrimaculata*	
Insecta	Odonata	Libellulidae	*Sympetrum sanguineum*	
Insecta	Odonata	Libellulidae	*Sympetrum striolatum*	
Insecta	Orthoptera	Acrididae	*Chorthippus brunneus*	
Insecta	Orthoptera	Acrididae	*Omocestus rufipes*	
Insecta	Orthoptera	Acrididae	*Omocestus viridulus*	

C. Appendix C: Site Photographs

Photograph 1: Lagoon 1 reedbed (looking south), Brookfoot Loop section, Cromwell Bottom NR (July 2017)

Photograph 2: Lagoon 1 reedbed (looking east), Brookfoot Loop section, Cromwell Bottom NR (July 2017)

Photograph 3: Lagoon 1 reedbed (dry ground layer and invading birch), Brookfoot Loop section, Cromwell Bottom NR (July 2017)

Photograph 4: Lagoon 1 (dried waterbody), Brookfoot Loop section, Cromwell Bottom NR (August 2017)

Photograph 5: Birch/ willow carr woodland (west of Lagoon 1), Brookfoot Loop section, Cromwell Bottom NR (May 2017). Dashed red lines approximate pathway of channel.

Photograph 6: Birch/ willow carr woodland (west of Lagoon 1), Brookfoot Loop Section, Cromwell Bottom NR (May 2017)

Photograph 7: Open habitat (grassland) at north-west edge of Brookfoot Loop section, Cromwell Bottom NR

Photograph 8: Open habitat (grassland) at north-west edge of Brookfoot Loop section, Cromwell Bottom NR (July 2017)

Photograph 9: Tall ruderal habitat, edge of birch/ willow carr woodland, Brookfoot Loop section, Cromwell Bottom NR (July 2017)

Photograph 10: Tall ruderal habitat, edge of birch/ willow carr woodland, Brookfoot Loop section, Cromwell Bottom NR (July 2017)

Photograph 11: White-letter hairstreak, Brookfoot Loop section, Cromwell Bottom NR.

D. **Appendix D:** Location of Pitfall Traps


Sphagnum bog
Lagoon 1
Birch/ willow carr wood
Freeman's Cut
River Calder
Calder and Hebble Navigation
Elland Rd
A6025
Brier Ln
Emerald Doors
White Rose Water Ski Club
Bottom Dr

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