


Spotting Pot Beetles

Survey Report and Habitat Recommendations

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Summary

Pot beetles (genus *Cryptocephalus*) are a fascinating group of beetles. Of the 19 species found in the UK, eleven have been recorded in Scotland and seven of these have conservation designations.

Scottish Natural Heritage (SNH) provided funding to Buglife through the 'Scottish Beetles' project to run surveys for the Ten-spotted pot beetle (*Cryptocephalus decemmaculatus*) and workshops to raise awareness and improve participants' identification skills of the different species of pot beetles and their leaf beetle relatives.

During the late summer of 2020, surveys with volunteers were carried out at Morrone Birkwood Site of Special Scientific Interest (SSSI) in Braemar and Muir of Dinnet National Nature Reserve (NNR) near the village of Dinnet to survey for the Ten-spotted pot beetle.

Guidance is provided within this document on managing habitat at both Morrone Birkwood and Muir of Dinnet for their pot beetles to ensure the long term survival of both species in Scotland.

Contents

1. Introduction to pot beetles

Pot beetles are a fascinating and charismatic group of beetles that are in the subfamily Cryptocephalinae within the Chrysomelidae leaf beetle family. These amazing beetles get their common name from the protective shell-like cocoon or 'pot' that the larvae live in, that is created using the beetle's own faeces (Figure 1) (Hubble, 2017).

Figure 1. A larvae of the Hazel pot beetle (*Cryptocephalus coryli*); image © Eakringbirds.

The pots are initially built by the female during and immediately after egg laying, with the egg being held between the rear metatarsi and covered by the female's faeces, the precise structure of the pot varies between the different pot beetle species (Hubble, 2017). Once covered, the pots are dropped to the ground amongst leaf litter and this often forms much of the larval diet. A hole is made at one end of the pot when the egg hatches allowing it to feed and move around in the leaf litter. As the larvae grow, the pot needs to be enlarged which it does using its own faeces. The larvae can take up to two years to develop into adults. Another key feature of this group is that the head of the adult is hidden under its bulging pronotum which is used to block up the entrance of its pot in its larval form. This is the source of the scientific name for the genus '*Cryptocephalus*' meaning 'hidden head'.

There are 19 species of pot beetle known to occur in the UK (table 1), with the Violet pot beetle (*Cryptocephalus violaceus*) recently being described as extinct and no longer on the UK list (Hubble, 2014). At least eleven species are thought to occur in Scotland (six of these have recent records on the NBN atlas (www.nbnatlas.org) and five have historic records that pre-date 1979 or even before the 1900s (Table 1). Many species of pot beetle have suffered declines in their distribution across the UK and are now quite rare. Six species are described as 'Endangered' and two as 'Vulnerable' in the recent status review (Table 1) (Hubble, 2014). Additionally, nine are described as Nationally Rare and five as Nationally Scarce within Great Britain. In Scotland, two are on the Scottish Biodiversity List, the Six-spotted pot beetle (*C. sexpunctatus*) and the Ten-spotted pot beetle (*C. decemmaculatus*) (Table 1).

Table 1. List of *Cryptocephalus* pot beetles known to occur in the UK, with notes on when the species was described and those recorded in Scotland; records taken from NBN Atlas and Cox, 2007. Notes also include reference to rarity designations for each species as described by Natural England (Hubble, 2014) including IUCN threat categories: 'Critically Endangered' ('Possibly Extinct') – CR (PE); 'Endangered' – EN; 'Vulnerable' – VU; 'Near Threatened' – NT; and 'Least Concern' – LC. Great Britain rarity designations: 'Nationally Rare' – NR and 'Nationally Scarce' – NS; and whether the species is on the Scottish Biodiversity List – SBL. Where scientific name is in bold, this highlights species with records (either historic or current records) from Scotland.

Scientific Name	Common Name	Notes
Cryptocephalus aureolus (Suffrian, 1847)		Historic records and a more recent record from 2015 in South Ayrshire. Rarity status: None, widespread across UK.
Cryptocephalus biguttatus (Scopoli, 1763)		Rarity status: VU, NR
Cryptocephalus bilineatus (Linnaeus, 1767)		Rarity status: LC, NS
Cryptocephalus bipunctatus (Linnaeus, 1767)	Two-spotted pot beetle	Historic records for this species from across Scotland. Recorded at Kirkconnell Flow SSSI in June 2017. Rarity status: LC, NS.
Cryptocephalus coryli (Linnaeus, 1767)	Hazel pot beetle	One record from Kincraig from 1946. No recent records. Rarity status: EN, NR
Cryptocephalus decemmaculatus (Linnaeus, 1767)	Ten-spotted pot beetle	Recorded in Scotland at Black Wood of Loch Rannoch, one site in England. Rarity status: EN, NR, SBL
Cryptocephalus exiguus (Schneider, 1792)	Pashford pot beetle	Rarity status: CR (PE), NR
Cryptocephalus frontalis (Marsham, 1802)		Rarity status: NT, NR
Cryptocephalus fulvus (Goeze, 1777)		Not recorded from Scotland. Rarity status: None, widespread in England and Wales.
Cryptocephalus hypochaeridis (Linnaeus, 1758)		Rarity status: LC, NS
Cryptocephalus labiatus (Linnaeus, 1761)	Black birch pot beetle	Recorded at several sites across Scotland. Rarity status: None, widespread across the UK.
Cryptocephalus moraei (Linnaeus, 1758)		Pre-1979 record for site in North Ayrshire. No recent records in Scotland. Rarity status: None, widespread in England and Wales
Cryptocephalus nitidulus (Fabricius, 1787)	Shining pot beetle	Rarity status: EN, NR
Cryptocephalus parvulus (Müller, 1776)		At least two old records from pre-1979 in Scotland. Rarity status: LC, NS.
Cryptocephalus primarius (Harold, 1872)	Rock-rose pot beetle	Records from Scotland from pre 1900s and none shown on NBN Atlas. Rarity status: EN, NR.
Cryptocephalus punctiger (Paykull, 1799)	Blue pepper-pot beetle	At least two old records from pre-1979 in Scotland. No recent records in Scotland. Rarity status: VU, NR

Cryptocephalus pusillus (Fabricius, 1777)		Recorded in Scotland in Dumfriesshire and Highlands. Rarity status: None, widespread across England and Wales.
Cryptocephalus quercetin (Suffrian, 1848)		Rarity status: EN, NR
Cryptocephalus sexpunctatus (Linnaeus, 1758)	Six-spotted pot beetle	Recorded in Scotland from Kirkconnell Flow NNR with records from May 2020 from two new areas in Dumfries & Galloway near Kirkton and at Racks Moss. Rarity status: EN, NR, SBL

2. Spotting pot beetles

NatureScot (Formerly SNH) provided Buglife with funding to run the 'Scottish Beetles' project (previously known as the 'Spotting Pot Beetle' project) during 2017, 2018, 2019 and most recently in 2020. There is a dedicated page for this project on the Buglife website (https://www.buglife.org.uk/projects/spotting-pot-beetles/) where project reports can be found with results of surveys from previous years:

In 2020 our aims were to:

- Survey for the Ten-spotted pot beetle with volunteers at Muir of Dinnet and Morrone Birkwood.
- Organise and run five introduction training workshops on beetles that will raise awareness and improve identification skills of beetles through two general workshops and three focused workshops on leaf beetles, ground beetles and ladybirds.
- Develop information sheets that introduce beetles in Scotland with three separate sheets on leaf beetles, ground beetles and ladybirds.

3. Ten-spotted pot beetle

The Ten-spotted pot beetle is characterised by five black spots on each yellow-orange elytron and a black pronotum with a distinctive yellow mark in the centre (Cox 2007; Hubble, 2012). The markings of this species are highly variable, displaying a range of spot sizes (Figure 8). Melanic forms with completely black elytra but retaining the yellow mark on the pronotum are known from the UK (known as subspecies *C. decemmaculatus bothnicus*) (Piper, 2002). Around 30% of both male and female individuals found at Camghouran at Loch Rannoch during the survey visit in the first year of this project displayed this colour form (Burgess & Shanks. 2017).

Figure 1. Three Ten-spotted pot beetles at Camghouran by Loch Rannoch in July 2019 showing the colour variation between a mating pair. From this image it is possible to see the size difference between the female and male.

Clear sexual dimorphism is non-apparent, although female beetles are often slightly bulkier reaching 4 mm in length, whereas males can reach 3 mm, females have relatively shorter prothoracic limbs and antennae (Figure 8) (Hubble, 2012). Adults of both sexes have wings, and will readily fly if disturbed, but studies of dispersal indicate they do not generally fly great distances. When disturbed adults (like other leaf beetles) typically feign death (thanatosis) and drop to the ground. The larvae of this species are brownish white with a black sclerotised head capsule and prothorax (Piper, 2002).

The Ten-spotted pot beetle is associated with willow (*Salix* species) growing in sheltered *Sphagnum* covered heathland habitat on hillsides on the edges of quaking bogs. Favoured host plants in Scotland appear to be small specimens (under 1 m tall) of Eared willow (*Salix aurita*) (Figure 9). Grey willow (*Salix cinerea*), Goat willow (*Salix caprea*), and occasionally Downy birch (*Betula pubescens*) have been recorded as being used in England (Cox, 2007).

Figure 2. Ten-spotted pot beetle feeding on Eared willow at Black Wood of Rannoch.

Adults of this species are usually found in May and June in England, although individuals have been found through to the end of August at the well-studied Wybunbury Moss NNR in Cheshire (Piper, 2002). Observations of wild larvae show that the immature stages of this species can be found beneath the adult host plants feeding on leaf litter from the adult host plant. Larval development generally takes two years in the wild, with very few adults emerging in some years.

Only two sites are currently known to support Ten-spotted pot beetles in the UK, Wybunbury Moss NNR in Cheshire and Camghouran on the south side of Loch Rannoch in Perthshire (Piper & Compton, 2013; Piper, 2013; Piper, 2015). Single specimens have previously been recorded from two other sites in Scotland: at Muir of Dinnet in Aberdeenshire in 1986, and within 'the Braemar area' in Aberdeenshire in 1959, however the exact locations of both sites are unknown (Littlewood & Stockan, 2013).

3.1. Muir of Dinnet

Located within the Cairngorms national park, next to the village of Dinnet, Muir of Dinnet National Nature Reserve (NNR) is a large and complex area of many habitats. The granite hills & post-glacial topography containing habitats such as nutrient-poor lochs, reedbeds, raised and quaking bogs, pine & birch woodland as well as species-rich dwarf-shrub heath. In addition to this several fields are distributed between these habitats leading to a change of upland to lowland habitat over a relatively short area and an increase in biodiversity. The site is known for its large numbers of overwintering geese and as a result is a Special Protection Area (SPA). The site also has several other designations for its geology and biodiversity such as SAC, SPA, SSSI and Ramsar. Large areas of the site are covered by actively regenerating woodland. Groves of aspen are found by New Kinord village and a small area of alder can be found beside the Vat Burn. Few areas of such high habitat diversity can be found in northern Scotland.

3.2. Morrone Birkwood

Morrone Birkwood is an unusual mixed habitat, the NNR covers 320 ha, with 98 ha of this surveyed. Part of the site has been fenced. The area that is fenced is unfortunately largely unsuitable for the beetle as it is very dense in areas and many of the trees over the preferred height of 1m. It is possible that the parts of the site found outwith the fenced area are too overgrazed.

Morrone (859m) is a foothill of the Cairngorms, above Braemar. The hill itself is mostly dominated by acid rocks but a band of lime-rich rock halfway down creates small crags and a string of calcareous flushes and springs. The lower slopes support a mix of juniper and birch woodland with some willow mixed in between, forming the finest example in Britain of a sub-montane birch-juniper wood on calcareous soils. Areas of calcareous grassland are also found within this area and the adjacent locally species-rich dwarf shrub heath. A representative range of sub-montane and montane heathland habitats is found above the wood including both damp and alpine heath.

The flora at this site is unusually diverse, at least 280 species of vascular plants and 270 species of bryophytes and lichen having been recorded. A number of rare species are found in the woodland, heathland and grassland and particularly on the craigs and in the spring flushes. There is a high diversity of fungi found throughout the site, with the majority being grassland species. The invertebrate fauna includes a high proportion of northern and montane species. There are a number of declining species and national rarities such as ten-spotted pot beetle, northern brown argus, green hairstreak and pearl-bordered fritillary butterflies and Geyer's whorl snail.

3.3. Ten-spotted pot beetle volunteer survey

Due to the pandemic the volunteer survey was delayed, however this did go ahead with reduced numbers on the 25th and 26th September with Cairngorms National Park lending volunteers for the surveys.

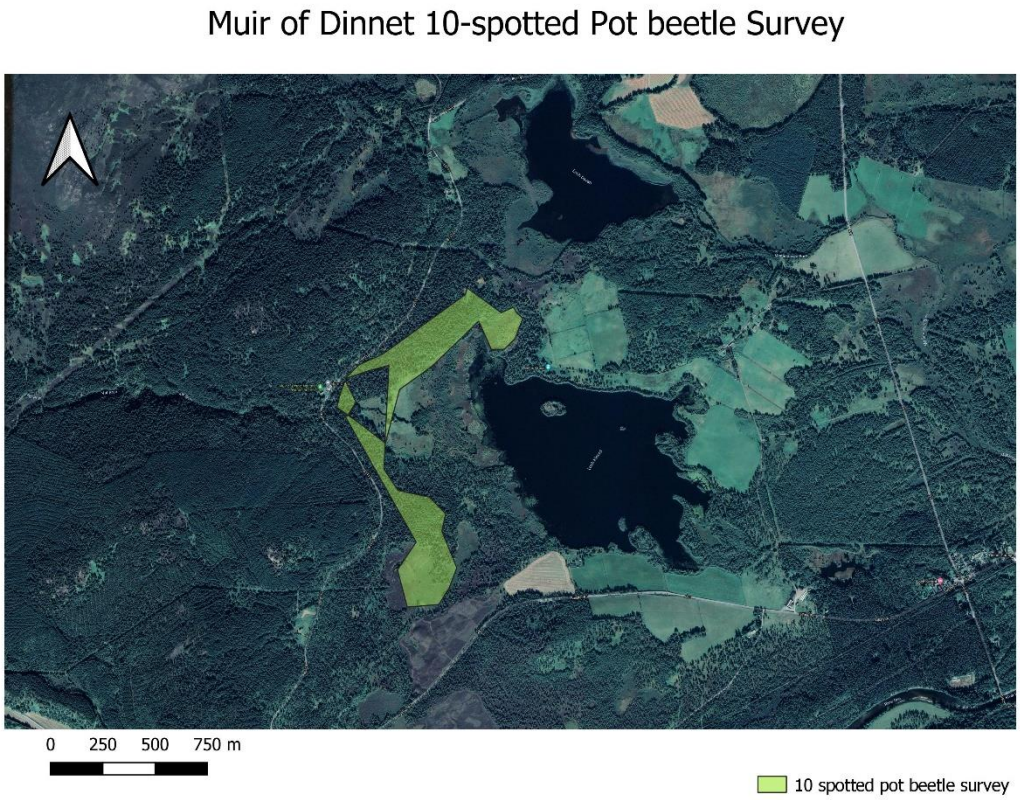

Figure 3 Map of Muir of Dinnet showing area Surveyed for 10-spotted pot beetle

On the first day at Muir of Dinnet (Figure 3) 4 volunteers set off. The first half of the day was spent exploring (GR NJ438000) as the edge of the loch, marshy conditions and short trees were highlighted as a possible habitat for the Ten-spotted pot beetle by the local reserves manager. Appropriately sized eared willows were found, however the conditions underfoot were exceedingly wet and no larval pots were found.

The weather on the day was cold, wet and windy until a small amount of sunshine appeared in the afternoon. This brought out species such as black darter and red admiral whilst surveying the meadows (NO43209952) despite the poor weather. The survey finished at Parkins Moss, finding almost no suitable habitat on the raised bog due to a lack of trees.

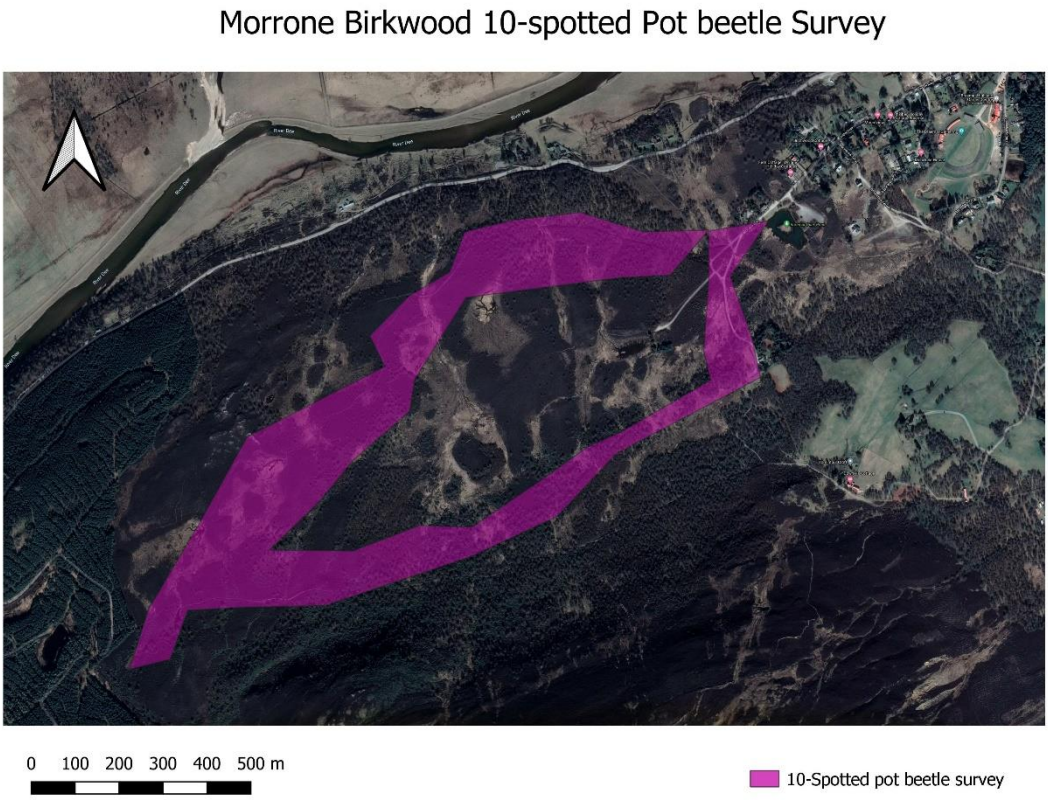

Figure 4 Map of Morrone Birkwood showing area surveyed for the 10-spotted pot beetle

On the second day at Morrone Birkwood (Figure 4), the Morrone Birkwood circular route was followed to try and identify suitable habitat. Additionally, up to (NO129898) was surveyed for suitable habitat. Unfortunately, weather conditions were again unfavourable with showers interrupting frequently. The Morrone Birkwood circular route was followed, with a detour at (NO128900). Some potential habitat was identified (NO127902), however an area has been fenced off in the past to prevent overgrazing and a fair amount of this was inaccessible due to low management and overgrowth, particularly the section towards the bottom of the slope within this fenced in area.

3.4. Habitat management recommendations for Ten-spotted pot beetle at Muir of Dinnet and Morrone Birkwood

1.

Action – Target survey work at Black Moss quaking bog at Muir of Dinnet.
Reason – This moss was not visited on this occasion due to safety & social distancing concerns. It seems likely that the best habitat may be found within Black Moss, therefore this area should be targeted for future survey work.

2.

Action – Good woodland management inside the fence boundary at Morrone Birkwood
Reason – Current woodland overgrowth is leading to a change in habitat type making the area unsuitable for the Ten-spotted pot beetle and potentially several other species, such as the….

3.

Action – Good deer management
Reason – Good deer management would restore the habitat, managing extremes, such as dense growth in parts of the fenced in area and overgrazing outwith the fence.

4. Further recommendations

As well as the suggested habitat management recommendations described above for the Ten-spotted pot beetle, there are several other actions to consider:

1.

Action - Monitor beetles at Black Wood of Rannoch (Ten-spotted pot beetle) to establish population size and health.
Reason - Ten-spotted pot beetles had not been recorded at Black Wood of Rannoch For 17 years until the surveys in 2019. Although the highest number of adults of both species were recorded during 2019, it is important to continue to survey and monitor for both species at the sites. This is particularly important as the surveys were not successful at finding the species at the historic sites surveyed in 2020. Due to the likelihood of a two-year lifespan it is strongly recommended that monitoring continues in order to establish the size and health of the population. Continued surveys to monitor population size and health are also recommended every five years for the Ten-spotted pot beetle by Littlewood & Stockan (2013). This is particularly important as no individuals have been found at historic sites outwith the Black Wood of Rannoch area.

2.

Action - Expand searches for suitable habitat to surrounding 1 km squares and attempt to find further sub-populations in the local areas around Braemar and Muir of Dinnet, specifically to include Black Moss for the Ten-spotted pot beetle.

Reason - Checking for suitable habitat in surrounding areas should be attempted to assess potential habitats for historic sites and the surrounding areas. Historical data often does not give specific co-ordinates and instead leaves a large area to search. Additionally, we had initially planned to survey for adults in June 2020 but due to the Coronavirus pandemic this was changed to larval pots in September with limited numbers of volunteers.

3.

Action – Continue to carry out searches for suitable habitat and the species at known historic locations across Scotland, specifically targeting adult flight time and areas of possible habitat identified in the 2020 surveys.

Reason - Checking for suitable habitat at locations where the species has been recorded in the past may enable remnant populations to be rediscovered. Revisiting more area in Braemar and Muir of Dinnet in the Cairngorms during the adult flight season is needed. Visits in June and early July would be recommended for the Ten-spotted pot beetle, and as well as searching for the beetles themselves the surveys could also focus on searching for preferred host plants and the condition of habitat. Searching an area with trained volunteers has proven to be very successful in past surveys.

4.

Action - Potential captive breeding of both species for re-introduction to known sites and historically known sites.
Reason - Captive rearing of the Ten-spotted pot beetle was undertaken in the past by Piper (2002). A captive breeding programme could help to boost numbers of the Ten-spotted pot beetle from the incredibly low population size at present, while habitat management work is taking place. The Royal Zoological Society of Scotland's Native Species Conservation Programme has expressed interest in working with this species. If successful, adults or mature larvae could be returned to the sites to help strengthen the local population, and potentially help recolonise other suitable sites surveyed historically (potentially both Morrone Birkwood and Muir of Dinnet) if adults are not found in subsequent surveys. This would be particularly useful if no more populations are found.

5. Conclusions

Ten-spotted Pot beetles are fascinating specialized insects with an interesting life cycle that involves females protecting each egg they lay by covering them with their faeces, and the larvae living and developing in these pots.

The Ten-spotted pot beetle are very rare in the UK and are on the Scottish Biodiversity List. They are only known from one site currently in Scotland. Due to their rarity, it is important that surveys, such as within this project, are completed to determine the distribution of the current population and if management of habitat is required to ensure their long-term survival in Britain.

Unfortunately, due to the ongoing pandemic surveys were delayed until September, meaning that instead of targeting the easily seen adult, the larval pots were surveyed for instead.

Despite volunteer help during these surveys the species was not found on this occasion. This does not mean that they are not present in the area. Several areas of possible habitat were identified or determined to be unsuitable habitat for the beetle.
The weather on survey days was not ideal, but despite this a number of species were recorded, including black darter and heath damselbug.

Due to the fact that these surveys were unsuccessful at finding the Ten-spotted pot beetle, it is highly recommended that the surveys are undertaken again during the adult flight period, particularly targeting areas highlighted as potential habitat, or not visited during the

surveys this year. This will help better identify any remnant populations from these areas, ensuring the long-term survival of the Ten-spotted pot beetle in Scotland.

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Appendix

Appendix 1**. Species of invertebrate recorded during the surveys at Muir of Dinnet NNR on 25th of September 2020.**

Order	Scientific name	Common Name	Grid Reference
Coleoptera	*Dor beetle*	Geotrupes stercorius	NO429997
	Lochmaea suturalis	Heather beetle	NJ435000
	Coccinella septpunctata	7-spot ladybird	NJ438000
Hemiptera	*Pentatoma rufipes*	Red Legged Shieldbug	NJ438000
	Elasmucha grisea	Parent bug	NJ43770016
	Nabis ericetorum	Heath Damselbug	NO429997
Hymenoptera	*Bombus terrestris*	Buff-tailed bumblebee	NJ435000
	Vespula vulgaris	Social wasp	NO432996
Lepidoptera	*Vanessa atlanta*	Red Admiral	NO432996
	Larentiinae	Pug Sp.	NO433988
Gastropoda	*Arion ater*	Large Black slug	NJ43770020
Odonata	*Pyrrhosoma nymphula*	Black Darter	NO43209952

Appendix 2**. Species of invertebrate recorded during the surveys at Morrone Birkwood on the 26th of September 2020.**

Order	Common Name	Scientific Name	Grid reference
Coleoptera	Leaf Beetle	*Galeruca tanaceti*	NO133907
Diptera	Tapered dronefly	*Eristalis tenax*	NO137910
Lepidoptera	Autumn green carpet	*Chloroclysta miata*	NO14169058
	November/autumnal moth agg	*Epirrita sp. agg*	NO13269023
	Fox moth	*Macrothylacia rubi*	NO133907
Hymenoptera	Forest cuckoo bee	*Apis mellifera*	NO1390
	White tailed bee	*Bombus lucorum*	NO128901
	Garden bumblebee	*Bombus hortorum*	NO128901
	Hairy Wood ant	*Formica lugubris*	NO13269023
Hemiptera	Plant bug	*Lygus sp*	NO1390

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