

REPORT OF FIELDWORK FOR THE WOODLAND TRUST

**A PITFALL TRAPPING SURVEY OF THE AUTUMNAL GROUND  
BEETLE (COL.: CARABIDAE) FAUNA OF GLEN FINGLAS, WEST  
PERTSHIRE (VC87)**

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**Abstract**

This report describes the carabid beetles recorded across a three week period of pitfall trapping at the Woodland Trust property of Glen Finglas, West Perthshire (VC87), in September and October 2012. Traps were set in transects through five different habitats: a grassland, oak woodland, birch woodland, heathland, and a stream-side. In total, 64 specimens of nine species were recorded, the most common of these being *Pterostichus madidus*. *Carabus problematicus* was the only species recorded across all habitats. Various abiotic environmental factors were measured with the intention of establishing their effect on the distribution and abundance of carabid species, but too few specimens were obtained overall to establish meaningful correlations. This study therefore represents a very preliminary investigation.

**Introduction**

Glen Finglas is situated near the town of Callander in West Perthshire (VC87)—approximately 20 miles north-west of Stirling—and is the Woodland Trust's largest British property, covering an area of nearly 12,000 acres (Woodland Trust, n.d.). The estate is dominated by areas of upland heath, interspersed with patches of mixed and deciduous woodland, around the Glen Finglas Reservoir (NN5009) and the northern shores of Loch Venachar, within the Loch Lomond and the Trossachs National Park. The site, though dominated by heathland, therefore features a range of diverse ecological habitats. Much prior work has been conducted on the estate by the Hutton Institute, investigating the ecological impact of grazing, including its effect on insect populations and predator-prey dynamics (Evans *et al.*, 2005a; 2005b; 2006a; 2006b; Walsh *et al.*, 2007; Dennis *et al.*, 2008; Douglas *et al.*, 2008; Littlewood, 2008; Vandenberghe *et al.*, 2009; Littlewood and Stewart, 2011; Prior *et al.*, 2011; Littlewood *et al.*, 2012; Villar *et al.*, 2013; 2014; Smith *et al.*, 2014; Evans *et al.*, 2015).

Despite having been subject to more interest among entomologists than any other family of Coleoptera, many aspects of the biology and ecology of the Carabidae remain unknown (Luff, 2007). This study therefore initially aimed both to determine the relative diversity and abundance of carabid species active across a

range of different habitats in autumn, and to detect the potential influence of various measured abiotic environmental factors on their occurrence. A series of pitfall trap transects were therefore established across several habitat sites within the Glen Finglas estate during September and October 2012, with regular measurements of moisture, pH, and temperature levels being taken. However, too few specimens were collected across the experimental period to allow for meaningful inferences with regard to the effect of variation in environmental variables and habitat. Hence, while all the raw data is included in the appendices, this report concentrates on describing the diversity of species collected.

### Methods

Five sites comprising, to the human observer, perceptibly different habitats were selected within the estate; a heathland (NN546072), grassland (NN545068), oak woodland (NN548068), birch woodland (NN545069), and an area adjacent to a stream (NN546067). These sites were situated relatively close to the estate car park given the need to regularly visit and service the traps. At each site, five pitfall traps were set at 1m intervals in an approximate transect, as far as the terrain would allow. Pitfall traps were clear plastic pint tumblers of 95cm diameter. Traps were filled with undiluted (blue) car antifreeze to an approximate depth of 2cm and sunk such that their rim was at ground level. Each trap was covered with a square of high-density foam held in place by tent pegs 2cm above ground level, acting as a roof to prevent the ingress of water. A *Westminster* multimeter was used to take measurements of soil pH (analogue scale, pH 4 – 8) and soil moisture (relative scale, 1 [dry] – 4 [wet]) at three points around each individual trap. Air temperature data was obtained from the archive of historical meteorological data provided by the Weather Underground website (Accessed Jan 2013), representing conditions at the relatively proximate Meteorological Office weather station at Glen Ogle (NN570281).

Traps were placed initially on 15/09/12 and emptied three times after one week intervals, on 22/09/12, 29/09/12, and 06/10/12. Specimens were transferred to a solution of 60% ethanol with a small amount of 5% glacial acetic acid added to aid preservation. Traps were then refilled with antifreeze, where possible the old antifreeze being reused. All specimens from a single habitat on any one week were amalgamated. After emptying the traps, measurements of soil moisture and pH were taken at three points around each individual trap. This procedure was repeated across all traps at all five sites. A Brunel MX3 stereomicroscope was used for examination under magnification.

### Results

From 15 September to 6 October 2012 across five different habitats at the Woodland Trust property of Glen Finglas, a total of only 64 specimens belonging to nine species of Carabidae were recorded by pitfall trapping. Species recorded and their abundance were as follows: *Abax parallelepipedus* 4; *Carabus problematicus* 17; *Leistus terminatus* 7; *Nebria salina* 1; *Patrobus assimilis* 2; *Poecilus versicolor* 1; *Pterostichus madidus* 27; *Pterostichus melanarius* 2; *Pterostichus niger* 3. The number of carabid beetles recorded in each of the different habitats (and species richness, *S*) were as follows: heathland 2 (1); stream-side 8 (2); grassland 11 (5); birch woodland 7 (4); oak woodland 36 (5). Of

all the species recorded, *C. problematicus* was the most widespread, occurring in all habitats sampled, with varying frequency, while *P. madidus* occurred across all except the heathland.

As random variation can exert a significant effect in samples of small size, and given the very limited nature of the number of specimens collected here, it is impossible to make meaningful speculations as to the effect of the measured environmental variables on species occurrence and abundance, or their distribution across habitats. A brief summary of the air temperature data collected may be pertinent to the very low overall recorded carabid abundance, and weekly means of maximum, minimum and average daily temperatures (with standard deviation) are therefore given, as follows: week one,  $\bar{x}_{max} = 8.43$  (1.90),  $\bar{x}_{min} = 4.14$  (1.77),  $\bar{x}_{avg} = 6.11$  (1.79); week two,  $\bar{x}_{max} = 7.86$  (1.57),  $\bar{x}_{min} = 4.57$  (0.98),  $\bar{x}_{avg} = 6.05$  (0.97); week three,  $\bar{x}_{max} = 7.88$  (1.25),  $\bar{x}_{min} = 4.13$  (1.81),  $\bar{x}_{avg} = 5.72$  (1.55).

### Discussion

Despite the initial aim of this study to establish the effects of a range of ecological factors on the abundance and occurrence of carabid species, it must be regarded as preliminary considering the limited extent of the specimens recorded. Indeed, the low overall trapped abundance of carabid beetles is curious given the relatively large number of traps utilised in this experiment. Loss of material did occur from two traps in the oak woodland, which were disturbed and entirely emptied of their contents, though this cannot account for the broader trend. It is possible that the low overall carabid abundance may have been a consequence of the time of year, if activity (due to reduced temperature) was decreasing and some species were dying off or entering hibernation; a significant number of species are known to hibernate, including many species of *Carabus* (Luff, 2007) and potentially a range of smaller carabids (Walters, 2010). Perhaps importantly, each weekly mean of average daily temperature was consistently below the 1981-2010 Scottish average of 8.0°C (Meteorological Office, 2013) which may have acted to reduce insect activity to an extent. However, Darby (2014) describes the results of a year-long pitfall trapping study conducted in Wiltshire which indicate that the abundance of carabid beetles, though not diversity of species, undergoes a second peak from late August to early October, after which it rapidly drops off.

Despite the considerable constraints imposed by small sample size, this study suggests several lines of enquiry which might be pursued in future. Considering the albeit preliminary distribution of species across the habitat sites, it is tempting to suppose that there is a dichotomous carabid assemblage within the autumnal biota of this locality; a community generally concentrated in grassland areas and another in mature oak woodland, with generalist species straddling these and a range of other less diverse habitats. Though far more evidence is required before such a finding could be definitively established, future studies concerned with optimising recording effort through pitfall trapping might be advised to concentrate in grassland and deciduous woodland areas, at least initially. Furthermore, a rigorous and long-term study at the site examining the temporal changes both in species richness and overall carabid abundance would be of particular interest, given the unusually low number of beetles recorded in this experiment. Finally, this study serves to indicate the likely required extent of any future work which hoped to examine correlations between environmental

variables and variation in the abundance and species richness of this group of insects using pitfall trapping.

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	Habitat Site / Week															Total						
	Heathland			Stream			Grassland			Birch Woodland			Oak Woodland				All					
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3		1	2	3			
<i>Abax parallelepipedus</i>																						
<i>Carabus problematicus</i>																						
<i>Leistus terminatus</i>																						
<i>Nebria salina</i>																						
<i>Patrobus assimilis</i>																						
<i>Poecilus versicolor</i>																						
<i>Pterostichus madidus</i>																						
<i>Pterostichus melanarius</i>																						
<i>Pterostichus niger</i>																						
<b>Total</b>	2	2	2	1	6	1	6	4	1	1	1	3	3	3	3	6	14	16	14	29	21	64
	2			8			11			7						36			64			

Table S1. Number of carabid beetles trapped during autumn 2012 at Glen Finglas, West Perthshire (VC87), in a range of habitats across a three week period. Week 1, 15/09/12 – 22/09/12; week 2, 22/09/12 – 29/09/12; week 3, 29/09/12 – 06/10/12.

Average Moisture and pH for Habitat												
Date	Heathland		Stream		Grassland		Birch Woodland		Oak Woodland		All	
15/09/12	3.6	5.2	2.9	6.1	3.4	6.2	2.9	6.1	3.3	5.8	3.2	5.9
22/09/12	2.6	5.8	2.4	6.2	3.1	6.2	2.6	6.1	3.1	6	2.8	6.1
29/09/12	2.4	6	2.2	6.5	2.7	5.9	2.8	6	2.7	5.9	2.6	6.1
06/10/12	2	6.2	2	6.2	2.9	6.1	2.3	6.1	2.9	6	2.4	6.1
<b>Overall Average</b>	<b>2.7</b>	<b>5.8</b>	<b>2.4</b>	<b>6.3</b>	<b>3</b>	<b>6.1</b>	<b>2.7</b>	<b>6.1</b>	<b>3</b>	<b>5.9</b>	<b>2.8</b>	<b>6</b>

Table S2. Mean recorded soil moisture (white columns) and pH (grey columns) across each habitat on each trap servicing visit. Moisture and pH were measured at three points around each trap using a Westminster multimeter. The meter measured pH on an analogue scale from pH 4 to pH 8 and moisture on a relative scale from 1 (dry) to 4 (wet).

Temperature (oC) / Time											
Date	12.50AM	3.50AM	6.50AM	9.50AM	12.50PM	3.50PM	6.50PM	9.50PM	Average	Max.	Min.
15-Sep	8	7	8	9	11	11	8	9	8.88	11	7
16-Sep	8	9	9	11	8	9	7	6	8.38	11	6
17-Sep	7	7	6		8	6	5	4	6.14	8	4
18-Sep	5	4	3	5	7	6	5	3	4.75	7	3
19-Sep	4	3	4	5	8	7	6	5	5.25	8	3
20-Sep	4	5	4	6	5	5	5	4	4.75	6	4
21-Sep	4	3	2	5	6	8	5	4	4.63	8	2
22-Sep	3	3	3	5	8	7	6	5	5.00	8	3
23-Sep	5	5	5	5	7	7	6	5	5.63	7	5
24-Sep	5	4	4	6	6	6		5	5.14	6	4
25-Sep	5	5	6	6	7	8	7	7	6.38	8	5
26-Sep	7	6	6	8	10	11	8	7	7.88	11	6
27-Sep	7	5	5	6	7	6	7	7	6.25	7	5
28-Sep	8	6	6	6	7	7	5	4	6.13	8	4
29-Sep	5	5	5		6	8	6	6	5.86	8	5
30-Sep	8	8	10	9	10	10	9	7	8.88	10	7
01-Oct	8	7	7	6	7	7	6	6	6.75	8	6
02-Oct	5	5	5	6	6	7	6	4	5.50	7	4
03-Oct	3	2	4	4	5	6	4	3	3.88	6	2
04-Oct	4		3	4	6	8	6	5	5.14	8	3
05-Oct	4	3	2	3	7	6	5	5	4.38	7	2
06-Oct	4	4	4	6	9	7	5	4	5.38	9	4

Table S3. Air temperature recorded at the nearby Meteorological Office weather station at Glen Ogle across each day of trapping. Data obtained from [www.wunderground.com](http://www.wunderground.com) (Accessed Jan. 2013). Daily average, minimum and maximum are shown, from which weekly values are calculated in-text.