

## The arachnids of Glasgow Botanic Gardens

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### ABSTRACT

This paper provides an overview of arachnids recorded between 2017 and 2019 in Glasgow Botanic Gardens, Scotland. Species belonging to the orders Araneae (spiders), Opiliones (harvestmen), and Pseudoscorpiones (false scorpions) are included. Notable species are discussed and a comparison is made with prior information on the arachnids of the Gardens.

### INTRODUCTION

CC was invited to survey arachnids at the glasshouses and exterior grounds of Glasgow Botanic Gardens (GBG), Scotland as part of the wider project, *On the Wildside Revisited: 200 years of wildlife in the Glasgow Botanic Gardens*, aimed at updating information on the fauna and flora of GBG about 20 years after a similar project (Downie & Forster, 2019). This paper provides an overview of the results of the arachnid surveys. It should be noted that Coleoptera (beetles) and Dictyoptera (cockroaches) collected during these surveys were also identified to species level, and are discussed in other papers in the series (Weddle, 2020; Cathrine, 2022).

Before the investigation described in this paper, only 15 arachnids had been identified to species level and included in Hancock (1999) and the GBG species list (Glasgow Natural History Society, 2017): nine Araneae (spiders), five Opiliones (harvestmen), and one Pseudoscorpiones (false scorpion).

### METHODS

Three survey visits were made by the CC to GBG between 2017 and 2018. During each of these, both “pooter” and “bugvac” sample methods (see below) were employed at a variety of sample locations within glasshouses and outdoors. In addition, Andrew Sinclair (Curator, GBG), collected specimens in 2019 which were identified and included in this paper. Specimens were collected from six broad areas which can be summarised as Begonia Backup, Kibble Palace, Main Range (glasshouse), The Long Pit, Gardens (outdoors), Wall (a brick wall, outdoors, to the west of The Long Pit) (Table 1). Ten locations were sampled throughout the exterior gardens, encompassing a range of habitats and situations. These sample location areas are equivalent to those that produced invertebrate records during the original *On the Wildside* project, with the exception of a disused railway station where samples

were obtained previously but which could not be accessed during these arachnid surveys. Specimens were preserved in a 70% isopropanol and 30% water mixture for later identification in the laboratory.

The vast majority of spiders require examination of genitals or secondary sexual organs under a microscope in order to confirm species. Although different species have their peak adult season at different times of year, in Scotland the largest number can be found in autumn. Therefore, to maximise the diversity of species recorded with limited survey effort, sampling was undertaken during autumn.

Sample and laboratory identification methods are described in further detail below.

### Pooter

Microhabitats were searched by “grubbing” in the ground layer, overturning leaves and stones, and searching deadwood, utilising a pooter to collect fragile invertebrates without damaging the features necessary for identification (Fig. 1A).

### Bugvac

A modified petrol-powered leaf blower (Husqvarna 125BVX) was used to vacuum sample invertebrates from ground level (Fig. 1B). Bugvac sampling has proved to be the most effective method of establishing the presence of species that live in less accessible microhabitats such as the base of vegetation, or for small invertebrates that are often under-recorded by more traditional sampling techniques (Wilson *et al.*, 1993). For example, this method was very effective for detecting the rare *Heliophanus dampfi* (a Red Data Book species), which prefers the bases of *Molinia* (moor-grass) and *Eriophorum* (cotton-grass) tussocks in bog habitats (Cathrine, 2012). Petrol-powered vacuum samplers appear to collect more individuals and species than battery-powered models (Wilson, 2020). Each sample involved pressing the bugvac nozzle to the ground for ten seconds at five points. Specimens were then emptied from the net into a white plastic tray and collected with forceps.

### Active search

These specimens were collected opportunistically by Andrew Sinclair.

Sample Location Area	Grid Reference	Date	Methods
Begonia Backup	NS56856753	01/02/2019	Active search
Gardens	NS5661567563	21/09/2017	Bugvac, pooter
Gardens	NS5661767564	12/10/2018	Pooter
Gardens	NS5661767717	03/08/2018	Bugvac
Gardens	NS5661967573	03/08/2018	Bugvac
Gardens	NS5663067665	03/08/2018	Bugvac
Gardens	NS5664967740	12/10/2018	Pooter
Gardens	NS5665767753	03/08/2018	Bugvac
Gardens	NS5669367550	12/10/2018	Pooter
Gardens	NS5673767498	03/08/2018	Bugvac
Gardens	NS5676967606	12/10/2018	Pooter
Kibble Palace	NS5690167466	12/10/2018	Pooter
Main Range	NS5681367511	21/09/2017	Bugvac
Main Range	NS5681367511	21/09/2017	Pooter
Main Range	NS5681367511	03/08/2018	Pooter
The Long Pit	NS5682067545	03/08/2018	Pooter
Wall	NS5681067573	12/10/2018	Pooter

**Table 1.** Details of arachnid survey sample locations, Glasgow Botanic Gardens, Scotland. Specimens at Begonia Backup were collected by Andrew Sinclair. Specimens at all other locations were collected by CC.



**Fig. 1.** Sampling methods employed in Glasgow Botanic Gardens, demonstrated by CC. (A) Pooter. (B) Bugvac. (Photos: Richard Weddle)

### Laboratory identification

Preserved specimens were identified by KG and CC in the lab with stereo-microscopes. Appropriate references were used for the identification of specimens, and comparisons were made with the Caledonian Conservation Ltd. reference collection where necessary, to confirm identification. Voucher specimens were retained.

### RESULTS

A total of 48 arachnid species was recorded and a full species list, including sample locations where they were recorded, is provided in Table 2. The Gardens was the most diverse area, with 38 species of arachnid recorded. Six species were recorded from the Main Range, five from Kibble Palace, four from The Long Pit, two from the Wall, and one from the Begonia Backup. The results for each order are detailed below, with a focus on particularly notable species. It should be noted that only specimens identifiable to species level are included in this paper. In addition, numbers of specimens are not reported here, as the survey was not quantitative and no inference of relative abundance could be made; the results of this survey can only be used to confirm presence.

### Araneae (spiders)

Thirty-nine species of spider were recorded, including one on the Spider Amber List (Harvey *et al.*, 2017), which is also considered to be local (*Allomengea scopigera*), one very local (*Larinioides sclopetarius*), and four local (*Oonops pulcher*, *Evarcha falcata*, and *Tetragnatha obtusa*) in the context of Scotland.

Order	Family	Species	Rarity Status	Sample Location Area					
				<i>Begonia Backup</i>	<i>Gardens</i>	<i>Kibble Palace</i>	<i>Main Range</i>	<i>Long Pit</i>	<i>Wall</i>
Araneae	Araneidae	<i>Araneus diadematus</i>				█		█	
Araneae	Araneidae	<i>Larinioides scolopetarius</i>	Very local			█			
Araneae	Araneidae	<i>Zygiella x-notata</i>			█		█		
Araneae	Linyphiidae	<i>Allomengea scopigera</i>	SAL; local		█				
Araneae	Linyphiidae	<i>Bathyphantes gracilis</i>			█				
Araneae	Linyphiidae	<i>Bathyphantes parvulus</i>			█				
Araneae	Linyphiidae	<i>Centromerita bicolor</i>			█				
Araneae	Linyphiidae	<i>Dicymbium nigrum</i>			█				
Araneae	Linyphiidae	<i>Diplocephalus cristatus</i>			█				
Araneae	Linyphiidae	<i>Diplocephalus latifrons</i>			█				
Araneae	Linyphiidae	<i>Drapetisca socialis</i>			█				
Araneae	Linyphiidae	<i>Erigone atra</i>			█				
Araneae	Linyphiidae	<i>Erigone dentipalpis</i>			█				
Araneae	Linyphiidae	<i>Labulla thoracica</i>							█
Araneae	Linyphiidae	<i>Linyphia triangularis</i>			█				
Araneae	Linyphiidae	<i>Neriene clathrata</i>			█				
Araneae	Linyphiidae	<i>Neriene montana</i>			█				
Araneae	Linyphiidae	<i>Oedothorax fuscus</i>			█				
Araneae	Linyphiidae	<i>Palliduphantes ericaeus</i>			█				
Araneae	Linyphiidae	<i>Savignia frontata</i>			█				
Araneae	Linyphiidae	<i>Tenuiphantes alacris</i>			█				
Araneae	Linyphiidae	<i>Tenuiphantes flavipes</i>			█				
Araneae	Linyphiidae	<i>Tenuiphantes mengei</i>				█			
Araneae	Linyphiidae	<i>Tenuiphantes tenuis</i>			█				
Araneae	Linyphiidae	<i>Tenuiphantes zimmermanni</i>			█				
Araneae	Linyphiidae	<i>Tiso vagans</i>			█				
Araneae	Lycosidae	<i>Pardosa amentata</i>			█				
Araneae	Oonopidae	<i>Oonops pulcher</i>	Local				█		
Araneae	Philodromidae	<i>Philodromus aureolus</i>			█				
Araneae	Pholcidae	<i>Pholcus phalangioides</i>					█	█	
Araneae	Salticidae	<i>Evarcha falcata</i>	Local				█	█	

Araneae	Tetragnathidae	<i>Metellina segmentata</i>							
Araneae	Tetragnathidae	<i>Pachygnatha degeeri</i>							
Araneae	Tetragnathidae	<i>Tetragnatha obtusa</i>	Local						
Araneae	Theridiidae	<i>Enoplognatha ovata</i>							
Araneae	Theridiidae	<i>Paidiscura pallens</i>							
Araneae	Theridiidae	<i>Parasteatoda tepidariorum</i>	Non-native						
Araneae	Theridiidae	<i>Phylloneta impressa</i>							
Araneae	Theridiidae	<i>Rugathodes sexpunctatus</i>	Non-native						
Opiliones	Gyantinae	<i>Dicranopalpus ramosus</i>	Non-native						
Opiliones	Leiobuninae	<i>Leiobunum rotundum</i>							
Opiliones	Nemastomatidae	<i>Nemastoma bimaculatum</i>							
Opiliones	Phalangiidae	<i>Mitopus morio</i>							
Opiliones	Phalangiidae	<i>Oligolophus tridens</i>							
Opiliones	Phalangiidae	<i>Paroligolophus agrestis</i>							
Opiliones	Phalangiidae	<i>Platybunus triangularis</i>							
Pseudoscorpiones	Neobisiidae	<i>Neobisium carcinoides</i>							
Pseudoscorpiones	Neobisiidae	<i>Roncus lubricus</i>	Very local						

**Table 2.** Arachnid species list for Glasgow Botanic Gardens, Scotland, including sample locations at which each was recorded. Shaded cells indicate a species was recorded at that sample location. “Very local” and “local” descriptions are in the context of Scotland. SAL: spider amber list. See Table 1 for further details regarding sample locations.

In addition, two non-native species were also recorded - *Parasteatoda tepidariorum* and *Rugathodes sexpunctatus*.

Thirty species of spider were recorded from the Gardens, five from Kibble Palace, five from the Main Range, four from The Long Pit, one from the Wall, and one from the Begonia Backup.

#### **Opiliones (harvestmen)**

Seven species of harvestman were recorded, including one introduced species - *Dicranopalpus ramosus*.

Seven species of harvestmen were recorded from the Gardens, and one species was recorded from the Wall. Harvestmen were not recorded from other areas.

#### **Pseudoscorpiones (false scorpions)**

Two species of false scorpions were recorded - *Roncus lubricus* and *Neobisium carcinoides*. *R. lubricus* is considered to be very local in the context of Scotland.

*R. lubricus* was recorded from the Main Range, and *N. carcinoides* from the Gardens. False scorpions were not recorded from other areas.

### **DISCUSSION**

The following sections discuss the notable species found during this arachnid survey for each order, and a comparison is made with the previous knowledge of arachnids in GBG.

#### **Araneae (spiders)**

Five notable species of spider were recorded during this survey.

*Allomengea scopigera*, a linyphiid, is included on the Spider Amber List (Harvey *et al.*, 2017) and has a local distribution in Scotland. This species is found in a range of wet habitats, and was recorded outdoors in the Gardens at GBG (Harvey *et al.*, 2002).

The araneid, *Larinioides sclopetarius*, is generally associated with large trees near water and has a very local distribution in Scotland (Harvey *et al.*, 2002). The combination of warmth and water features at Kibble Palace, where it was recorded, provides an optimal habitat for this species.

*Oonops pulcher*, which has a local distribution in Scotland, was found in the Main Range. This species is often associated with *Amaurobius* spp., feeding on the remains of prey in their webs (Bee *et al.* 2017). *Amaurobius* spp. are abundant throughout GBG, particularly in the glasshouses. Although specimens belonging to this genus were collected during survey visits, none were mature and so could not be identified to species level.

*Evarcha falcata*, a jumping spider (Salticidae) associated with woodland, was recorded in the Main Range. Although it is known to occur in Scotland, with a local distribution, it has not been previously recorded from the Glasgow area (Bee *et al.*, 2017).

The tetragnathid spider, *Tetragnatha obtusa*, is found in woodland, and was recorded from Kibble Palace. It has a very restricted distribution in Scotland, is considered to be local, and has not been recorded from the Glasgow area before (Bee *et al.*, 2017).

Two non-native spiders were recorded, both belonging to the family Theridiidae. *Parasteatoda tepidariorum* has been recorded in GBG previously (Hancock, 1999). Although its native range is unclear, it is likely to have originated in the neotropics or warm climate in Asia, and cannot survive outdoors in Scotland (Levi, 1967; Roberts, 1996; Faúndez & Téllez, 2016; Bee *et al.*, 2017; World Spider Catalog, 2022). *P. tepidariorum* was abundant in all interior areas surveyed. *Rugathodes sexpunctatus*, which originates from North America, was first reported from the Glasgow Necropolis in the U.K. in 2012 (although a specimen collected in 2009 was later confirmed to be this species), but has since been found in Dunbartonshire, South Lanarkshire, and Clackmannanshire, so may be more widespread in Scotland than previously thought (Davidson, 2012; Davidson & Merrett, 2014; Cathrine & Currie, 2020; Davidson & Cathrine, 2020). *R. sexpunctatus* was recorded from the exterior Gardens area.

#### **Opiliones (harvestmen)**

The introduced species, *Dicranopalpus ramosus*, was found in the Gardens area, and is increasingly widespread in Scotland. However, it has recently been found that *D. caudatus*, previously thought to be synonymous with *D. ramosus*, is a separate species and is also present in the U.K. It has been confirmed that some specimens of *D. caudatus* have been misidentified as *D. ramosus* (Wijnhoven & Prieto, 2015; Davidson, 2019). In the present survey all specimens were confirmed to be *D. ramosus*. This species is largely synanthropic in Scotland (Hillyard, 2005). *D. ramosus* appears to originate from the Iberian Peninsula, France and Morocco but is now widespread throughout Europe (Wijnhoven, 2009).

#### **Pseudoscorpiones (false scorpions)**

The record of *Roncus lubricus* at GBG is just the second for Scotland (Gerald Legg, pers. comm.). Based on data held by the Pseudoscorpion Recording Scheme, this is the first record from a glasshouse in Scotland; the previous Scottish record was made on the shore of the Solway in 1998. However, that record of *R. lubricus* was in shingle, while the specimens collected at GBG were found under gravel in the entrance to the Main Range: both microhabitats are similar in structure. This species is found on sea-shores as well as synanthropic situations including glasshouses and old gardens (Legg & Jones, 1988; Legg & Farr-Cox, 2016).

*Neobisium carcinoides* is the most widespread “species” of false scorpion found in Scotland and is found in almost every habitat including woodland, sea-shore, peatland, grassland, mountain tops, and urban environments. However, recent research has revealed considerable taxonomic complexity. For example, Harvey (2013) lists eight species synonymous with

*N. carcinoides* worldwide, whilst Muster *et al.* (2021) found at least 12 putative cryptic species based on DNA barcoding of *N. carcinoides* specimens in Germany. Therefore, there is a high degree of uncertainty over the identification of specimens in this complex pending the publication of further details.

### Comparison with previous knowledge of arachnids in Glasgow Botanic Gardens

The results of this survey have increased the total number of arachnid species known from GBG from 15 to 51: the number of Araneae (spiders) has increased from eight to 41, Opiliones (harvestmen) from five to seven, and Pseudoscorpiones (false scorpions) from one to three.

Species previously recorded based on Hancock (1999) and Glasgow Natural History Society (2017) were refound with the exception of three species: two spiders (*Metellina merianae* and *Palystes castaneus*) and one pseudoscorpion (*Ephippiochthonius tetrachelatus*).

*Metellina merianae* is a species of tetragnathid spider which is extremely similar in appearance to *M. segmentata* which was recorded during this survey. These two species are widespread and common, often coexisting. Although either can be mature in spring, summer, and autumn, *M. merianae* has its adult peak in spring and early summer, whereas mature *M. segmentata* are mostly found during late summer and autumn. Many immature *Metellina* sp. were collected during the *On the Wildside Revisited* surveys, and some of these may have been *M. merianae*. It is considered highly likely that *M. merianae* is still present at GBG, and that it was not recorded during this survey due to the visits being undertaken in autumn. Other spider species present at GBG with adult peak seasons during autumn may also have been missed.

*Palystes castaneus*, recorded at GBG in 1863, is native to South Africa, belonging to the family Sparassidae (Croeser, 1996; Hancock, 1999). It is worth noting that the taxonomy relating to this genus has undergone substantial revision since 1863, and it would be worth re-examining the specimen if it has been retained. There are no representatives of Sparassidae occurring in Scotland, as they cannot survive in the Scottish climate. It is likely this record relates to an individual animal, or small number of individuals, transported with a plant specimen (Hancock, 1999), and that this species has not persisted at GBG. The introduction of non-native invertebrates to the GBG was probably not uncommon, particularly historically when biosecurity measures were less robust than in the present day, and there may have been many examples of this for arachnid species which have not been recorded.

*Ephippiochthonius tetrachelatus* was found in the Main Range in 1988 by Adrian Rundle, who also recorded this species in the People's Palace during the same visit to Glasgow (Richard Weddle, pers. comm.). It has been recorded from scattered locations throughout south, central and western Scotland (Hancock, 1999;

Biological Records Centre, 2022). Although often associated with synanthropic situations, including glasshouses, this false scorpion is also found in natural habitats under stones, in leaf litter, and in decaying vegetation. False scorpions can be challenging to collect, and additional survey efforts employing a wide range of methods targeting these animals are likely to find that *E. tetrachelatus* persists and reveal additional species at GBG. Although bugvac is an effective method for collecting false scorpions, the addition of leaf litter sieving, bark traps, artificial bird nest traps, and Tullgren funnels, would provide more robust results for these arachnids.

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