Habitat Survey Report

Pollinator Network Survey: Manor Woods Valley

Louis Amor (MSc UWE)

Executive Summary

Pollinator Network surveys were conducted across 3 unimproved neutral grasslands in Manor Woods Valley Nature Reserve, Bristol. Distinct species compositions and network structures were found between sites. However, bipartite analysis revealed no network level differences. Bees played a larger role in pollination within “Valley Heights Meadow” than the other 2 sites, with “The Wildflower Meadow” completely lacking any bee-plant interactions in favour of fly pollination. The potential source of these differences is discussed alongside recommendations for strengthening plant-pollinator networks.

Introduction

Global insect populations are facing a myriad of anthropogenic pressures, with substantial widescale loses described as an “insect apocalypse” (Wagner *et al*., 2021). Subsequently, vital insect ecosystem services are under severe threat, including pollination, with fundamental functional, regulatory and provisional services to both wild and commercial ecosystems (Katumo *et* al., 2022). Pollinator network surveys quantify plant-pollinator interactions, revealing the diversity, structure and quality of these interactions and therefore providing invaluable insights into ecosystem health (Ferreira, Boscolo and Viana, 2013). Through evaluating certain features of these networks, such as their symmetry and the relative influence of individual species or interactions, the impacts of anthropogenic pressures can be assessed, alongside management practices to strengthen ecosystem functionality (Ferreira, Boscolo and Viana, 2013; Weaver, Ascher and Mallinger, 2022).

This report aims to apply these methods to Manor Woods Valley (MWV) local nature reserve, a Site of Nature Conservation Interest in Bristol (51.424514, -2.608298) (Bristol City Council, 2026). This site is managed by Bristol City Council and Manor Woods Valley Group (MWVG), local volunteers who have conducted extensive reports on the sites plant and pollinator communities (MWVG, 2026). This report is the first analysis of the interaction of these communities within 3 areas of unimproved neutral grassland, key habitats for pollinator activity (Sexton and Emery, 2020). The Wildflower Meadow (TWM) is the largest site, formed from soil tipping in the 1970s and mowed annually for hay since 2018 (MWVG, 2023). The Orchard Triangle (TOT), adjacent to TWM, was subject to bramble management in 2010, allowing the formation of grassland (MWVG, 2023). Finally, Valley Heights Meadow (VHM) is the smallest of these grasslands, with management including annual mowing and the sowing of wildflower seeds in 2018/19 (MWVG, 2023). Through investigating the plant-pollinator networks of these sites, this report aims to assess network structure, functioning and resilience, and recommend key management practices to be introduced to strengthen these metrics.

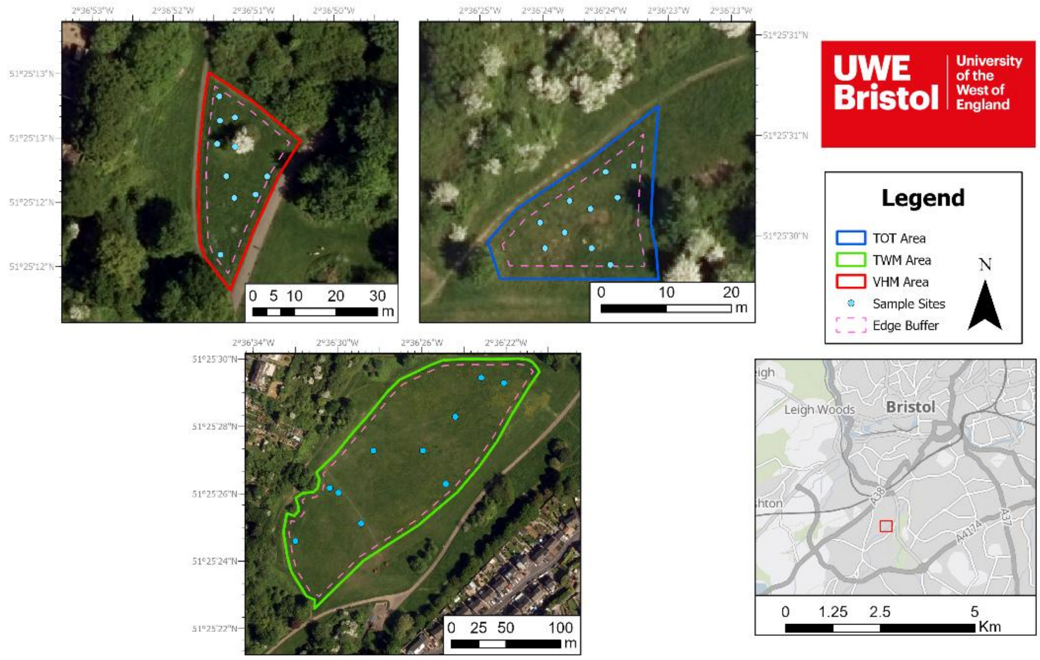
Methodology

Data Collection

Pollinator network surveys were conducted at Manor Woods Valley on July 13-14th between 10:00am-15:00pm, with consistent temperatures of 23-24°c and windspeeds up to 13mph. The surveys followed the UK POMS Flower-Insect Timed Count approach, with a 10-minute observation period within a 0.5 x 0.5m quadrat, noting each interaction between a pollinator and wildflower (POMS, 2025). Pollinators were classified into 10 categories: Honeybee, Bumblebee, Solitary Bee, Wasp, Hoverfly, Other Fly, Small Insects, Beetle, Butterflies and moths, and Other. Plants were classified to species level using Collins “Complete Guide to British Wildflowers”, and the number of floral units within each quadrat was counted using UK POMS guidelines (Sterry, 2008; PoMS, 2025).

10 sample locations within each grassland were generated randomly within ArcGIS Pro V. 3.5.2’s “generate random points” function (Figure 1) (Esri, 2026). Survey order for sites was randomised to avoid temporal influence on pollinator activity. While there is mixed evidence on the influence of edge effects on pollinator activity, potential influence was minimised by generating sample points within a buffer of site boundaries (Souza, Silva & Dodonov, 2025). However, due to the spatial limitations of the TOT and VHM sites, these buffers were only 2m, compared to 5m for TWM. To ensure spatial breadth of samples, and to avoid spatial autocorrelation, generated points were at least 4m apart from each other.

To compare site plant-pollinator networks, network indices were extracted through analysis in RStudio v.4.5.2, within the “bipartite” package (Dormann, Gruber & Fruend, 2008, Posit, 2026). These include “Shannon’s Diversity Index”, a measurement of interaction diversity; “link density”, “pollinator generality” and “plant vulnerability”, measures of network robustness; and “web asymmetry” and “connectance”, measures of network structure (Dormann, Fruend and Gruber, 2017). Data was pooled to generate site network figures; however, network indices were calculated using data from each individual observation sample. Individual sample data was also used to investigate species influence within sites, with the use of the “bipartite” and “dplyr” packages to generate relevant indices (Dormann, Gruber & Fruend, 2008; Wickham *et al.*, 2026). These include “normalised degree” and “species strength” as a measure of centrality and network importance respectively. Data was compared using non-parametric Kruskall-Wallis tests, as all data violated the assumptions of a parametric t-test.



Contains OS data © Crown Copyright and database right 2026. Contains data from OS Zoomstack

Figure 1: Manor Woods Valley Sites and Sample Locations. Aerial Images from Edina (2026)

Results

Overall, 155 plant-pollinator interactions were recorded, consisting of 10 species of wildflower and 9 groups of pollinators across 30 quadrat samples. The greatest diversity of wildflowers was recorded in TOT (9 species), with the majority of floral units consisting of Ragwort (*Jacobaea vulgaris*) (27%) and Lady's Bedstraw (*Galium verum*) (22%) (fig. 2). This was followed by VHM (7 species), of which Bird's-foot trefoil (*Lotus corniculatus*) (39%) and Field Binweed (*Convolvus arvensis*) (31%) had the most prominent flowering units (fig. 2). Finally, TWM consisted of 6 species, of which Wild Carrot (*Daucus carota*) (39%) *and L. corniculatus* (30%) were the most numerous flowering unit (fig.2). There was no significant difference in the average number of plant species per quadrat between the sites ($\chi^2(2) = 1.53$, $p > 0.4$), nor the number of pollinator groups ($\chi^2(2) = 2.26$, $p > 0.3$).

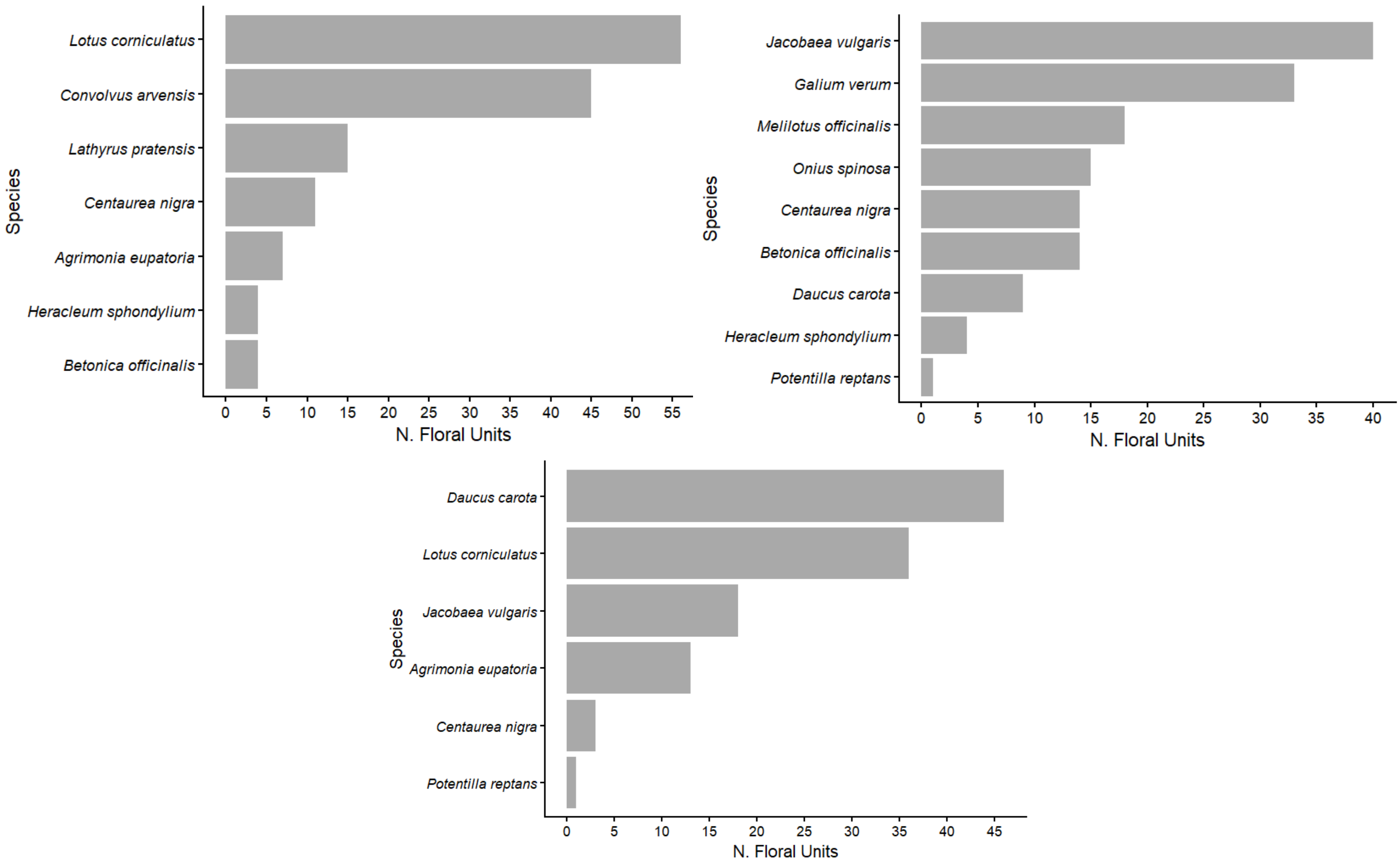


Figure 2: *Number of Floral Units at Manor Woods Valley*. Top Left: TWM, Top Right: TOT, Bottom-Centre: TWM

Bipartite Network analysis revealed the greatest number of unique plant-pollinator interactions was found in VHM (17) (figure 3), followed by TOT (13) (figure 4) and TWM (5) (figure 5). The 2 dominant interactions at VHM occurred between honeybees and *L. corniculatus*, alongside small insects and *C. arvensis*, accounting for 12% of the VHM interactions each. Honeybees accounted for 32% of the total interactions made at VHM, pollinating every plant species observed. Despite this, no significant difference was found in normalised degree ($\chi^2(5) = 3.9$, $p>0.5$) or species strength ($\chi^2(5) = 2.59$ $p>0.7$) within pollinator groups. Similarly, *C. arvensis* accounted for 44% of observed interactions, yet no differences were found in normalised degree ($\chi^2(4)=5.3$, $p>0.2$) or species strength ($\chi^2(4)=4.49$, $p>0.3$)

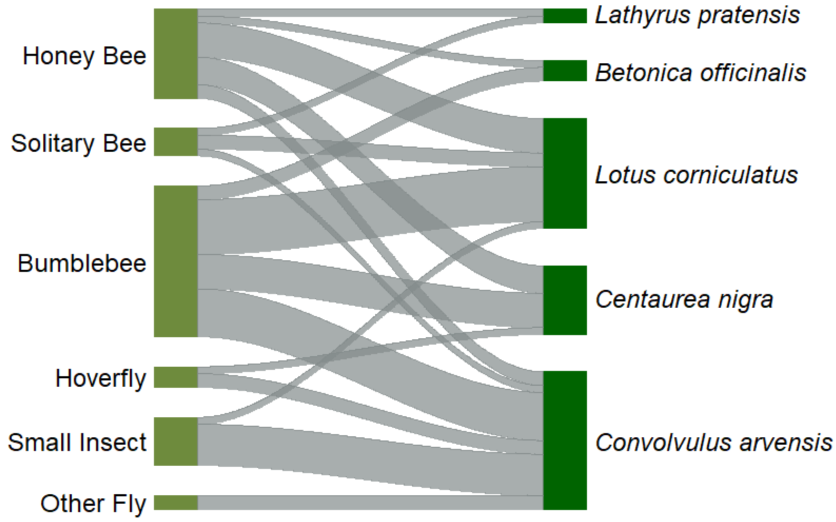


Figure 3: Valley Heights Meadow Plant-Pollinator Network

Within TOT, the dominant pollinator-plant interaction occurred between hoverflies and *D. carota*, occurring in 19% of observations. However, both hoverflies and other flies were the most active pollinators, each contributing 23.8% to the total pollinator interactions recorded. No significant differences were found in normalised degree ($\chi^2(6)=7.54$, $p>0.2$) or species strength ($\chi^2(6)=8.48$, $p>0.2$) between pollinator groups. *D. carota* was the most frequently visited wildflower, accounting for 47% of observed interactions, yet no significant differences were found in normalised degree ($\chi^2(4)=7.8$, $p>0.2$), or species strength ($\chi^2(4)=7.8$, $p>0.09$).

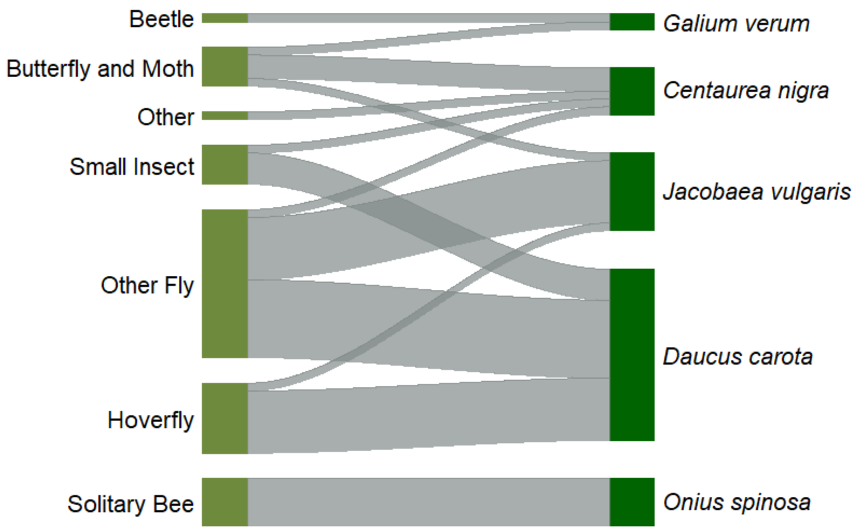


Figure 4: The Orchard Triangle Plant-Pollinator Network

Both other fly and *D. carota*, alongside small insect and *D. carota* contributed the most to pollinator-plant observations within TWM (36% each). Other fly was the dominant pollinator group, consisting of 54% of interactions, yet no significant differences were found in normalised degree ($\chi^2(2) = 1.4$, $p>0.4$), species strength ($\chi^2(2) = 4.15$, $p>0.1$), or partner diversity ($\chi^2(2) = 1$, $p>0.6$). A Kruskal-Walls test revealed *D. carota* had significantly central role within the wildflower community, with a significant normalised degree result ($\chi^2(3) = 8$, $p<0.05$), alongside a post-hoc Dunn's test with Holm correction revealing *D. carota* had a significantly greater normalised degree score (Mdn = 1, IQR = 0), than *J. vulgaris* (Mdn = 0.5, IQR = 0). However, no difference in species strength was found ($\chi^2(3) = 4.33$, $p>0.05$), suggesting the importance of this centrality to the community may be minimal.

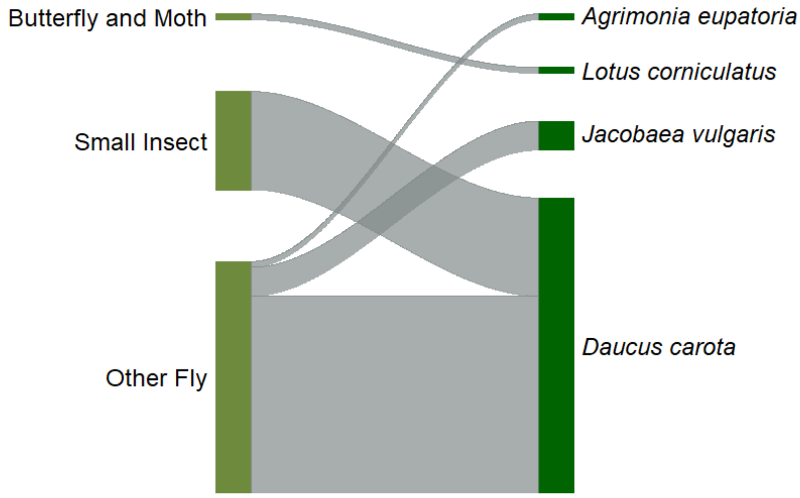


Figure 5: The Wildflower Meadow Plant-Pollinator Network

Despite the differences in the structure of these networks, there were no significant differences found in the network level web asymmetry ($\chi^2(2) = 1.65$, $p>0.4$) or connectance ($\chi^2(2) = 0.405$, $p>0.8$). Additionally, the diversity of interactions did not differ between sites, with no significant difference found in the Shannon's Index of the interactions ($\chi^2(2)=1.53$, $p>0.4$). Finally, no differences were found in the vulnerability of the sites, with no significant difference in link density ($\chi^2(2)=0.592$, $p>0.7$), pollinator generality ($\chi^2(2)=0.0461$, $p>0.9$) nor plant vulnerability ($\chi^2(2)=0.789$, $p>0.6$). Site level network indices are found in Table 2.

Table 1: Network indices generated from plant-pollinator analyses across the 3 study sites at Manor Woods Valley.

Indices	VHM	TWM	TOT
Web Asymmetry	0.0909	-0.143	0.167
Connectance	0.567	0.417	0.371
Shannon	2.58	1.02	2.18
Link Density	3.37	1.609	2.16
Generality	3.19	1.44	1.89
Vulnerability	3.56	1.78	2.43

Discussion

Pollinator network surveys provide key insights into the plant-pollinator interactions which underline ecosystem functionality, revealing the impact of management and anthropogenic pressures on ecosystem health (Kaiser-Burnbury *et al*., 2017; Weiner *et al*., 2014). Grasslands act as a major source of resources for insect pollinators within urban environments like MWV (Dylewski, Maćkowiak and Banaszak-Cibicka, 2019; Sexton and Emery, 2020). Hence, understanding how grassland habitats within MWV differ in their composition, structure and functionality can provide insights for potential management strategies for local pollinator populations.

There were clear compositional and structural differences between the 3 grassland habitats surveyed, with each site differing in dominant species floral units, and pollinator-plant interactions. Of these differences, the absence of bee-plant interactions within TWM is the most striking, with only one bee type found in the adjacent site, TOT. Declines in bee diversity are often correlated with increasing land-use intensity and lower quality habitat (Ekroos *et al*., 2020). In their place, flies were the most active pollinators within TWM, which represent important contributors to plant diversity (Ssymank *et al*., 2008). While flies replace bees as dominant pollinators as niches shift with elevation increases, that is likely not the case in this context (McCabe and Cobb, 2021). For instance, *D. carota* had the most numerous floral units within TWM, of which honeybees are an important pollinator (Bareke *et al*., 2025). Further research is needed to assess the source of these differences; however, it has been suggested that decreased funding for mowing within TWM will result in biodiversity declines, which may explain these findings (MWVG, 2023).

One recommendation is to run community wildflower sowing activities around TWM and TOT, using bees as a focal pollinator type to encourage action. Bees are the most recognised and charismatic pollinator group and therefore may be more likely to encourage local participation (Sumner, Law and Cini, 2018). Wildflower sowing has been demonstrated to increase floral diversity within grasslands, improving resource provision and strengthening bee populations (Blackmore and Goulson, 2014). Additionally, maintaining annual mowing of all sites is essential to ensure low-nutrient, diverse grassland habitats (Smith, Barret and Milner, 2018). If funding costs for mowing are a future concern, the use of animal grazers such as goats may be an alternative to maintain this regulatory management naturally (MWVG, 2023; Tälle *et al*., 2016)

The pollinator networks surveyed in this report are only representative of the diversity present in July, during a long period of heatwaves in the UK (Met Office, 2026). This is particularly important for TWM, as typically, this habitat is dominated by Corky-Fruited Water Dropwort (*Oenanthe pimpinelloides*), which during the time of study was seeding and not attracting what is likely a complete pollinator community. Therefore, conducting repeats of this approach earlier in the season gives a better representation of the total diversity of these networks. Additionally, no significant differences at network level were found between the sites using bipartite analysis, despite clear lower diversity of interactions in TWM than TOT and VHM (Table 1). This is likely the result of low sampling numbers, with greater sampling effort needed in future repeats of these methods.

Acknowledgements

I would like to thank Peter Loy-Hancocks of the MWVG for the enlightening tour of the site and insights on its management.

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Appendix

Appendix 1: Accepted Risk Assessment for Survey Work

University of the West of England BRISTOL

Ref: R7435

Describe the activity being assessed:	Assessed by:	Endorsed by:
Off-campus postgraduate research activity. The activity will take place at the public nature reserve Manor Woods Valley in Bishopsworth, Bristol (see site location here) and will be carried out by a postgraduate student during daylight hours. The student will undertake a pollinator network survey across 3 accessible grasslands on site, which vary in age, size, management strategies and historic uses. Timed observation plots and vegetation surveys will be used in this project. The student will use the Flower-Insect Timed (FIT) counts approach, which involves observing and recording flowers and pollinating insects within a quadrat for a specified period (usually 10 minutes). The planned activity will take place in July, across 5 days, consisting of 3-4 hours of surveys per day UWE safe systems of work will be adhered to at all times, with particular attention paid to SS0W11 Incidental Exposure to Hazardous Microorganisms (see here).	Mark Ashby	Bethan Hindle
Who might be harmed: Student – Louis Amor **How many exposed to risk** 1	**Date of Assessment:** 22/06/26	**Review date(s):** 22/06/27

Hazards Identified *(state the potential harm)*	Existing Control Measures	S	L	Risk Level	Additional Control Measures	S	L	Risk Level	By whom and by when	Date completed
Weather – exposure to cold, wet and windy weather, leading to illness or hypothermia.	Activity is scheduled to occur in July, when the weather is most likely to be sunny and warm.	3	2	6	Student will avoid working in poor weather conditions by planning work in conjunction with weather forecasts. If very poor working conditions are forecasted (e.g., an amber or	3	1	3	Student before the activity and	

Weather – exposure to sunny weather leading to sunburn.					red weather warning), the planned activity will be postponed for another day/cancelled. Work must not be conducted in the event of an amber or red weather warning. The student will check the weather forecast and any weather warnings on the day of the activity before departure. Student will assess weather on arrival and continue to assess weather throughout the activity. If the weather deteriorates, the student will consider briefly taking shelter somewhere on-site or ending the activity. The student will bring and wear appropriate clothing depending on the expected weather on the day. If the weather is sunny, the student will wear clothing that covers their arms and legs (for protection from the sun). If the weather is sunny, the student will apply sun cream to exposed skin and have a sunhat and sunglasses to hand. If the weather is frosty or icy, the student will wear warm hats and gloves to stay warm. The student will assess if paths are icy on departure and arrival, and will be careful when walking on icy paths, if it is safe to do so, to avoid slipping and falling. The student will bring a supply of water and food to maintain comfort levels throughout the day.				during the activity Student before leaving Student at survey Student before and throughout activity Student throughout the activity Student before the activity Student throughout the activity Student before and throughout the activity	

Personal injury from falling timber.	The student will not undertake the activity in areas underneath damaged, detached, or dead-hanging branches, where there are signs of unstable trees or controlled felling, and will respect any relevant signage.	4	1	4	The student will stop the activity during high winds and lightning conditions	4	1	4	The student throughout the activity.	
Lone working. Working in remote areas. Not being able to summon help if needed. Personal attack leading to personal injury.	Student will be working in a public nature reserve and will not be working in remote areas. Student is advised to carry a charged mobile phone with them at all times. The mobile coverage across the site is good.	4	1	4	The student will always carry a charged mobile phone and will bring a portable charger (battery pack and cable). The student will make sure that their location can be tracked and updated on an app i.e life360. Be vigilant and know the area and where you can go in case someone is showing signs of inappropriate behaviour or aggression. If someone is following you, walk to an area where there are more people, and if needed, contact friends/family/staff or emergency services. The student will inform Mark Ashby of their location and expected return time before the activity. Mark Ashby or one of the technicians should call the student or emergency contact if the student does not return when they are expected to return; the student will inform Mark Ashby of their personal contact details and emergency contact details (i.e. telephone number).	4	1	4	Student, On the day of the activity Student, throughout the activity Student, throughout the activity Student, before the activity	
Slips/trips/falls when walking to the field sites leading to minor cuts and abrasions; broken limbs; sprained ankles.	Student is advised to wear appropriate footwear, i.e., sturdy walking boots with good ankle support. Student is advised to take care and to watch footing whilst walking during the activity particularly where the ground may be icy, muddy, wet or slippery.	3	1	3	Wear light-coloured clothing with long trousers tucked into their socks. Wear appropriate footwear, i.e., sturdy walking boots with good ankle support.	3	1	3	Student throughout the activity	

					Watch your footing while walking during the activity, particularly where the ground may be wet, flooded, muddy, or slippery.				Student throughout activity Student throughout the activity	
The contraction of Lyme's disease from a tick bite.	Tick bites are more common in Spring/Summer months, than in Autumn/Winter months. Student acknowledges that working in the field carries the risk of picking up ticks. Student is advised to wear long trousers tucked into their socks so that ticks cannot attach or climb up the leg. Ideally, wear light-coloured clothing so that ticks are visible.	3	1	3	Check for ticks on your body after you have been out in the field. If ticks are found, remove them as soon as possible with a tick-removing tool. These can be/will be part of the first-aid kit. Ask technical or academic staff to provide one before beginning the activity. Student will carry a first aid kit with them. If you develop any of the following symptoms: Headache, Extreme Fatigue, a typical bull's eye rash, spreading outwards, not necessarily in the area of the bite, seek medical advice and mention you have experienced a tick bite. Awareness and knowledge of dangerous species, and where they could be.	3	1	3	Student during and after the activity. Student during and after activity Student during activity Student, if concerned Student throughout the activity	
Cuts, bites or adverse reactions caused by plants and animals, e.g. contact with nettles, dogs, wild mammals, birds, biting/stinging insects, etc, leading to rashes, physical injury.	Student is advised by Mark Ashby to: 1) Avoid coming into extensive contact with plants, and wear long trousers & sleeves when working in long grass. 2) Avoid close proximity with insect nests (e.g. ant, bee, wasp). 3) not provoke or approach wildlife (e.g. wild mammals, birds or reptiles), ensure minimal disturbance of habitats and avoid contact with pets.	3	2	6	Follow the rules outlined in existing control measures. In the event of a minor sting/cut/bite, participants to consider seeking medical attention, depending on severity., The student will carry a first aid kit with them. In the event of a moderate sting/cut/bite (such as a large cut or an animal bite), the	3	1	3	Student during the activity Student throughout activities. Student throughout activity	

					student should seek emergency medical attention (call 111 or 999). Any student hypersensitive to insect bites or plants should bring personal medicines.				Student throughout activity	
Contact with plants/animals leading to allergic reaction or anaphylactic shock.		5	1	5	Student to inform Mark Ashby of any existing allergies relevant to the activity. Student responsible for carrying their own allergy medication.	4	1	4	student, throughout activities. Student throughout activity	
Personal injury from contact with grazing animals, as a result of a personal attack.	The student will avoid areas where grazing animals are present if possible. Respect livestock signage and use designated paths	5	1	5	Do not approach grazing animals directly and maintain a reasonable distance from the animals, walking quietly and quickly and leaving any gates as they are found.	5	1	5	The student throughout the activity	
Coming into contact with moving road traffic or off-road vehicles can lead to physical injury	No activities will take place close to the roadside.	5	1	5	Be aware of traffic. Do not cross roads on blind bends or near hill crests. If any roads are to be crossed, use designated crossing points where possible. Stay vigilant for off-road vehicles (e.g. 4x4s, golf buggy, lawnmower), ensure you are visible to any in nearby proximity, and avoid getting close to them when moving.	5	1	5	Student, throughout activities.	
Incidental ingestion of dirty water, dirt or faeces when eating leading to infection and severe illness. Agents that can cause GI tract infections are common in the environment, particularly where animal excrement is present.	Student has been informed before the activity about the risk of contracting an infection through incidental ingestion or inhalation of contaminated matter during fieldwork The planned activities do not require any interaction or handling of soil. CHSS SS0W11 'Incidental Exposure to HG2 Microorganisms during Environmental	4	1	4	The student will maintain normal hygiene practices, such as washing hands thoroughly with soap and running water before any lunch or refreshment breaks using the handwashing facilities. The student will avoid contact with animal excrement and will wash hands (with running water and soap) as soon as possible if contact occurs.	4	1	4	The student, before and during the activity. The student, before and during the activity.	

Other infectious agents in the environment, such as *Salmonella*, *E. coli* O157, *Campylobacter* and other infectious agents	Fieldwork, Field Trips or Similar Activities in the UK' will be adhered to at all times (see here).				A copy of SSOW 11 will be provided to the student				Mark Ashby, before any work begins	

RISK MATRIX: (To generate the risk level).

Very likely 5	**5**	**10**	**15**	**20**	**25**
Likely 4	**4**	**8**	**12**	**16**	**20**
Possible 3	**3**	**6**	**9**	**12**	**15**
Unlikely 2	**2**	**4**	**6**	**8**	**10**
Extremely unlikely 1	**1**	**2**	**3**	**4**	**5**
Likelihood (L) ↑ **Severity (S)** →	**Minor injury – No first aid treatment required 1**	**Minor injury – Requires First Aid Treatment 2**	**Injury - requires GP treatment or Hospital attendance 3**	**Major Injury 4**	**Fatality 5**

ACTION LEVEL: (To identify what action needs to be taken).

POINTS:	RISK LEVEL:	ACTION:
1 – 2	NEGLIGIBLE	No further action is necessary.
3 – 5	TOLERABLE	Where possible, reduce the risk further
6 - 12	MODERATE	Additional control measures are required
15 – 16	HIGH	Immediate action is necessary
20 - 25	INTOLERABLE	Stop the activity/ do not start the activity