How to Consider Terrestrial Invertebrates in Ecology Projects

Heliophanus dampfi

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CIEEM Webinar. 04 November 2020.

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Which of these sites is likely to support invertebrate communities of conservation importance, and warrants detailed survey to inform an Ecological Impact Assessment?

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Overview

- Why

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- Why… am I here?

Professional ecologist for over 15 years including:

- Previously Buglife planning casework officer
- Ecological consultant for 12 years

Much remains the same for invertebrates!

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Overview

- Why

- How

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Overview

- Why
  - Legislation
  - Conservation importance
  - Preliminary Ecological Appraisal
  - Ecological Impact Assessment
  - Mitigation, compensation, enhancement

- How

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Overview

- Why
  - Legislation
  - Conservation importance
  - Preliminary Ecological Appraisal
  - Ecological Impact Assessment
  - Mitigation, compensation, enhancement

- How
  - Stage 1: Desk Study
  - Stage 2: Initial Invertebrate Site Assessment
  - Stage 3: Detailed Surveys

What Are Invertebrates?

- The vast majority of species in terrestrial ecosystems.

What Are Invertebrates?

- The vast majority of species in terrestrial ecosystems.

98% of all known terrestrial and freshwater animal species in Scotland are invertebrates.*

*Ward, S.D. 1997. *The number of terrestrial and freshwater species in Scotland. Scottish Natural Heritage Review No. 84.* Scottish Natural Heritage, Battleby.

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Butterflies (sub-group of Lepidoptera): 59 species

(UK species numbers)

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Spiders (Araneae): >600 species

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Butterflies (sub-group of Lepidoptera): 59 species

Spiders (Araneae): >600 species

Beetles (Coleoptera):

>4,000 species

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Butterflies (sub-group of Lepidoptera): 59 species

Spiders (Araneae): >600 species

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True-flies (Diptera):

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Butterflies (sub-group of Lepidoptera): 59 species

Spiders (Araneae): >600 species

Beetles (Coleoptera):

>4,000 species

True-flies (Diptera):

>5,000 species

Parasitoid wasps (sub-group of Hymenoptera): >6,000 species

(UK species numbers)

Why Consider Invertebrates?

- Legislation
- Conservation importance
- Preliminary Ecological Appraisal
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Why Consider Invertebrates?

- Legislation
  - The Habitats Directive
    - European Protected Species
    - Special Areas of Conservation (SACs)
  - The Wildlife and Countryside Act
    - Schedule 5 species
  - Sites of Special Scientific Interest (SSSIs)
  - Biodiversity Duty
    - Scotland: Scottish Biodiversity List
    - England: NERC Section 41
    - Wales: NERC Section 42
    - Northern Ireland: Northern Ireland Priority Species

Why Consider Invertebrates?

- Conservation importance
  - IUCN Red List
  - Local Red Data Books
  - Joint Nature Conservation Committee (JNCC)
  - Local Biodiversity Action Plans

Why Consider Invertebrates?

- Conservation importance
  - **IUCN Red List**
  - **Local Red Data Books**
  - **Joint Nature Conservation Committee (JNCC)**
  - Local Biodiversity Action Plans

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Abbreviation	Status	Definition
CE	Critically Endangered	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the IUCN criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.
EN	Endangered	A taxon is Endangered when the best available evidence indicates that it meets any of the IUCN criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.
VU	Vulnerable	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.
NT	Near Threatened	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now (or Lower risk- conservation dependant in the pre-1994 criteria), but is close to qualifying for or is likely to qualify for a threatened category in the near future. In Britain, this category includes species which occur in 15 or fewer hectads but do not qualify as Critically Endangered, Endangered or Vulnerable.

IUCN. 2012. *IUCN Red List Categories and Criteria: Version 3.1. Second edition.* IUCN, Gland, Switzerland and Cambridge, UK.

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Abbreviation	Status	Definition
RDB1	Red Data Book 1	Endangered: Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included are taxa which are known from a single location or only one 10 km square, taxa which occur in habitats known to be especially vulnerable, and taxa which have shown a continuous decline over the last 20 years and now exist in five or fewer 10 km squares.
RDB2	Red Data Book 2	Vulnerable: Taxa believed likely to move into the Endangered (RDB1) category in the near future. This includes taxa of which most or all populations are declining as a result of over-exploitation, extensive destruction of habitat or other environmental factors; taxa with populations that have been seriously depleted and whose ultimate security is not yet assured; and taxa with populations that may still be abundant but are under threat from serious adverse factors throughout their range.
RDB3	Red Data Book 3	Rare: Taxa with small populations that are not at present Endangered (RDB1) or Vulnerable (RDB2), but are at risk. In the UK this is considered to be species which exist in 15 or fewer 10 km squares.

Shirt, D.B. 1987. *British Red Data Books: 2 Insects.* Joint Nature Conservation Committee (JNCC)/English Nature.

Bratton, J.H. 1991. *British Red Data Books: 3. Invertebrates other than insects.* Joint Nature Conservation Committee (JNCC)/English Nature, Peterborough.

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Abbreviation	Status	Definition
RDBK / DD	Red Data Book K / IUCN Data Deficient	Insufficiently Known: Taxa suspected to be of conservation concern but which are data deficient and so cannot be assigned to other categories with confidence.
NR	Nationally Rare	Occurring in 15 or fewer hectads in Great Britain.
NS	Nationally Scarce	Taxa which are recorded in 16-100 hectads (10km squares) but not included in one of the Red List Categories.
Local / Very Local	Very Local	Described as locally or very locally distributed within relevant nation or regional context in literature. Usually qualitative.

IUCN. 2012. *IUCN Red List Categories and Criteria: Version 3.1. Second edition.* IUCN, Gland, Switzerland and Cambridge, UK.

Shirt, D.B. 1987. *British Red Data Books: 2 Insects.* Joint Nature Conservation Committee (JNCC)/English Nature.

Bratton, J.H. 1991. *British Red Data Books: 3. Invertebrates other than insects.* Joint Nature Conservation Committee (JNCC)/English Nature, Peterborough.

http://data.jncc.gov.uk/data/478f7160-967b-4366-acdf-8941fd33850b/conservation-designations-uktaxa-spreadsheet-constituent-lists.pdf

Why Consider Invertebrates?

- Preliminary Ecological Appraisal
  - Rapid assessment of ecological features present, or potentially present, normally at early stage of project.
  - Purpose is to inform 'clients' by:
    - identifying likely ecological constraints
    - identifying potential mitigation measures and ecological enhancement opportunities
    - identifying any additional surveys that may be required to inform an Ecological Impact Assessment

CIEEM. 2017. *Guidelines for Preliminary Ecological Appraisal, 2nd edition.* Chartered Institute of Ecology and Environmental Management, Winchester.

Why Consider Invertebrates?

- Ecological Impact Assessment

Ecological Impact Assessment is the process of identifying, quantifying and evaluating the potential impacts of defined actions on ecosystems or their components (Treweek, 1999).

Purpose is to provide 'decision-makers' with information about the likely significant ecological effects associated with a project (in the absence of and with mitigation where this is possible).

CIEEM. 2018. *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.1.* Chartered Institute of Ecology and Environmental Management, Winchester.

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You can't assess impacts if you don't know what's there!

CIEEM. 2018. *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.1.* Chartered Institute of Ecology and Environmental Management, Winchester.

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THOUGHT TO BE EXTINCT FOR OVER 100 YEARS AND NEVER BEFORE RECORDED IN SCOTLAND!

Palloptera laetabilis © Steven Falk

https://www.flickr.com/photos/63075200@N07/collections/

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Why Consider Invertebrates?

- Ecological Impact Assessment
  - Surveys to inform baseline
  - Baseline description and impact assessment
    - Habitats
    - Communities
    - Individual species

Why Consider Invertebrates?

- Ecological Impact Assessment: Features
  - Habitats

Conservation status is determined by the sum of the influences acting on the habitat and its typical species, that may affect its long-term distribution, structure and functions, as well as the long-term survival of its typical species within a given geographical area.

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Why Consider Invertebrates?

- Ecological Impact Assessment: Features
  - Habitats

Conservation status is determined by the sum of the influences acting on the habitat **and its typical species**, that may affect its long-term distribution, structure and functions, as well as the long-term survival **of its typical species** within a given geographical area.

Why Consider Invertebrates?

- Ecological Impact Assessment: Features
  - Communities: SSSI Selection Criteria

    - High quality communities in regional context.
    - Sole representatives of particular habitats in regional context.

Curson, J., Howe, M., Webb, J., Heaver, D. & Tonhasca, A. 2019. *Guidelines for the Selection of Biological SSSIs. Chapter 20 Terrestrial and Freshwater Invertebrates.* Joint Nature Conservation Committee, Peterborough.

Why Consider Invertebrates?

- Ecological Impact Assessment: Features
  - Individual species
    - Legally protected, conservation importance, etc.
    - SSSI Selection Criteria:

      Species as above, but also where, for example, a site is the only known location for a Nationally Scarce species within a region, or where there are no SSSIs which include these species. (It may make more sense to include multiple such species within a habitat-based species assemblage.)

Curson, J., Howe, M., Webb, J., Heaver, D. & Tonhasca, A. 2019. *Guidelines for the Selection of Biological SSSIs. Chapter 20 Terrestrial and Freshwater Invertebrates.* Joint Nature Conservation Committee, Peterborough.

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ANNEX 1: FULL SPECIES LIST TABLE

The following table provide a full list of species recorded during 2019 invertebrate surveys at Hamilton Low Parks SSSI. Species with conservation status or rarity designation are highlighted by grey shading. The introduced spider, *Rugathodes sexpunctatus*, is highlighted by black shading. 'M' indicates male specimens, and 'F' females.

Order	Family	Taxon	OS Grid Reference	Number	Sex	Stage	Date	Conservation Status	Sampling Method	Recorder	Identification	Determiner
Araneae	Amaurobiidae	*Amaurobius fenestralis*	NS7151257588	1	M	Immature	10/09/2019		Bark Trap	N. Currie / C. Denham	N. Currie	C. Cathrine
Araneae	Amaurobiidae	*Amaurobius fenestralis*	NS7156157558	1	F	Adult	10/09/2019		Bark Trap	N. Currie / C. Denham	N. Currie	C. Cathrine
Araneae	Amaurobiidae	*Amaurobius fenestralis*	NS7156857563	14	9M, 5F	Adult	10/09/2019		Bark Trap	N. Currie / C. Denham	N. Currie	C. Cathrine
Araneae	Amaurobiidae	*Amaurobius fenestralis*	NS7156957541	8	2M, 6F	Adult	10/09/2019		Bark Trap	N. Currie / C. Denham	N. Currie	C. Cathrine
Araneae	Amaurobiidae	*Amaurobius fenestralis*	NS7162757485	8	3M, 5F	Immature	10/09/2019		Bark Trap	N. Currie / C. Denham	N. Currie	C. Cathrine
Araneae	**Aranaeidae**	***Larinioides patagiatus***	**NS7155857554**	**1**	**M**	**Adult**	**18/07/2019**	**NS**	**Deadwood Search**	**C. Cathrine**	**C. Cathrine**	**C. Cathrine**
Araneae	Linyphiidae	*Bathyphantes gracilis*	NS7147457591	1	M	Adult	16/07/2019		Bugvac	C. Cathrine	N. Currie	C. Cathrine
Araneae	Linyphiidae	*Dicymbium nigrum*	NS7147457591	1	F	Adult	16/07/2019		Bugvac	C. Cathrine	N. Currie	C. Cathrine
Araneae	Linyphiidae	*Dicymbium nigrum*	NS7146757587	1	F	Adult	10/09/2019		Pitfall Trap	N. Currie / C. Denham	N. Currie	C. Cathrine
Araneae	Linyphiidae	*Diplocephalus cristatus*	NS7155857554	1	F	Adult	16/07/2019		Bugvac	C. Cathrine	N. Currie	C. Cathrine
Araneae	Linyphiidae	*Diplocephalus latifrons*	NS7147457591	3	F	Adult	18/07/2019		Leaf Litter Seive	C. Cathrine	N. Currie	C. Cathrine
Araneae	Linyphiidae	*Diplocephalus latifrons*	NS7155857554	1	M	Immature	18/07/2019		Leaf Litter Seive	C. Cathrine	N. Currie	C. Cathrine
Araneae	Linyphiidae	*Diplocephalus latifrons*	NS7146757587	1	F	Adult	13/08/2019		Pitfall Trap	N. Currie / C. Denham	N. Currie	C. Cathrine
Araneae	Linyphiidae	*Diplocephalus latifrons*	NS7157057554	4	1M, 3F	Adult	13/08/2019		Pitfall Trap	N. Currie / C. Denham	N. Currie	C. Cathrine
Araneae	Linyphiidae	*Diplocephalus latifrons*	NS7157057554	3	F	Adult	10/09/2019		Pitfall Trap	N. Currie / C. Denham	N. Currie	C. Cathrine
Araneae	Linyphiidae	*Diplocephalus picinus*	NS7195456786	1	M	Adult	10/09/2019		Leaf Litter Seive	C. Denham	N. Currie	C. Cathrine
Araneae	Linyphiidae	*Helophora insignis*	NS7179957293	1	F	Adult	13/08/2019		Bugvac	N. Currie	N. Currie	C. Cathrine
Araneae	Linyphiidae	*Helophora insignis*	NS7195456786	2	F	Adult	13/08/2019		Bugvac	N. Currie	N. Currie	C. Cathrine
Araneae	Linyphiidae	*Helophora insignis*	NS7195456786	2	1M, 1F	Adult	10/09/2019		Bugvac	N. Currie	N. Currie	C. Cathrine
Araneae	Linyphiidae	*Helophora insignis*	NS7170857480	2	F	Adult	10/09/2019		Sweep	C. Denham	N. Currie	C. Cathrine
Araneae	Linyphiidae	*Labulla thoracica*	NS7151257588	2	F	Immature	10/09/2019		Bark Trap	N. Currie / C. Denham	N. Currie	C. Cathrine
Araneae	Linyphiidae	*Labulla thoracica*	NS7195456786	2		Adult	10/09/2019		Bugvac	N. Currie	N. Currie	C. Cathrine

Cathrine, C. & Currie, N. 2020. *Hamilton Low Parks SSSI saproxylic invertebrate survey. Scottish Natural Heritage Research Report No. 1194.* SNH, Inverness.

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Table 10. Summary of results

Group	Species Recorded	Saproxylic Species	Species with Conservation / Rarity Status
Araneae (spiders)	22		• *Larinioides patagiatus* NS
Coleoptera (beetles)	55	• *Dromius quadrrimaculatus* • *Salpingus planirostris* • *Atrecus affinis* • *Quedius xanthops* • *Austrolimnophila ochracea*	• *Pterostichus cristatus* NS • *Cercyon melanopcephalus* SBL • *Megasternum concinnum* SBL • *Quedius xanthops* NS
Dermaptera (earwigs)	1		
Diptera (true flies)	25	• *Austrolimnophila ochracea*	
Chilopoda (centipedes)	2		
Diplopoda (millipedes)	4		
Hemiptera (true bugs)	10		
Hymenoptera (bees, wasps, ants, and sawflies)	3		
Isopoda (woodlice)	2		
Opiliones (harvestmen)	10		
Pseudoscorpiones (pseudoscorpions)	1		
Pulmonata (slugs and snails)	6		
Total	**141**	**5**	**3 NS, 2 SBL**

Cathrine, C. & Currie, N. 2020. *Hamilton Low Parks SSSI saproxylic invertebrate survey.* Scottish Natural Heritage Research Report No. 1194. SNH, Inverness.

Why Consider Invertebrates?

- Mitigation, compensation, enhancement
  - Planting schemes
  - Habitat replacement
  - Habitat creation
  - Micro-habitat creation
  - Translocation

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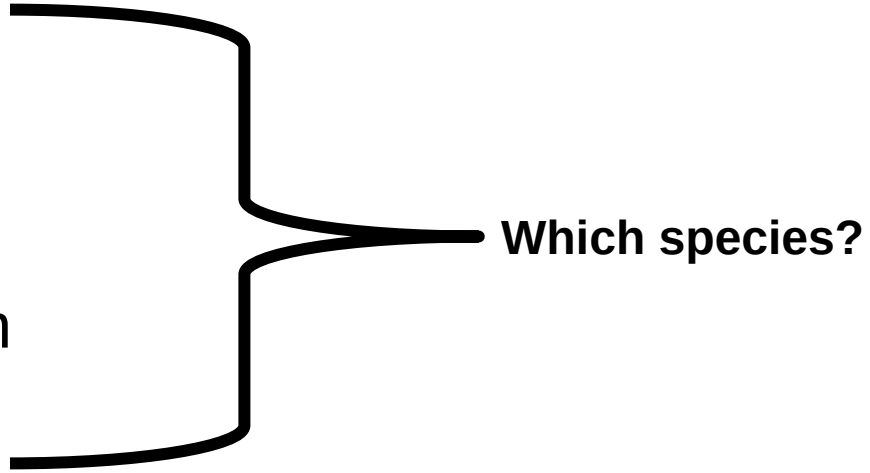

Planting

Food plant:

labiates

Planting

Food plant:

labiates

Nest site:

deadwood

Habitat / Micro-habitat

Bolitophagus reticulatus

Fomes fomentarius

Wood Ant Translocation

Cathrine, C. 2015. Wood Ant Nest Translocations. *In Practice* 89, 14-18.

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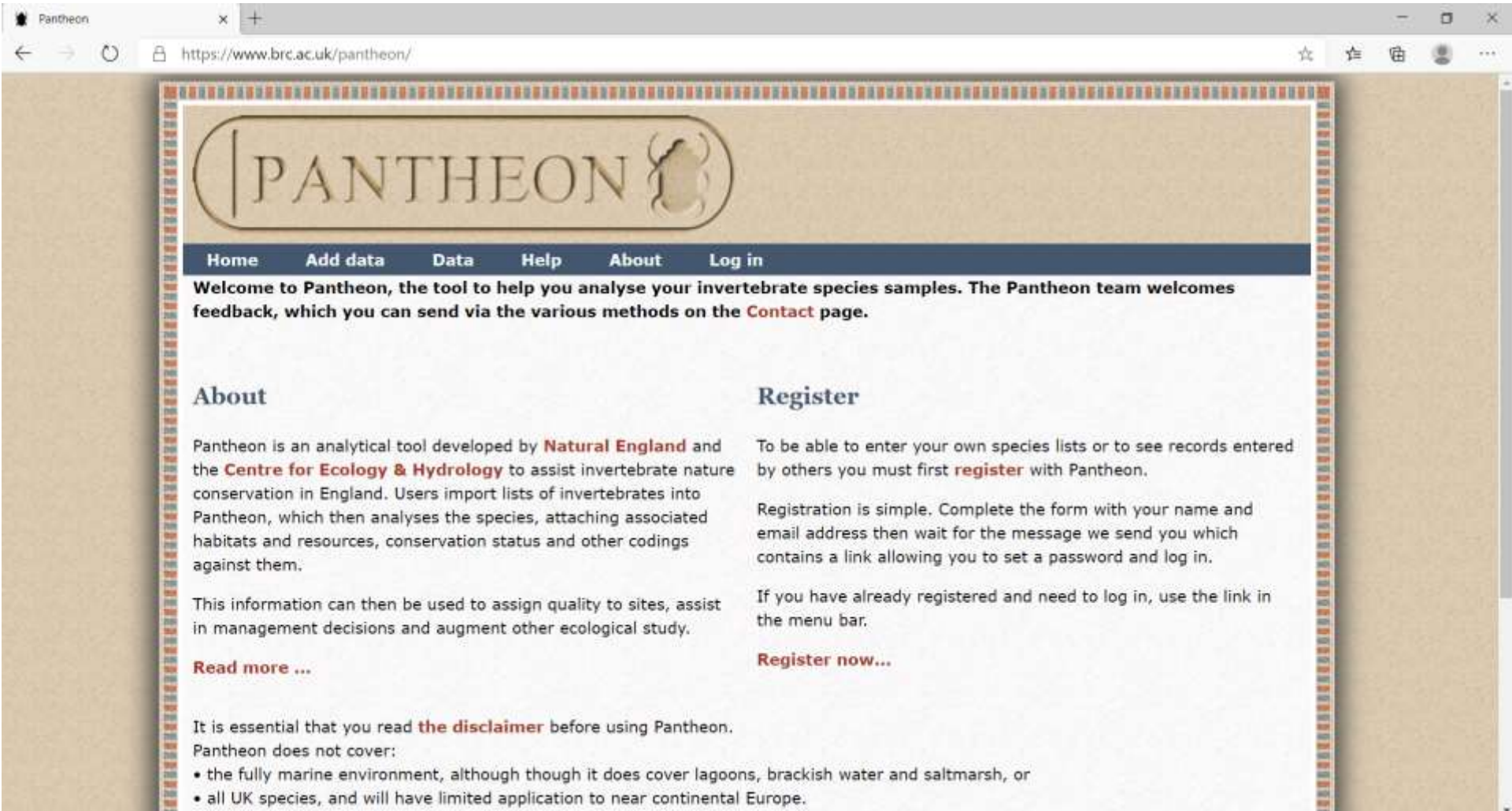
www.brc.ac.uk/pantheon/



How to Consider Invertebrates?

- Stage 1: Desk Study
- Stage 2: Initial Invertebrate Site Assessment
- Stage 3: Detailed Surveys

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Ensures proportionate approach appropriate to each site / project.

How to Consider Invertebrates?

- Stage 1: Desk Study

  - NBN
  - Local records centres
  - National recording schemes
  - Site Condition Monitoring
  - Habitat data (Phase 1 / UKHab / NVC)

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- Stage 1: Desk Study

  - NBN
  - Local records centres
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  - Habitat data (Phase 1 / UKHab / NVC)

  Ensure licences allow commercial use!

How to Consider Invertebrates?

- Stage 2: Initial Invertebrate Site Assessment
  - Purpose is to determine if targeted detailed invertebrate surveys are required, and, if so, to inform design.
  - Site visit by suitably experienced invertebrate specialists to assess habitat suitability for supporting invertebrate communities of conservation importance
  - Varied habitat structure is of particular importance to invertebrate communities

How to Consider Invertebrates?

- Stage 2: Initial Invertebrate Site Assessment
  - Expert judgement essential, but some key habitats:
- Semi-natural broad-leaved woodland (and native pine woodland in Scotland)
- Flower-rich grasslands
- Peatland
- Wetlands (e.g. damp flushes, ponds, streams, rivers, wet woodland and coastal habitats)
- Open Mosaic Habitat on Previously Developed Land (OMH) (also known as ‘brownfield’)

How to Consider Invertebrates?

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  - Expert judgement essential, but some key habitats:
    - Semi-natural broad-leaved woodland (and native pine woodland in Scotland)
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    - Peatland
    - Wetlands (e.g. damp flushes, ponds, streams, rivers, wet woodland and coastal habitats)
    - Open Mosaic Habitat on Previously Developed Land (OMH) (also known as ‘brownfield’)
    - Other unusual / specialist habitats (e.g. mountains, vegetated shingle, machair, high quality heathland etc.)

How to Consider Invertebrates?

- Stage 2: Initial Invertebrate Site Assessment
  - Open Mosaic Habitat on Previously Developed Land

    - Can support invertebrate communities as rich, diverse, and of similar conservation importance as broad-leaved woodland.
    - Offers complex habitat structure with a range of micro-habitats.

Criteria used to identify and define Open Mosaic Habitat on Previously Developed Land (OMH) (after Riding *et al.* 2010)

Criterion	Description
1	The site is at least 0.25 ha in size.
2	Known history of disturbance at the site or evidence that soil has been removed or severely modified by previous use(s) of the site. Extraneous materials/substrates such as industrial spoil may have been added.
3	The site contains some vegetation. This will comprise early successional communities consisting mainly of stress tolerant species (e.g. indicative of low nutrient status or drought). Early successional communities are composed of a) annuals or b) mosses/liverworts or c) lichens or d) ruderals or e) inundation species or f) open grassland or g) flower-rich grassland or h) heathland.
4	The site contains un-vegetated, loose bare substrate and pools may be present.
5	The site shows spatial variation, forming a mosaic of one or more of the early successional communities plus bare substrate, within 0.25 ha.

Riding, A., Critchley, N., Wilson, L. & Parker, J. 2010. *Definition and mapping of open mosaic habitats on previously developed land: Phase 1. Defra Research Report WC0722.* Department for Environment Food and Rural Affairs, London.

Example Habitat Features

Broad Habitat	Invertebrate Habitat Features
Semi-natural broad-leaved woodland / native pine woodland	Diverse habitat structure including clearings Diverse age structure Diverse native tree species mix Diverse understory species mix Range of fungi Veteran trees with deadwood features (e.g. rot holes and sap runs) Range of deadwood habitats, with renewal sources Wet areas Bare patches South-facing slopes
Flower-rich grasslands	Diverse habitat structure Diverse species mix Bare patches

Example Habitat Features

Broad Habitat	Invertebrate Habitat Features
Peatland	Diverse habitat structure Bare patches Sparsely vegetated peat Active peat-forming sphagnum Pools Diverse plant mix
Wetlands	Many invertebrate species of conservation importance are associated with wetland habitats, such as flushes, wet grasslands, wet woodland, and coastal habitats. In addition, many invertebrate species of conservation importance with terrestrial adult stages rely on wetlands, ponds, streams, rivers, lochs / lakes, and exposed riverine sediments for larval stages.

Example Habitat Features

Broad Habitat	Invertebrate Habitat Features
Open Mosaic Habitat on Previously Developed Land (Brownfield)	Former industrial sites with mosaics of different habitat types in close proximity to one another, including: • bare/sparsely vegetated ground • species-rich early successional vegetation • woodland (including deadwood) • ephemeral wetlands • south-facing slopes can be important for supporting invertebrates such as solitary bees

How to Consider Invertebrates?

- Stage 2: Initial Invertebrate Site Assessment
  - Needs to be undertaken by an experienced invertebrate specialist, as is currently subjective.
  - Could be undertaken alongside Extended Phase 1 habitat survey if surveyor also has suitable invertebrate skills and experience (allow sufficient survey time).
  - UK Habitat Classification hierarchical approach could offer excellent opportunities to gather data useful to inform invertebrate experts, and may increase efficiency in Stage 2 assessments.

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How to Consider Invertebrates?

- Stage 2: Initial Invertebrate Site Assessment

Key references used to design approach:

Buglife. 2009. *Planning for Brownfield Biodiversity: A best practice guide.* Buglife – The Invertebrate Conservation Trust, Peterborough.

Buglife. 2016. *Good planning practice for invertebrates: surveys.* Buglife – The Invertebrate Conservation Trust, Peterborough.

English Nature. 2005. *Organising surveys to determine site quality for invertebrates. A framework guide for ecologists.* English Nature, Peterborough.

Gibson, C.W.D. 1998. *Brownfield: Red data – The values artificial habitats have for uncommon invertebrates.* English Nature Resources Report No 273. English Nature.

Macadam, C., Bairner, S. & Cathrine, C. 2013. *Open mosaic habitats on previously developed land: survey and recommendations for habitat planning and management in Scotland. Scottish Natural Heritage Commissioned Report No. 606.*

How to Consider Invertebrates?

- Stage 3: Detailed Surveys
  - Must be designed and led by invertebrate specialists.
  - May target one or more indicator groups with large numbers of species including those of conservation importance associated with the specific habitat.
  - If multiple taxa are involved, it is likely multiple invertebrate specialists will be required.

How to Consider Invertebrates?

- Stage 3: Detailed Surveys
  - Range of survey methods.
  - At least three field visits between April and October – more may be required.
  - If there are target species ensure correct methods are used at the right time of year.
  - Sufficient laboratory time for identification.
  - Voucher specimens.
  - Reference collections and museums.

How to Consider Terrestrial Invertebrates in Ecology Projects

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Philodromus margaritatus

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Which of these sites is likely to support invertebrate communities of conservation importance, and warrants detailed survey to inform an Ecological Impact Assessment?

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8.

Conclusions

- Invertebrates are a major component of ecosystems, and the foundation of most ecosystem services.
- Legislation and conservation importance provide a framework.
- Invertebrates can be considered at habitat, community, or species level as appropriate in Ecological Impact Assessment.
- A staged approach ensures proportionate surveys:
  - Stage 1: Desk Study
  - Stage 2: Initial Invertebrate Site Assessment
  - Stage 3: Detailed Surveys

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Glyphipterix equitella

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