A survey of ponds at Barkbooth Lot Nature Reserve, Cumbria

A report for Freshwater Habitats Trust

Fenland Botanical surveys

July 2016

1. Introduction

Barkbooth Lot Nature Reserve has been identified as a Flagship Pond site by the Freshwater Habitats Trust due to its exceptional importance for freshwater biodiversity. The 27 hectare reserve is located near Crosthwaite in the south-eastern Lake District. The reserve contains oak woodland and open fell with a mosaic of bracken and unimproved grassland. There are also two small tarns (one fenced and used as a water supply) and a shaded woodland pond. The main tarn is notable for its rich invertebrate fauna including a population of Medicinal Leech.

A preliminary search of the tarn at SD 417 907 (henceforth 'the tarn') was made on 18th March 2016 by Martin Hammond and Garth and Sue Foster. The site was considered potentially suitable for the Endangered diving beetle *Hydroporus rufifrons*, which has its British stronghold in southern Lakeland. However, this species could not be found. The tarn and a small woodland pond near the reserve entrance were surveyed in more detail on 23rd June 2016 by Martin Hammond and Jonathan Graham. This survey used PSYM, the standard methodology for assessing the ecological quality of ponds (Environment Agency, 2002).

PSYM (**P**redictive **Sy**stem for **M**ultimetrics) uses six 'metrics' (measurements) representing important indicators of ecological quality. The three botanical metrics are:

- diversity of emergent and submerged plant species
- the number of uncommon species
- Trophic Ranking Score (TRS, an indication of nutrient status based on selected plant species)

The three invertebrate family-level metrics are:

- Average Score Per Taxon (ASPT, an estimation of biological water quality based on the sensitivity of different invertebrate families to organic enrichment)
- diversity of dragonfly, damselfly and alderfly families
- diversity of water beetle families

These are based on a timed sample with effort divided equally between each meso-habitat present within the pond (e.g. submerged vegetation, open water, floating-leaved vegetation). PSYM requires identification of invertebrates to family level only but in this survey material was identified to species level wherever possible.

Environmental data obtained for each pond include: surface area, altitude, grid reference, water pH, presence/absence of inflows, substrate composition, degree of shade, accessibility to livestock and cover of emergent vegetation.

The PSYM software compares the observed data with values predicted from a large reference dataset of undegraded ponds. PSYM predicts how a high quality pond with similar attributes *should* score for each metric, and compares the predictions with the survey

results. The scores for individual metrics are combined to produce an Index of Biotic Integrity (IBI), which provides an overall indication of the ecological quality of the pond. Ponds can then be categorised as Very Poor, Poor, Medium and Good. PSYM results are provided in Appendix 1 and summarised briefly for the relevant ponds in section 2 below.

2. The ponds surveyed

The woodland pond (SD 4181 9080) has a surface area of around 300 square metres and is shaded by overhanging trees. A water sample produced a pH reading of 5.04 with electrical conductivity (a measure of solute content) of 120 µS/cm^{-1}. It contains patches of Bog Pondweed *Potamogeton polygonifolius* and Flote-grass *Glyceria fluitans* with marginal vegetation comprising Velvet Bent *Agrostis canina*, Common Sedge *Carex nigra*, Cow-horn Bog-moss *Sphagnum denticulatum* and Flat-topped Bog-moss *S. fallax*. Only seven widespread aquatic macro-invertebrate taxa were recorded.

PSYM assessment gave the shaded pond an Index of Biotic Integrity of 28%, denoting Poor ecological quality. Diversity of submerged and emergent plants was much lower than predicted and no uncommon wetland plants were observed. The Trophic Ranking Score was only around half that predicted, producing a null score. This suggests that the flora of the pond is indicative of much more oligotrophic conditions than would be expected for a high quality pond with similar attributes. In the PSYM model this is inferred as evidence of degradation due to the historic effects of acid deposition. In fact the TRS metric for this pond is based on only three species, so it would be misleading to infer much from this.

The pond scored well for biological water quality (ASPT), poorly for representation of water beetle families and produced a null score for representation of damselflies, dragonflies and alderflies.

The tarn (SD 4174 9074) has a surface area of around 880 square metres and is unshaded. A water sample produced a pH reading of 6.25 with electrical conductivity of 60 µS/cm^{-1}. The latter is a very low reading and suggests exceptionally clean water.

The tarn has patchy cover of Broad-leaved Pondweed *Potamogeton natans* and wide margins characterised by mixtures of sedges (principally Bottle Sedge *Carex rostrata*), low herbs and bryophytes. A carpet of Bottle Sedge and Cow-horn Bog-moss occupies one end of the tarn. Submerged water plants are sparse but include Translucent Stonewort *Nitella translucens* and Lesser Bladderwort *Utricularia minor*. An annotated list of wetland plants is provided in Appendix 2.

PSYM assessment produced an Index of Biotic Integrity of 94%, placing it within the top (Good) category of ecological integrity. It scored highly for five of the six metrics, exceeding predicted values for representation of uncommon plants and all three invertebrate metrics (i.e. the results were better than predicted based on reference data for high quality ponds with similar attributes). Diversity of submerged and emergent plants was almost double the predicted figure. The only metric with a slightly lower score was Trophic Ranking, which was moderate. In this case TRS was lower than predicted, which is probably due to the exceptional quality of the pond rather than any legacy of degradation from acid deposition.

3. Results

3.1 Invertebrates

A total of 74 aquatic macro-invertebrate taxa were recorded from the reserve during the two visits (Appendix 2). Of these, 66 were recorded from the tarn including 44 in the PSYM sample. Raw data have been provided in spreadsheet format. Just under half the taxa recorded from the tarn (45%) were water beetles with the next most speciose groups being water bugs (18%) and Odonata (14%).

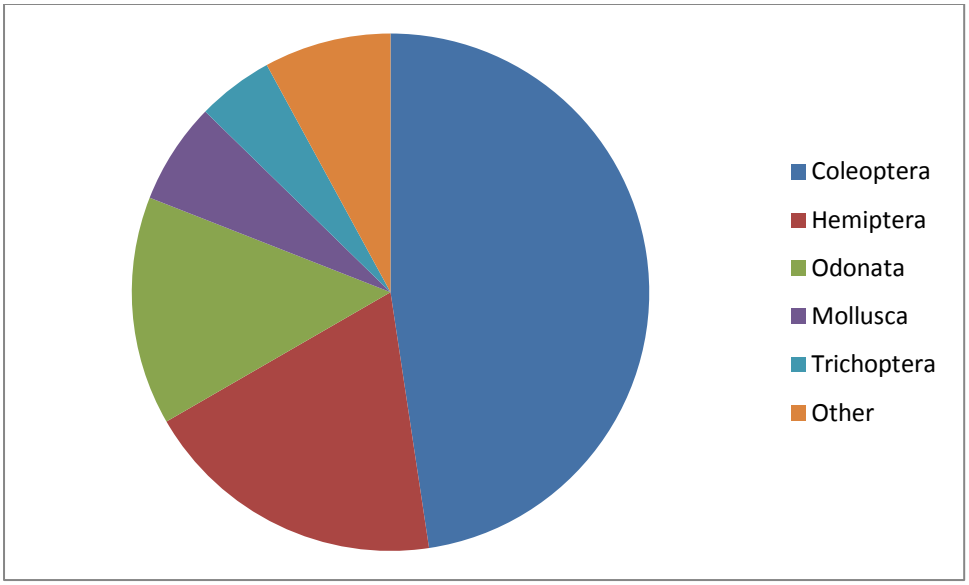

Figure 1: composition of the aquatic invertebrate fauna of the tarn by number of species recorded

A few acid-water species were found such as the Black Darter dragonfly *Sympetrum danae*, the lesser water-boatman *Sigara scotti* and the Moorland Backswimmer *Notonecta obliqua*. However, there was no distinct bog-pool fauna and most of the invertebrates recorded are either broadly tolerant or characteristic of waters of intermediate pH. Few phytophagous species (specialist plant-feeders) were recorded but Broad-leaved Pondweed supports the reed-beetle *Donacia versicolorea* and at least one China-mark moth species.

3.2 Wetland plants

A total of 43 wetland plants were recorded from the Tarn on 23rd June (Appendix 2).

3.3 Priority Pond assessment

Priority Ponds are defined as the best ca. 20% of ponds in England and Wales based on a range of criteria. These were originally developed for the UK Biodiversity Action Plan but Priority Ponds are recognised as a Habitat of Principal Importance for conservation under Section 41 of the Natural Environment & Rural Communities Act. The Tarn meets at least six criteria for Priority Pond status (Table 1).

Criterion	
PSYM Good ecological quality	✓
UKBAP species/Species of Principal Importance	Mud Snail
Protected Species	Medicinal Leech
Exceptional assemblage (30+ wetland plant species)	43 species
Exceptional assemblage (50+ aquatic macro-invertebrate species)	66 species
3 or more Nationally Scarce invertebrate species	Medicinal Leech, Mud Snail, *Helochares punctatus*

Table 1: Application of Priority Pond criteria

4. Species of conservation concern

4.1 Invertebrates

Medicinal Leech *Hirudo medicinalis* (Hirudinidae)

GB status: Protected under Schedule 5 of the Wildlife & Countryside Act 1981
Global status: Near Threatened

Medicinal Leeches are sanguivorous (blood-feeding) invertebrates, well known for their therapeutic use in blood-letting. This use has been documented since prehistoric times and became very popular in the 18th and 19th centuries, supported by a trade in many millions of animals. They continue to be used in specialist surgery, although the species reared commercially in Britain nowadays is the eastern European *Hirudo verbena*. While the historic use of leeches had dubious therapeutic credentials, they secrete a range of active compounds including hirudin, the most powerful natural anti-coagulant known, as well as vasodilators and anti-inflammatories (Elliott & Dobson, 2015), so leeching probably provided genuine benefits for a limited range of conditions. Leech harvesting was from wild populations, but the extent to which the species was introduced (or discarded) into ponds is unknown.

Over-exploitation combined with land drainage and the loss of stock-watering ponds led to a massive decline in populations during the 20th century. By the end of the century, Medicinal Leech was restricted to a few remaining strongholds in the New Forest, Dungeness, South Wales, Anglesey, the Lake District and the west of Scotland. It is extinct in Ireland and rare throughout western Europe; the species is threatened in at least 15 countries (Elliott & Dobson, 2015). Veterinary anti-parasite drugs such as avermectins are likely to pose a threat to remaining populations. In some Lake District sites, deepening of tarns to stock with Brown Trout has produced cooler conditions unfavourable to Medicinal Leeches, which require warm water (Elliott & Dobson, 2015).

Globally, the Medicinal Leech is classified by the IUCN as Near Threatened since "the potential and actual loss of wetland habitats, the global decline of amphibians, abandonment of traditional grazing practices and the scarcity of mammalian blood in leech diet are likely to affect populations and geographical ranges" (Utevsky *et al*., 2014).

Although Medicinal Leeches feed preferentially on mammal blood, amphibians can provide an alternative food source, albeit of lower nutritional value. After a large feed, it can take up to 200 days for a Medicinal Leech to digest its meal, so they only need to feed irregularly when mammalian hosts are available. These hermaphroditic animals lay egg cocoons above the water line in July and August: the 10 mm long cocoons are laid among plant roots or in moss. A leech may lay several, each containing 5 to 15 eggs. Hatching occurs 4 to 10 weeks after deposition and young leeches take at least two years to reach sexual maturity (Elliott & Mann, 1979).

Medicinal Leeches require warm water for feeding and reproduction: in a study of a Lake District tarn, most leeches were active only when water temperature reached 19°C (Elliott & Dobson, 2015 and references therein); the upper lethal temperature range is above 39°C.

Around 15-20 Medicinal Leeches of varying ages were seen during the course of the survey, suggesting a healthy population. Studies of two populations in contrasting habitats both produced estimates of population density around 0.1 animals/m² (Elliott & Dobson, 2015 and references therein), which would suggest a population of around 88 in the Barkbooth Lot tarn.

Mud Snail *Omhiscola glabra* (Lymnaeidae)

GB status: Nationally Scarce; Species of Principal Importance
Global status: Near Threatened (Prié *et al.*, 2011)

Mud Snail is a pond snail closely associated with nutrient-poor pool systems and pond margins on agriculturally-unimproved land. This species favours seasonal water bodies or draw-down zones around more permanent ponds. It appears to be poorly dispersive and most sites are on remnants of semi-natural heaths and commons. Mud Snail has declined massively, with post-1999 records from only 47 hectads in Great Britain (Seddon *et al.*, 2014). The global population was recently estimated to have declined by 20-25% over 15 years with a 25-49% decline in Great Britain during the period 1985-2010 (Prié *et al.*, 2011). It is scarce and declining in most parts of its limited global range (Mud Snail is restricted to Western Europe) and has become extinct in Ireland and Poland.

During the June survey, several live Mud Snails were found on Bottle Sedge at the edge of the Tarn. Kerney (1999) mapped post-1965 records for three hectads (10 km squares) in the southern Lake District but only a pre-1965 record for SD49.

Helochares punctatus, a scavenger water beetle (Hydrophilidae)

GB status: Nationally Scarce

Although listed as Nationally Scarce by Foster (2010), *H. punctatus* is a localised rather than rare beetle, mostly associated with acidic bog-pools at low to moderate elevations but sometimes occurring in base-rich ponds. It is present in good numbers in the mossy edges of the tarn.

4.2 Plants

No less than 11 wetland plants recorded from the tarn are included in the England Red List (Stroh *et al*., 2014) (Table 2). Most of these are widespread plants which underwent serious and prolonged decline in England during the second half of the 20th century, especially in the southern and eastern lowlands. Most of these are likely to have survived better in Cumbria than in the arable lowlands.

Botanical name	English name	England status[1]
Carex echinata	Star Sedge	NT
Carex vesicaria	Bladder Sedge	VU
Comarum palustre	Marsh Cinquefoil	NT
Eriophorum angustifolium	Common Cotton-grass	VU
Hydrocotyle vulgaris	Marsh Pennywort	NT
Pedicularis palustris	Marsh Lousewort	VU
Potentilla erecta	Tormentil	NT
Ranunculus flammula	Lesser Spearwort	VU
Triglochin palustris	Marsh Arrow-grass	NT
Utricularia minor	Lesser Bladderwort	VU
Veronica scutellata	Marsh Speedwell	NT

Table 2: English Red List vascular plants recorded from Barkbooth Lot tarn, June 2016

5. Implications for conservation management

The shaded pond is of relatively low ecological importance and is not a priority for conservation management.

The tarn is an outstanding example of a clean water pond of high ecological value, and is a habitat for Medicinal Leech and Mud Snail. It is clearly in excellent condition and management should aim to maintain the status quo. Continued access by livestock is important as mammalian blood is of much higher nutritional value to Medicinal Leeches than amphibian blood. However, stock should not be treated with veterinary medicines

[1] NT = Near Threatened; VU = Vulnerable. See Stroh *et al*. (2014) for status definitions.

which persist in the animals' bloodstream or are excreted in dung. Features such as marginal sedge beds and *Sphagnum* lawns are likely to be important for both Medicinal Leech (e.g. for egg-laying) and Mud Snail.

Scrub encroachment, permanent raising of water levels or the development of tall, dense emergent vegetation over large parts of the tarn would be detrimental to Medicinal Leech as this species requires warm, exposed conditions.

Both Medicinal Leech and Mud Snail are amenable to monitoring by trained volunteers, and PSYM provides a replicable method for monitoring overall ecological quality. Resurvey every five years or so is recommended as a means of identifying any significant change in habitat quality.

6. References

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APPENDIX 1: PSYM DATA

Pond	**Tarn**	**Shaded Pond**
Date	23-Jun-16	23-Jun-16
Grid ref	SD 417 907	SD 418 908
Plant metrics		
No. of submerged + marginal plant species (not including floating leaved)	35	7
Number of uncommon plant species	6	0
TRS	4.9666667	3.7333333
Invertebrate metrics		
ASPT	5.35	4.6
Odonata + Megaloptera	4	0
Coleoptera	4	2
Environmental variables		
Altitude	73	74
Shade (%)	1	90
Inflow (0/1)	0	1
Grazing (%)	100	0
Water pH	6.25	5.04
Emergent plant cover (%)	30	15
Base: silt/clay (1-3)	3	3
Base: sand/gravel (1-3)	1	1
Base: peat (1-3)	1	1
Base: rock (1-3)	1	1
Area (m^2)	880	300
RESULTS		
Submerged + marginal plants		
Predicted	17.9	18.0
Actual	35	7
EQI	1.95	0.39
IBI	3	1
Uncommon plants		
Predicted	4.0	3.6
Actual	6	0
EQI	1.49	0.00
IBI	3	0
TRS		
Predicted	5.63	6.94
Actual	4.97	3.73
EQI	0.88	0.54
IBI	2	0
ASPT		
Predicted	5.16	5.01
Actual	5.35	4.60
EQI	1.04	0.92

IBI	3	3
OM families		
Predicted	2.85	1.73
Actual	4	0
EQI	1.40	0.00
IBI	3	0
Coleoptera families		
Predicted	3.86	4.16
Actual	4	2
EQI	1.04	0.48
IBI	3	1
Sum of Individual Metrics	17	5
Index of Biotic Integrity (%)	**94%**	**28%**
PSYM quality category (IBI >75%=Good, 51-75%= Moderate, 25-50%=Poor, <25%=V Poor)	**Good**	**Poor**
Priority Pond? (Good ecological quality)	**Yes**	**No**

APPENDIX 2: WETLAND PLANTS RECORDED FROM THE TARN, JUNE 2016

SPECIES	ENGLISH NAME	ABUNDANCE
Agrostis canina	Velvet Bent	+
Agrostis stolonifera	Creeping Bent	+
Bryum pseudotriquetrum var. *pseudotriquetrum*	Marsh Bryum	+
Calliergon cordifolium	Heart-leaved Spear-moss	F
Calliergonella cuspidata	Pointed Spear-moss	O
Cardamine pratensis	Lady's Smock	R
Carex canescens	White Sedge	L
Carex demissa	Common Yellow Sedge	O
Carex echinata	Star Sedge	O
Carex nigra	Common Sedge	O
Carex panicea	Carnation Sedge	L
Carex rostrata	Bottle Sedge	LA
Carex vesicaria	Bladder Sedge	L
Cirsium palustre	Marsh Thistle	O
Comarum palustre	Marsh Cinquefoil	L
Eleocharis palustris	Common Spike-rush	O
Eleogiton fluitans	Floating Club-rush	F
Epilobium palustre	Marsh Willowherb	+
Epilobium parviflorum	Lesser Hairy Willowherb	R
Epilobium sp. (other)	a willowherb	R
Eriophorum angustifolium	Common Cotton-grass	+
Galium palustre ssp. *palustre*	Common Marsh Bedstraw	O
Glyceria fluitans	Flote-grass	L
Hydrocotyle vulgaris	Marsh Pennywort	L
Juncus acutiflorus	Sharp-flowered Rush	L
Juncus articulatus	Jointed Rush	L
Juncus bulbosus	Bulbous Rush	O
Juncus effusus	Soft Rush	+
Menyanthes trifoliata	Bogbean	L
Nitella translucens	Translucent Stonewort	O
Pedicularis palustris	Marsh Lousewort	R
Phalaris arundinacea	Reed Canary Grass	VL
Potamogeton natans	Broad-leaved Pondweed	A
Potamogeton polygonifolius	Bog Pondweed	LF
Potentilla erecta	Tormentil	R
Ranunculus flammula	Lesser Spearwort	O
Sphagnum denticulatum	Cow-horn Bog-moss	F
Sphagnum inundatum	Lesser Cow-horn Bog-moss	+
Triglochin palustris	Marsh Arrow-grass	R
Utricularia minor	Lesser Bladderwort	Local
Veronica scutellata	Marsh Speedwell	O
Viola palustris	Marsh Violet	R

Warnstorfia exannulata		LF

APPENDIX 3: AQUATIC MACRO-INVERTEBRATES RECORDED FROM THE RESERVE, MARCH AND 23rd JUNE 2016

SPECIES	ENGLISH NAME	FAMILY	ORDER
Pisidium sp.	a pea-mussel	Sphaeriidae	Bivalvia
Donacia versicolorea	a reed-beetle	Chrysomelidae	Coleoptera
Plateumaris discolor	a reed-beetle	Chrysomelidae	Coleoptera
Limnobaris dolorosa	a weevil	Curculionidae	Coleoptera
Agabus affinis	a diving beetle	Dytiscidae	Coleoptera
Agabus bipustulatus	a diving beetle	Dytiscidae	Coleoptera
Agabus nebulosus	a diving beetle	Dytiscidae	Coleoptera
Agabus sturmii	a diving beetle	Dytiscidae	Coleoptera
Hydroporus erythrocephalus	a diving beetle	Dytiscidae	Coleoptera
Hydroporus gyllenhalii	a diving beetle	Dytiscidae	Coleoptera
Hydroporus incognitus	a diving beetle	Dytiscidae	Coleoptera
Hydroporus palustris	a diving beetle	Dytiscidae	Coleoptera
Hydroporus planus	a diving beetle	Dytiscidae	Coleoptera
Hydroporus pubescens	a diving beetle	Dytiscidae	Coleoptera
Hydroporus striola	a diving beetle	Dytiscidae	Coleoptera
Hydroporus tristis	a diving beetle	Dytiscidae	Coleoptera
Hydroporus umbrosus	a diving beetle	Dytiscidae	Coleoptera
Ilybius montanus	a diving beetle	Dytiscidae	Coleoptera
Laccophilus minutus	a diving beetle	Dytiscidae	Coleoptera
Rhantus suturalis	a diving beetle	Dytiscidae	Coleoptera
Gyrinus substriatus	Common Whirligig beetle	Gyrinidae	Coleoptera
Haliplus fulvus	an algivorous water beetle	Haliplidae	Coleoptera
Haliplus ruficollis	an algivorous water beetle	Haliplidae	Coleoptera
Helophorus aequalis	a scavenger water beetle	Helophoridae	Coleoptera
Helophorus brevipalpis	a scavenger water beetle	Helophoridae	Coleoptera
Helophorus flavipes/obscurus ♀	a scavenger water beetle	Helophoridae	Coleoptera
Helophorus grandis	a scavenger water beetle	Helophoridae	Coleoptera
Hydraena riparia	a moss beetle	Hydraenidae	Coleoptera
Ochthebius minimus	a moss beetle	Hydraenidae	Coleoptera
Anacaena globulus	a scavenger water beetle	Hydrophilidae	Coleoptera
Anacaena lutescens	a scavenger water beetle	Hydrophilidae	Coleoptera
Coelostoma orbiculare	a scavenger water beetle	Hydrophilidae	Coleoptera
Enochrus coarctatus	a scavenger water beetle	Hydrophilidae	Coleoptera
Enochrus ochropterus	a scavenger water beetle	Hydrophilidae	Coleoptera
Helochares punctatus	a scavenger water beetle	Hydrophilidae	Coleoptera
Hydrobius subrotundus	a scavenger water beetle	Hydrophilidae	Coleoptera
Contacyphon sp. larvae	marsh beetle larvae	Scirtidae	Coleoptera
Odeles marginata	a marsh beetle	Scirtidae	Coleoptera
Chaoboridae	phantom midge larvae	Chaoboridae	Diptera
Chironomidae	non-biting midge larvae	Chironomidae	Diptera

Culicidae	a mosquito larva	Culicidae	Diptera
Dixidae	meniscus midge larvae	Dixidae	Diptera
Cloeon dipterum	Pond Olive	Baetidae	Ephemeroptera
Omphiscola glabra	Mud Snail	Lymnaeidae	Gastropoda
Radix balthica	Wandering Snail	Lymnaeidae	Gastropoda
Hirudo medicinalis	Medicinal Leech	Hirudinidae	Hirudinea
Corixa punctata	a lesser water-boatman	Corixidae	Hemiptera
Hesperocorixa castanea	a lesser water-boatman	Corixidae	Hemiptera
Hesperocorixa sahlbergi	a lesser water-boatman	Corixidae	Hemiptera
Sigara distincta	a lesser water-boatman	Corixidae	Hemiptera
Sigara scotti	a lesser water-boatman	Corixidae	Hemiptera
Sigara semistriata	a lesser water-boatman	Corixidae	Hemiptera
Gerris lacustris	Common Pond-skater	Gerridae	Hemiptera
Gerris odontogaster	Toothed Pondskater	Gerridae	Hemiptera
Nepa cinerea	Water Scorpion	Nepidae	Hemiptera
Notonecta obliqua	Moorland Backswimmer	Notonectidae	Hemiptera
Plea minutissima	Pygmy Backswimmer	Pleidae	Hemiptera
Microvelia reticulata	a lesser water-cricket	Veliidae	Hemiptera
?Elophila nymphaeata	China-mark moth larvae	Pyralidae	Lepidoptera
Aeshna cyanea	Southern Hawker	Aeshnidae	Odonata
Aeshna juncea	Common Hawker	Aeshnidae	Odonata
Enallagma cyathigerum	Common Blue Damselfly	Coenagrionidae	Odonata
Ischnura elegans	Blue-tailed Damselfly	Coenagrionidae	Odonata
Pyrrhosoma nymphula	Large Red Damselfly	Coenagrionidae	Odonata
Lestes sponsa	Emerald Damselfly	Lestidae	Odonata
Libellula quadrimaculata	Four-spotted Chaser	Libellulidae	Odonata
Sympetrum danae	Black Darter	Libellulidae	Odonata
Sympetrum striolatum	Common Darter	Libellulidae	Odonata
Triaenodes bicolor	a caddis-fly	Leptoceridae	Trichoptera
Limnephilus lunatus	a caddis-fly	Limnephilidae	Trichoptera
Limnephilus sp.	a caddis-fly	Limnephilidae	Trichoptera
Planariidae	-	Turbellaria	Turbellaria