

# Survey of aquatic macro-invertebrates in new dykes and a pond at Paull, East Yorkshire

## Summary

Realignment of the Humber bank between Paull and Thorgumbald resulted in loss of a large borrow pit situated behind the original embankment which was known to support a rich assemblage of water beetles and other aquatic insects. At the same time, new aquatic habitats have been provided in the form of extensive dykes and a pond behind the new embankments. In July 2003, vegetation was transferred from the former borrow pit to the new water bodies and an attempt was also made to translocate invertebrates.

A survey of aquatic macroinvertebrates in the new water bodies was undertaken in April 2004, both to judge the effectiveness of the translocation work and to assess the overall fauna.

The new water bodies support several scarce water beetles. These include opportunistic colonists of raw ponds such as *Hygrotus nigrolineatus* and *Scarodytes halensis* as well as specialists of coastal / brackish water habitats including *Haliphus apicalis*, *Agabus conspersus* and *Enochrus bicolor*. Some of these species may be of ephemeral occurrence but others will hopefully have established resident populations. None of the specialist brackish water Corixid bugs were found but these had not been present in the former borrow pit. Caddis flies were represented by two larval taxa, one of which is typical of ion-rich waters. The brackish water amphipod *Gammarus zaddachi* is abundant. Most other aquatic invertebrates were ubiquitous freshwater or wide tolerance species.

It is difficult to evaluate the efficacy of translocation of vegetation and invertebrates from the former borrow pit to the new water bodies. However, the presence of species which do not normally colonise raw, early-successional habitats but favour richly-vegetated ponds and dykes and are known to have been translocated indicates some success. Almost certainly, the translocation of perennial water plants has been valuable in providing immediate vegetation structure and by introducing attached eggs, larvae, pupae or adults.

The presence of several brackish water invertebrates indicates that conditions in the new aquatic habitats are sufficiently ion-rich to support a specialised invertebrate fauna. This is probably due to aerial deposition and at least some of these species appear to have established breeding populations. Potentially, the establishment of a pond and connecting dykes with low-end brackish water could provide habitats of regional importance for the conservation of aquatic invertebrates.

## 1. Introduction

Realignment of the Humber bank between Paull and Thorgumbald resulted in loss of a large borrow pit situated behind the original embankment. At the same time, new aquatic habitats have been provided in the form of extensive soke dykes behind the new embankments and a pond close to South Pasture Drain. In July 2003, vegetation was transferred from the former borrow pit to the new water bodies and an attempt was also made to translocate invertebrates (the former borrow pit was known to support a rich assemblage of water beetles and other aquatic insects).

This survey was commissioned by the Environment Agency with the aims of:

(a) providing baseline data on the aquatic invertebrates colonising the new water bodies within twelve months of construction, and

(b) assessing whether the attempt to translocate invertebrates from the former borrow pit had been successful.

Sampling was carried out on 14th April 2004 by Martin Hammond and Robert Merritt. Four sampling points were selected (see below) and each was worked vigorously with a pond net until no further species could be found. Care was taken to trawl all features of the water body at each sampling point, e.g. submerged and water-margin vegetation, exposed substrate. Collections of water plants were also examined in a bucket to look for attached invertebrates.

## **2. Sampling points**

Sampling points were selected to represent the new water bodies constructed at Paull.

SP1 (National Grid Reference TA 1800 2512) is a rather steep-sided pond near the visitors' car park. It contained very little vegetation apart from limited algal growth, a few clumps of a liner-leaved pondweed and occasional pieces of bladder wrack (presumably blown over the estuary wall during a storm). A small amount of woody debris was present.

SP2 (TA 1798 2515) is the dyke nearest the car park, to the west of the pond. A length of around 70 metres was sampled. Vegetation translocated from the former borrow pit is well-established including patches of sea club-rush (*Bolboschoenus maritimus*) and submerged stands of spiked water milfoil (*Myriophyllum spicatum*), thread-leaved water crowfoot (*Ranunculus trichophylos*) and common stonewort (*Chara vulgaris*).

SP3 (TA 1819 2477) covers around 100 metres towards the western end of the new soke dyke east of South Pasture Drain. There are patches of grey club-rush (*Schoenoplectus tabernaemontani*) and submerged mixtures of spiked water milfoil, thread-leaved water crowfoot and a liner-leaved pondweed (probably *Potamogeton pusillus*). This section includes shallow water with trailing grasses at the westernmost end of the ditch.

SP4 (TA 1890 2411) covers a section of around 100 metres further east along the same dyke.

## **3. Invertebrates recorded**

### **3.1 Aquatic Coleoptera (beetles)**

Water beetles are often amongst the most abundant and speciose insects in standing water habitats. The ecology and distribution of British species is well-known and these insects are readily sampled throughout most of the year, making them very useful in conservation assessment.

38 water beetle taxa were recorded, which is diverse for a site with poorly-developed vegetation structure. By far the greatest diversity of species was found at SP3 where 29 taxa were found. This section of dyke has dense mats of floating grasses in very shallow water as well as submerged waterweeds and emergent monocots: a very favourable habitat structure for water beetles. This SP produced nearly double the number of species

found at SP2 (n =16), which has healthy growth of submerged macrophytes including *Chara* but little complex marginal vegetation in shallow water. The algivorous *Haliphus confinis* and *H. obliquus* recorded here are often associated with *Chara*. SP1 produced a significant suite of small diving beetles found in open, sparsely-vegetated standing waters, often in ponds or ditches which have recently been created or cleared. These have striped or highly patterned wing cases in contrast to the predominantly dark and uniform colouration of beetles found in richly-vegetated ponds and include *Hydroglyphus pusillus*, *Hygrotus confluens*, *H. nigrolineatus* and *Scarodytes halensis*. SP4 was poor in water beetles (n=10).

Of 41 aquatic beetles recorded from the former borrow pit in 2000-2003, 26 (63%) were present in the new habitats in April 2004. Allowing for chance and seasonal influences, it can be assumed that between two-thirds and three-quarters of the species present in the former borrow pit have been retained in the local area, either through translocation or spontaneous colonisation of the new water bodies.

Of eight Nationally Scarce water beetles recorded from the former borrow pit, three were found in the new habitats (*Haliphus apicalis*, *Agabus conspersus* and *Dytiscus circumflexus*). Larvae of *Ilybius* sp. were present in the dyke at SP3 and may represent a fourth scarce species, *I. subaeneus* (which had already colonised this dyke by July 2003). Three Nationally Scarce species not previously recorded in the vicinity were found (*Hygrotus nigrolineatus*, *Scarodytes halensis* and *Enochrus bicolor*).

The high turnover of species in this type of habitat can be illustrated by records of the genus *Enochrus*, which are known to be good fliers (e.g. Hammond, 2001). Four have been recorded at Paull, the most widespread species (*E. testaceus*) being found both in the former borrow pit and in one of the new dykes (SP2). Of the rarer *Enochrus*, *E. halophilus* was found in the borrow pit was not collected in the new water bodies; *E. quadripunctatus* was found in one of the new dykes in July 2003 but not before or since; *E. bicolor*, not previously known from the site, was found in April 2004. This suggests that records (especially of single specimens) do not necessarily demonstrate the presence of an established breeding population - but equally it shows that even some rarer species will migrate into the new habitats and, if conditions are suitable, may become established.

It is possible to assess the 'quality' of water beetle assemblages by calculating a Species Quality Index (SQI). This represents the mean Species Quality Score (SQS) for the species present; the SQS is based on the national and regional status of each species, using a logarithmic scale from 1 (ubiquitous) to 32 (nationally threatened). The SQI for the former borrow pit was 2.66, the SQI for the new habitats is 2.67. Consequently, the 'quality' of both assemblages is very similar. However, scarce brackish water species were better represented in the former borrow pit, whereas the SQI for the new habitats is boosted by the presence of scarce pioneer species such as *Hygrotus nigrolineatus* and *Scarodytes halensis*. An SQI score above 2.0 indicates a good quality site for water beetles.

### **3.2 Aquatic Hemiptera - Heteroptera (water bugs)**

The water bugs are a diverse group including water crickets, pond-skaters, water-measurers, saucer bugs, water scorpions, backswimmers and lesser water-boatmen. Many water bugs show distinct preferences in terms of water chemistry and habitat structure (e.g. amount of vegetation or successional stage).

A total of 16 species were recorded, which is good for this type of habitat especially as a number of common species were not found. The most diverse sampling points was SP2 (nine species), the other locations producing six or seven species each. As would be expected, most are insects which move rapidly into new habitats (e.g. the three common pond-skaters) or are associated with early successional conditions (e.g. the lesser water-boatmen *Sigara falleni*, *S. lateralis* and *Arctocoris germari*). Two bugs typical of more vegetated ponds - the saucer bug *Ilyocoris* and the lesser backswimmer *Plea* - were only found in two and one locations respectively.

None of the true brackish water species (*Corixa affinis*, *Sigara selecta* and *S. stagnalis*) were found, but equally none had been recorded from the former borrow pit. *Sigara concinna* (SP1) favours ponds of high ionic status, though not extending into the more strongly brackish conditions preferred by *S. stagnalis*. The rather uncommon water boatman *Cymatia bonsdorfii* was thought to have been seen in the net at SP3 but none were found when material was examined in the laboratory. This species was present in the former borrow pit. *Arctocoris germari* is an infrequent species in Yorkshire, previously recorded from a small number of gravel pits and sparsely-vegetated lakes.

### **3.3 Trichoptera (caddis flies) and Ephemeroptera (mayflies)**

Although numerous cased caddis larvae of varying appearance were collected, these proved to be of just two (possibly three) species. Some Limnephilid caddis larvae change the construction of their cases as they develop, so can appear quite dissimilar at different developmental stages. *Limnephilus affinis* / *incisus*<sup>1</sup> probably refers to the former, a widespread species associated with coastal dykes which extends into brackish water.

Both taxa were present at SP 1 & 2 with *L. ?affinis* at SP3. The water bodies are probably too new for many caddis to have been able to colonise. The dyke at SP3/4 has minimal flow and a rather uniformly silty clay bed; these conditions are not suitable for many caddis.

Small numbers of mayfly nymphs were collected at SP3 but had disappeared from samples examined in the laboratory.

### **3.4 Odonata (damselflies and dragonflies)**

Mayfly nymphs were recorded at SP 2 & 3, consisting of Blue-tailed Damselfly (*Ischnura elegans*) and *Coenagrion* sp. (very probably Azure Damselfly, *C. puella*).

### **3.5 Molluscs**

The only mollusc found was the ubiquitous Wandering Snail (*Lymnaea peregra*), present in some quantity at SP 2, 3 & 4. Sediment samples failed to reveal any small bivalves such as *Pisidium* spp.

### **3.6 Leeches**

A single species of leech, the common *Glossiphonia complanata*, was found at SP2.

<sup>1</sup> This pair of species cannot be separated in the larval stage

### 3.7 Amphipods and Isopods (Crustacea)

Samples were taken of amphipods (Gammaridae) and water-slaters (Asellidae). The amphipod *Gammarus zaddachi*, a brackish water species, was present in good numbers at SP 1,2 & 4 with immature indet Gammarus at SP3 presumably being the same species. According to Fryer (1993), this species has been found in Yorkshire at Blacktoft Sands, Thorne Quay and nearby warping drains and in the River Ouse; it may, however, be widespread around the Humber.

The only Isopod was the ubiquitous *Asellus aquaticus*.

### 3.8 Fish and amphibians

Small numbers of Ten-spined Stickleback were present at each location.

Common Toad spawn was noted in the dyke at SP2. Several adult Smooth Newts were caught at SP3.

## 4. Assessment of the translocation initiative

It is very difficult to assess the effectiveness of the attempt to translocate invertebrates from the former borrow pit into the new water bodies. A number of species had spontaneously colonised the new dykes beforehand and even those known to have been transferred may also have arrived under their own steam. However, aquatic insects characteristic of well-vegetated ponds such as the saucer bug *Ilyocoris cimicoides*, the lesser backswimmer *Plea leachi* and the water beetle *Noterus clavicornis* are rarely found in water bodies of very recent origin. These three species are known to have been transferred from the former borrow pit in good numbers and are present at least locally in the new water bodies.

Of eight Nationally Scarce water beetles recorded from the former borrow pit, three were found in the new habitats (*Haliphus apicalis*, *Agabus conspersus* and *Dytiscus circumflexus*). All these species were believed to have been translocated<sup>2</sup>, although it cannot be assumed that they have not established unassisted.

The weevil *Lictodactylis leucogaster* was not found despite having been translocated in large numbers and its food plant (spiked water-milfoil) being well-established and vigorous. However, the phenology of this species is not well known and it may not be present in adult form this early in the year. Larvae of *Ilybius* sp/spp were present in the dyke at SP3 and may include *I. subaeneus*, a species which had already colonised this dyke by July 2003.

A very obvious benefit of translocating vegetation from the former borrow pit has been to provide food and shelter for invertebrates in the new habitats. Vegetation has established very well, particularly in the dyke at SP2, where there are fine stands of spiked water-milfoil, thread-leaved water-crowfoot, common stonewort and sea club rush. Lesser pondweed is more dominant in the dyke at SP3/4, with water-milfoil and water-crowfoot more patchy. In this dyke submerged macrophytes were coated in clayey silt, presumably washed in from agricultural field drains.

<sup>2</sup> Large numbers of adult *Haliphus* were moved from the old borrow pit but cannot be distinguished in the field; *Dytiscus* sp. larvae were most likely to be *D. circumflexus*

**Table 1 Nationally scarce water beetles recorded from the former borrow pit**

<b>Species</b>	<b>Translocated</b>	<b>Present in new habitat</b>
<i>Haliplus apicalis</i>	?	y
<i>Hygrotus parallelogramus</i>	N	N
<i>Agabus conspersus</i>	y	Y
<i>Ilybius subaeneus</i>	N	nc
<i>Dytiscus circumflexus</i>	y	y
<i>Enochrus halophilus</i>	N	N
<i>Ochthebius marinus</i>	N	N
<i>Lictodactylis leucogaster</i>	Y	nc

Y – yes, in large numbers (y = in small numbers); N – not found; nc – not confirmed but may be present

## 5. Species of conservation concern

Six of the beetles recorded during the current survey are listed as Nationally Scarce (Foster, in prep).

### *Haliplus apicalis* (Nationally Scarce, NSb)

A small ovoid algivorous water beetle associated with brackish or otherwise very ion-rich ponds and dykes. There are recent records from nine hectads (10 km. squares) in the Yorkshire and Humber region. Sites are scattered along the Humber from Broomfleet to Welwick, including Barton clay pits on the south bank. It also occurs at two sites inland, a single outpost on the east coast and around the Tees estuary.

This beetle occurs in well-vegetated standing or slow-flowing water and requires no specific management measures at this site.

### *Hygrotus nigrolineatus* (Nationally Scarce, NSa)

A small diving beetle which has only colonised Britain within the last 20 years. It is a pioneer species of early successional ponds and gravel pits. *Hygrotus nigrolineatus* has been recorded from six other widely scattered sites in the Yorkshire and Humber region. Given the high level of recent recording effort, this indicates a genuinely rare species, albeit opportunist and highly mobile; it could occur in some of the many gravel pits in the Hull Valley.

*H. nigrolineatus* is a fugitive species which appears to establish relatively short-lived populations. It is not found in very shallow water bodies and will probably remain restricted to the pond until successional conditions become unsuitable. Although rare, site specific management is not really appropriate for this species since new water bodies are continuously created.

### *Scarodytes halensis* (Nationally Scarce, NSb)

A small diving beetle with broken markings on its pale wing cases, a common feature of dytiscids inhabiting sparsely-vegetated sandy or gravelly substrates. It is a southern and eastern species, at the northern edge of its British range in Yorkshire: there are a handful of recent records including one other from South Holderness.

*S. halensis* could benefit from rotational clearance of vegetation in the new water bodies so that there are always some areas of sparsely-vegetated substrate.

*Agabus conspersus* (Nationally Scarce, NSb)

A medium-sized, spotted brown diving beetle restricted to shallow brackish waters. Although it can be plentiful where it occurs, *A. conspersus* is very local in the Yorkshire and Humber region. It is restricted to a small number of sites between North Ferriby and Easington, with records from six hectads.

*Agabus conspersus* tolerates a range of successional conditions and would presumably benefit from rotational clearance of the dykes at Paull.

*Dytiscus circumflexus* (Nationally Scarce, NSb)

A Great Diving Beetle found in larger ponds and drains, most frequently near the coast; it has spread northwards and inland in recent decades, in contrast to the decline of some other members of the genus. *Dytiscus* species prey on invertebrates, amphibian tadpoles and small fish, and are often top predators in ponds.

There are recent records from 17 hectads in the Yorkshire and Humber region, mostly clustered along the north bank of the Humber, in the central Vale of York and in the western Vale of Pickering. *D. circumflexus* still has a restricted distribution in Britain but is not threatened. No specific conservation measures are suggested at Paull but this species would presumably benefit from richly-vegetated (though not reed-choked) conditions with abundant prey.

*Enochrus bicolor* (Nationally Scarce, NSb)

This scavenger water beetle is restricted to brackish pools and dykes. It has been recorded over a range of salinity values up to 63 ppt (Greenwood & Wood, 2003) and can be found in more saline conditions than most water beetles tolerate. A single specimen was collected from the dyke at SP2 so it is unclear whether a breeding population has established; *E. bicolor* has not been detected previously at Paull.

*Enochrus bicolor* has a very restricted distribution in the Yorkshire and Humber region, with recent records for a handful of sites along the outer Humber estuary and one location on Teeside. The record from the present survey is the most westerly apart from an isolated inland population near Thorne. At the latter site it has been associated with saline mine water pumped to the surface, and may not persist now this practice has ceased.

## 6. Brackish water indicators

Many specialist invertebrates of coastal or brackish waters are of conservation interest in the sense that their habitat is highly restricted and many have quite exacting requirements. The water beetles *Haliphus apicalis*, *Agabus conspersus* and *Enochrus bicolor*, the caddis fly *Limnephilus affinis* and the amphipod *Gammarus zaddachi* are all associated with coastal or brackish standing waters; the lesser water boatman *Sigara concinna* is also characteristic of ion-rich waters. The presence of several such species suggests that the new water bodies at Paull are sufficiently ion-rich to develop a specialised coastal invertebrate fauna. Since the new water bodies are hydrologically isolated from the estuary, it is likely that salt spray provides the main brackish influence.

Assuming that caddis larvae identified as *Limnephilus affinis / incisus* are the former, this species is obviously breeding. This caddis occurs in both coastal and inland ponds, pools and ditches of high ionic content (Wallace, 1991). *Gammarus zaddachi* is said not to be able to breed in freshwater (Fryer, 1993) so the good numbers of both sexes present suggest that conditions are sufficiently brackish to allow reproduction. *Haliphus apicalis* and *Enochrus bicolor* were only recorded as single individuals which does not prove the establishment of breeding populations, though it should be noted that the former species is only identifiable by dissection of males so it could be present in significant numbers. *Agabus conspersus* was common and probably breeding.

It should be noted that although some 'brackish' water invertebrates tolerate high salinities, many seem to favour low-end brackish conditions. Such communities are quite distinct from those of saline lagoons or estuarine habitats subject to frequent tidal incursions. Long-term studies of an Essex saltmarsh subject to rare episodes of tidal flooding have indicated that most brackish water beetles only reappeared when salinity fell below about 15 ppt and electrical conductivity was less than 15 mScm<sup>-1</sup> (Greenwood & Wood, 2002).

## 7. References

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## APPENDIX: SPECIES LISTS

### Sampling Point 1: Pond at TA 1800 2512

#### Trichoptera (caddis-flies)

Limnephilidae

*Limnephilus affinis / incisus* larvae

*Limnephilus marmoratus* larvae

#### Coleoptera (beetles)

Halplidae (algivorous water beetles)

*Halplus lineatocollis* several

*Halplus ruficollis* agg.

Noteridae (burrowing water beetles)

*Noterus clavicornis* several

Dytiscidae (diving beetles)

*Hydroglyphus pusillus*

*Hygrotus confluens* several

*Hygrotus inaequalis*

*Hygrotus nigrolineatus* four caught

*Hydroporus palustris* two

*Scarodytes halensis* one collected

*Agabus conspersus* four caught

Hydrophilidae (scavenger water beetles)

*Hydrobius fuscipes*

#### Hemiptera - Heteroptera (water bugs)

Gerridae (pond skaters)

*Gerris odontogaster*

Notonectidae (backswimmers)

*Notonecta viridis*

Corixidae (lesser water boatmen)

*Arctocorisa germari*

*Callicorixa praeusta*

*Sigara concinna*

*Sigara distincta*

*Sigara dorsalis*

*Sigara lateralis*

*Sigara nigrolineata*

#### Amphipoda (freshwater shrimps and sandhoppers)

Gammaridae

*Gammarus zaddachi*

## Sampling point 2: Dyke at TA 1798 2515

### Amphipoda

Gammaridae  
*Gammarus zaddachi*

### Isopoda

Asellidae  
*Asellus aquaticus*

### Annelida (leeches)

Glossiphoniidae  
*Glossiphonia complanata*

### Mollusca

Lymnaeidae (pond snails)  
*Lymnaea peregra*

### Odonata (damselflies and dragonflies)

*Ischnura elegans* larvae

### Trichoptera (caddis-flies)

Limnephilidae  
*Limnephilus affinis / incisus* larvae  
*Limnephilus marmoratus* larvae

### Coleoptera (beetles)

Halplidae (algivorous water beetles)  
*Halplus confinis*  
*Halplus lineatocollis*  
*Halplus obliquus*  
*Halplus ruficollis*

Noteridae (burrowing water beetles)  
*Noterus clavicornis*

Dytiscidae (diving beetles)  
*Laccophilus minutus*  
*Hydroglyphus pusillus*  
*Hygrotus confluens*  
*Hygrotus inaequalis*  
*Hydroporus palustris*  
*Agabus conspersus*  
*Colymbetes fuscus*

Hydrophilidae (scavenger water beetles)

*Megasternum concinnum*

*Hydrobius fuscipes*

*Laccobius colon*

*Enochrus testaceus*

### **Hemiptera - Heteroptera (water bugs)**

#### **Gerridae (pond skaters)**

*Gerris odontogaster*

*Gerris thoracicus*

#### **Naucoridae (saucer bugs)**

*Ilyocoris cimicoides*

#### **Pleidae (lesser backswimmers)**

*Plea leachi*

#### **Corixidae (lesser water boatmen)**

*Corixa punctata*

*Callicorixa praeusta*

*Sigara dorsalis*

*Sigara lateralis*

*Sigara nigrolineata*

## Sampling point 3: Dyke at TA 1819 2477

### Amphipoda

Gammaridae  
*Gammarus sp.* immatures

### Mollusca

Lymnaeidae  
*Lymnaea peregra*

### Araneae (spiders)

*Paradosa sp.* immature  
*Pirata sp.* immature  
*Tetragnatha extensa*  
*Pachygnatha clerki*  
*Oedothorax fuscus*  
*Lepthyphantes gracilis*

### Odonata (damselflies and dragonflies)

*Coenagrion sp.* larva  
*Ischnura elegans* larvae

### Trichoptera (caddis-flies)

Limnephilidae  
*Limnephilus affinis / incisus* larvae

### Coleoptera (beetles)

Halipidae (algivorous water beetles)  
*Halipus apicalis* one male collected  
*Halipus immaculatus* numerous

Noteridae (burrowing water beetles)  
*Noterus clavicornis*

Dytiscidae (diving beetles)  
*Laccophilus minutus*  
*Hydroglyphus pusillus*  
*Hygrotus confluens*  
*Hygrotus inaequalis*  
*Hydroporus palustris*  
*Hydroporus planus*  
*Hydroporus tessellatus*  
*Agabus bipustulatus*  
*Agabus conspersus*  
*Ilybius sp.* indet larvae  
*Colymbetes fuscus*

*Dytiscus circumflexus*                      one caught

Helophoridae

*Helophorus aequalis*

*Helophorus grandis*

*Helophorus obscurus*

Hydrophilidae

*Cercyon marinus*

one collected

*Megasternum concinnum*

*Hydrobius fuscipes*

*Anacaena limbata*

*Laccobius colon*

*Helochares lividus*

*Enochrus bicolor*

one collected

*Enochrus testaceus*

*Cymbiodyta marginella*

Hydraenidae

*Ochthebius minimus*

Heteroceridae

*Heterocerus fenestratus*

### **Hemiptera - Heteroptera (water bugs)**

Gerridae

*Gerris lacustris*

*Gerris odontogaster*

*Gerris thoracicus*

Corixidae

*Hesperocorixa linnaei*

*Sigara lateralis*

*Sigara nigrolineata*

## Sampling Point 4: Dyke at TA 1890 2411

### Amphipoda

Gammaridae

*Gammarus zaddachi*

### Odonata (damselflies and dragonflies)

*Ischnura elegans*

### Coleoptera (beetles)

Dytiscidae (diving beetles)

*Hygrotus impressopunctatus*

*Agabus bipustulatus*

*Agabus conspersus*

*Colymbetes fuscus*

*Dytiscus marginalis*

Helophoridae

*Helophorus grandis*

Hydrophilidae (scavenger water beetles)

*Laccobius colon*

*Cymbiodyta marginella*

Hydraenidae

*Ochthebius dilatatus*

*Ochthebius minimus*

### Hemiptera - Heteroptera (water bugs)

Gerridae (pond skaters)

*Gerris thoracicus*

*Gerris odontogaster*

Naucoridae (saucer bugs)

*Ilyocoris cimicoides*

Notonectidae (backswimmers)

*Notonecta viridis*

Corixidae (lesser water boatmen)

*Sigara dorsalis*

*Sigara falleni*

*Sigara lateralis*

## **Appendix 2: combined species list**

### **Annelida (leeches)**

*Glossiphonia complanata*

### **Mollusca**

Lymnaeidae

*Lymnaea peregra*

### **Amphipoda**

Gammaridae

*Gammarus zaddachi*

### **Isopoda**

Asellidae

*Asellus aquaticus*

### **Odonata (damselflies and dragonflies)**

*Coenagrion* sp. (indet larvae)

*Ischnura elegans*

### **Trichoptera (caddis-flies)**

Limnephilidae

*Limnephilus affinis / incisus*

*Limnephilus marmoratus*

### **Coleoptera (beetles)**

Halplidae (algivorous water beetles)

*Halplus apicalis*

*Halplus confinis*

*Halplus immaculatus*

*Halplus lineatocollis*

*Halplus obliquus*

*Halplus ruficollis*

Noteridae (burrowing water beetles)

*Noterus clavicornis*

Dytiscidae (diving beetles)

*Laccophilus minutus*

*Hydroglyphus pusillus*

*Hygrotus confluens*

*Hygrotus impressopunctatus*

*Hygrotus inaequalis*

*Hygrotus nigrolineatus*

*Hydroporus palustris*  
*Hydroporus planus*  
*Hydroporus tessellatus*  
*Scarodytes halensis*  
*Agabus bipustulatus*  
*Agabus conspersus*  
*Ilybius* sp. (indet larvae)  
*Colymbetes fuscus*  
*Dytiscus circumflexus*  
*Dytiscus marginalis*

Helophoridae  
*Helophorus aequalis*  
*Helophorus grandis*  
*Helophorus obscurus*

Hydrophilidae (scavenger water beetles)  
*Cercyon marinus*  
*Megasternum concinnum*  
*Hydrobius fuscipes*  
*Anacaena limbata*  
*Laccobius colon*  
*Helochares lividus*  
*Enochrus bicolor*  
*Enochrus testaceus*  
*Cymbiodyta marginella*

Hydraenidae  
*Ochthebius dilatatus*  
*Ochthebius minimus*

Heteroceridae  
*Heterocerus fenestratus*

### **Hemiptera - Heteroptera (water bugs)**

Gerridae (pond skaters)  
*Gerris lacustris*  
*Gerris thoracicus*  
*Gerris odontogaster*

Naucoridae (saucer bugs)  
*Ilyocoris cimicoides*

Pleidae (lesser backswimmers)  
*Plea leachi*

Notonectidae (backswimmers)  
*Notonecta viridis*

Corixidae (lesser water boatmen)  
*Corixa punctata*



*Callicorixa praeusta*  
*Arctocorisa germari*  
*Hesperocorixa linnaei*  
*Sigara concinna*  
*Sigara distincta*  
*Sigara dorsalis*  
*Sigara falleni*  
*Sigara lateralis*  
*Sigara nigrolineata*