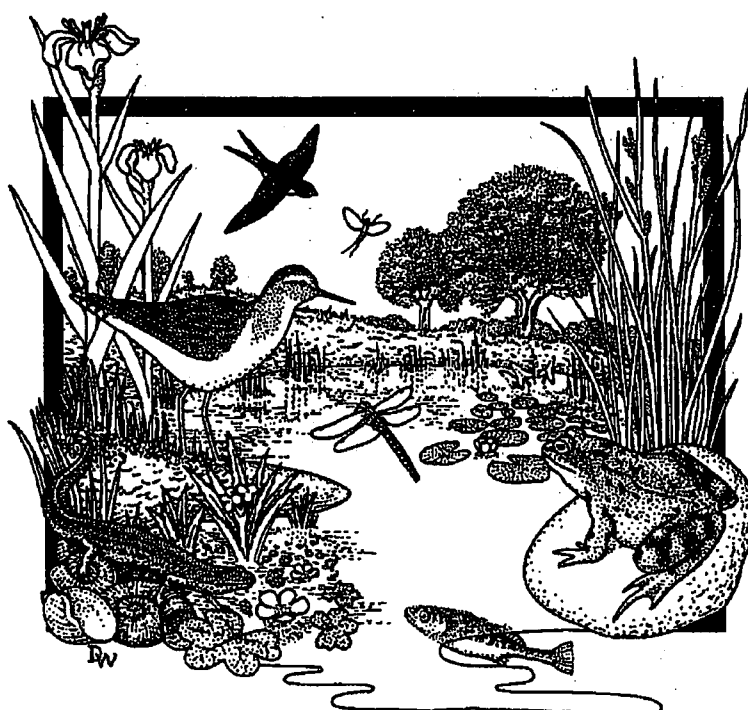


The aquatic macroinvertebrate fauna of Orton Brickpits, Peterborough

Project 95142 Limnology study: Peterborough Southern Township

A report to WWF UK



March 1998

Pond Action

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Executive Summary

This report describes the results of a survey of aquatic macroinvertebrates in ponds at Orton Brick Pits, near Peterborough, on 21 and 23 May 1996. The aim of the survey was to provide a preliminary assessment of the conservation value of the aquatic macroinvertebrate assemblages on the Orton site.

All ponds surveyed supported Nationally Scarce or Red Data Book water beetle species. In addition, 3 nationally local water bug species, and single nationally local dragonfly, caddisfly and mayfly species, were recorded.

The conservation value of the water beetle assemblage was assessed in comparison to other sites in East Anglia. Overall the beetle fauna was of similar quality to long-established wetland sites such as Woodwalton and Wicken Fens. Only sites of exceptional biological quality, such as the pingo fens of Thompson Common, had higher quality water beetle assemblages than Orton.

Overall, the results confirm the high quality of aquatic habitats at Orton. It is recommended that as much of the site as possible is retained as a non-urbanised area as all waterbodies on the site seem likely to be potentially high quality habitats.

To mitigate the losses of habitat associated with urbanisation of the site it is recommended that special attention is paid to maintaining habitat diversity (size, age and seasonality of ponds) and to preventing water pollution from surrounding urban areas.

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1. Introduction

This report describes the results of a survey of aquatic macroinvertebrates in ponds at Orton Brick Pits, near Peterborough, on 21 and 23 May 1996. The aim of the survey was to provide a preliminary assessment of the conservation value of the aquatic macroinvertebrate assemblages on the Orton site.

2. Background information about the site

The Orton Brick Pits site covers an area of approximately 160 hectares. The site comprises a series of approximately 100 large ridges and furrows formed by clay extraction. The furrows are broadly orientated on a north-west to south-east axis. Individual furrows are typically 5-15 m wide, and 5-10 m high, and vary in length up to 600m. Most furrows contain permanent or temporary waterbodies which vary in size from small seasonal pools of a few square metres to large, permanent, ponds up to 300m in length and over 2 m deep.

The age of the furrows (and presumably the waterbodies) varies across the site, generally being more recent on the west of the site, towards the active working face of the brick pit. The oldest furrows (scheduled for infilling) were in the north-east portion of the site and were believed to be in excess of 60 years old.

Approximately 60% of the site is currently zoned for urban development, including most of the older parts of the site (including a number of the waterbodies described in this report).

3. Methods

Approximately six person days were spent surveying the site for macroinvertebrates. During this time 11 ponds (or groups of ponds) were surveyed. Figure 1 shows the location of the ponds included in the survey. The survey focused on the older waterbodies on the east of the site in the area zoned for urban development.

Macroinvertebrates were surveyed using a field search technique. Each pond was surveyed by three surveyors working for approximately 40 minutes at each site. Macroinvertebrates were collected using a standard 1mm mesh hand net and by hand searching for cryptic specimens. Netted material was sorted through on the bankside in large white trays. Specimens which could not be identified in the field were returned to the laboratory for further identification.

Invertebrates from 12 taxonomic groups were collected and identified to species level:

Tricladia	(flatworms)
Gastropoda	(snails)
Hirudinea	(leeches)
Araneae	(spiders)
Malacostraca	(freshwater shrimps and slaters)
Ephemeroptera	(mayflies)
Odonata	(damselflies and dragonflies)
Hemiptera	(water bugs)
Megaloptera	(alderflies)
Trichoptera	(caddisflies)
Lepidoptera	(moths)
Coleoptera	(beetles)

Larvae of Diptera (true flies) were identified to family level.

The conservation value of each of the waterbodies was assessed in terms of water beetle species richness and rarity. Assessments were based on the water beetle component of the assemblage because the field search technique was not appropriate for comparison with standard National Pond Survey invertebrate survey methods (in which assessments of conservation value are based on the occurrence of all the major macroinvertebrate taxa). In practice, the majority of species of nature conservation importance in the ponds were water beetles so it is unlikely that results were greatly biased by this approach. Appendix 1 gives details of the methodology used to assess the quality of each waterbody.

Other species collected and identified (refer to Appendix 3 for a full species list) are briefly discussed in the report but were not used in the assessment of conservation value.

The conservation scores for each waterbody were compared with extensive data published by JNCC on the conservation value of water beetle assemblages in East Anglian freshwater habitats (Foster and Eyre 1992).

It should be noted that the assessment of the value of the waterbodies at Orton is likely to be a *conservative* estimate for the following reasons:

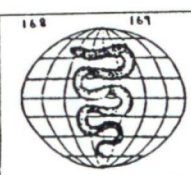
- only a small proportion of waterbodies were surveyed,
- macroinvertebrates were sampled in only one season and surveys undertaken at other times of the year may result in 30-50% more species being recorded.



ORTON BRICKPITS

**FIG. 1 LOCATION OF WATERBODIES
SAMPLED FOR AQUATIC
MACROINVERTEBRATES**

Drawing No
Date
Scale - 1:2500
© HCI 1996



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4. Results

4.1 Species recorded and conservation value of the assemblages

A total of 118 macroinvertebrate species were recorded at the site, 33 of which were uncommon, including 14 Local species, 17 Nationally Scarce species and 2 Red Data Book 3 species (See Appendix 5 for brief ecological notes on uncommon species recorded at Orton Brickpits).

The waterbodies surveyed had on average 45 species of aquatic macroinvertebrate (range = 29 to 58). The maximum number of uncommon species observed in a waterbody was 16 (waterbodies 21o and 46a). 27 of the uncommon species recorded were water beetles, 3 were water bugs and an uncommon dragonfly, caddisfly and mayfly were also observed. The two Red Data Book species recorded, the water beetles *Dryops similis* and *Hydrochus elongatus*, were found predominantly within the older waterbodies on the east of the site.

Table 4.1 Uncommon species and calculation of Species Quality Score (SQS) for each waterbody

	Waterbody										
	17g	19h	21o	34f	35n	36a	46a	53a	56d	61a	71-1
Total No. of species	55	36	58	29	48	46	43	54	38	44	46
Total No. of uncommon species	12	9	16	7	15	8	16	14	15	11	13
Local	5	6	7	4	6	5	5	6	3	3	7
Nationally Scarce	7	3	9	3	9	3	9	7	10	7	5
RDB3	0	0	0	0	0	0	2	1	2	1	1
Total No. of water beetle species	24	18	30	17	29	17	34	24	30	31	31
Score	62	41	80	34	72	36	92	75	86	68	66
SQS (mean score per species)	2.4	2.3	2.7	2.0	2.5	2.1	2.7	3.1	2.9	2.2	2.1

Foster and Eyre (1992) suggest that Species Quality Scores of 2 or more are representative of "good" sites for water beetles. All of the waterbodies in the survey had SQSs of more than 2 (range = 2.0 to 3.1), indicating that all support valuable water beetle assemblages.

Looked at more broadly, comparison with the results of Foster and Eyre (1992) shows that the Orton ponds are amongst the highest quality sites in East Anglia in terms of their water beetle assemblages. Only 7% of the sites listed by Foster and Eyre in the whole of East Anglia had higher SQS scores than those recorded at Orton. Overall, the Orton ponds were equivalent in quality to sites in long established wetlands such as Dersingham Bog, Woodwalton Fen, Wicken Fen, Upton Broad Fen in the Norfolk Broads and Epworth Turbary (in the Thorne Moors complex at the head of the Humber Estuary).

Generally, only sites in East Anglia of exceptional importance for water beetles (and other aquatic assemblages) scored more highly than Orton, particularly the pingo fens of areas such as Thompson Common and East Walton Common. Some of these sites are considered to be of international importance for their water beetle assemblages (Foster and Eyre 1992).

4.2 Brief description of waterbody characteristics

This section provides a brief summary of the location and physical characteristics of each waterbody as well as detailing the number of aquatic macroinvertebrates observed and how many were uncommon.

17g

Waterbody 17g is located on the south-west of the site and is elongate in shape. 55 species of macroinvertebrate were observed, 12 of which were uncommon.

19h

Located on the western side of the site towards the working face of the brickpits, 19h is a small and slightly elongate waterbody. 36 species of macroinvertebrate were observed in the waterbody, 9 of which were uncommon.

21o

21o represents a series of waterbodies in the south-west corner of the site - one large thin waterbody with a series of small and more rounded waterbodies to the south. 58 species were recorded from the waterbody, 16 of which were Local or Nationally Scarce species.

34f

Located in the central area of the site 34f is a long, narrow waterbody. 29 species were recorded of which 7 were found to be uncommon.

35n

35n is a medium sized waterbody located on the south of the site. 48 species were recorded, 15 of which were uncommon.

36a

36a is found to the north of the site and is one of the larger waterbodies present at Orton Brickpits (its maximum width is more than three times the width of the average waterbody). 46 species were recorded, 8 of which were uncommon.

46a

46a is a small waterbody on the north of the site. During the survey 43 species were observed, 16 of which were uncommon. Both Red Data Book 3 species were present in the waterbody.

53a

Located on the north-east of the site 53a is medium sized and is likely to be one of the older waterbodies present. 54 species of macroinvertebrate were recorded, 14 were classified as uncommon. The RDB3 water beetle *Hydrochus elongatus* was present within the waterbody.

56d

56d is a medium sized waterbody on the east of the site. 38 species were identified, 15 of which were uncommon. This waterbody had both RDB3 species present as well as 10 Nationally Scarce and 3 Local species.

61a

61a is a small waterbody on north-east of site. Of the 11 waterbodies surveyed 61a is located furthest from the working face of the brickpit and is presumably one of the oldest waterbodies. 44 species were present, 11 of which were uncommon and one of them an RDB3 species.

71-1

71-1 is a large U-shaped waterbody within the southern sector of the site. 46 species were recorded, 13 of which were uncommon. The Red Data Book water beetle *Dryops similis* was recorded in the waterbody.

5. Conclusions and Recommendations

All water bodies surveyed in this preliminary survey of the Orton site had high conservation value water beetle assemblages. In terms of their water beetles alone, the ponds surveyed were all amongst the top 10% of sites in East Anglia. The high quality of the site is indicated by the fact that all of the water bodies surveyed supported 3 or more Nationally Scarce species.

The ponds with Red Data Book species (46a, 53a, 56d, 61a and 71-1) were all located in the older north-east section of the site. It is likely that most of these waterbodies will be infilled as the site is built on.

The quality of the Orton site is probably due to a combination of factors. In general, three factors seem to be important in determining the biological quality of freshwater systems: relatively unpolluted water, physical habitat diversity (a mixture of permanent, semi-permanent and permanent ponds for example, with good vegetation structure) and proximity to established wetlands. Orton appears to fulfil all of these requirements. There was every indication from the biota on the site that water quality was good. The site has a mixture of permanent, semi-permanent and seasonal water bodies. Also, being on the edge of the Fens, it is relatively close to other wetland complexes of high quality.

Recommendations

The results of the survey strongly suggests that as much of the site as possible should be retained as a non-urbanised area as all waterbodies on the site seem likely to be potentially high quality habitats. However, recognising that a large proportion of the site is zoned for building two factors require special attention in the future:

- (i) maintaining habitat diversity on the site
- (ii) maintain water quality (and particularly preventing pollution from the adjacent urban areas)

Maintaining habitat diversity

In order to maintain the maximum nature conservation interest on the site, management should aim to retain water bodies of a range of sizes, depths, degrees of permanence and age. Given the nature of the site, a long term programme of pond creation (to feed new ponds into the successional process) would be the ideal way of achieving this objective, although it might not be practically feasible given space constraints. If one new furrow (or its equivalent in a Pinkhill Meadow style pond complex (Williams *et al.* 1997) could be excavated every 5 years, this would ensure that new ponds were available for some time into the future. Alternatively an experimental programme of rotational disturbance could be tested.

Protecting water quality

In the longer term, water quality is likely to become a critical issue. The construction of buildings near the site, and the consequent production of large quantities of contaminated surface runoff, means that care must be taken to avoid pollution of the

site. Urban surface runoff is potentially highly polluting and is likely to contain nutrients, sediments, oils, heavy metals and biocides. If routed into the remaining areas of the Orton site it could, potentially, be highly damaging. It is a high priority, therefore, to ensure that urban runoff does not enter the Orton site or contaminate any groundwater supplies that might be feeding the ponds.

In the light of the quality of the Orton ponds it is recommended that further surveys of the site would be useful. Most effective would be a monitoring programme designed to determine whether the site was maintaining its ecological quality. Such work could be undertaken using the new Pond-PSYM technique developed by Pond Action for the Environment Agency (Biggs *et al.* 1998).

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APPENDICES

Appendix 1 Calculation of the Species Quality Score

The conservation value of each waterbody was assessed on the basis of the number of water beetle species recorded and their status. The Species Quality Score used by Foster and Eyre (1992) is defined as the mean score per species. In Foster and Eyre's study site lists which covered the full range of water beetle taxa were selected from around the country. These lists were ordinated and classified using the statistical programs DECORANA and TWINSpan. Sites were ranked within endgroups according predominantly to their Species Quality Score.

The Species Quality Score is calculated as follows:

1. Each water beetle species recorded in a waterbody is given a value according to its national distribution status. Table A1.1 shows the scoring system used for macroinvertebrates. The scores awarded range from 1 for the commoner species through a geometric progression to 32 for the rarest species. Foster and Eyre adapted these scores for each region and their scores for Lincolnshire and northern East Anglia were used in the calculations to allow for a direct comparison between the results. It should be noted that some of these scores have been updated since the report was published in 1992.
2. The values for each water beetle species are added together to give a total value for each waterbody.
3. The total value is divided by the number of water beetle species present in the waterbody to give a Species Rarity Score.
4. The Species Rarity Score is used to provide an assessment of the conservation value of the waterbody in terms of its water beetle assemblage. Scores over 2.0 are considered to be indicative of "good" sites (Foster and Eyre, 1992).

Table A1.1 Macroinvertebrate conservation scores

Description	Score	Macroinvertebrates
Common	1	Species generally regarded as common
Local	2	Species which, whilst not rare, are restricted in occurrence
Nationally Scarce	4	Nationally scarce. Recorded from 16-100 10 x 10 km grid squares in Britain
RDB3	8	Red Data Book: Category 3 (Rare)
RDB2	16	Red Data Book: Category 2 (Vulnerable)
RDB1	32	Red Data Book: Category 1 (Endangered)

Appendix 2 Macroinvertebrate species recorded in each waterbody

Species	Status	Foster & Eyre Score	Score	Waterbody										
				17g	19h	21o	34f	35n	36a	46a	53a	56d	61a	71l
Snails														
Armiger crista			1	-	-	-	-	-	-	-	-	-	-	+
Hippeutis complanatus			1	-	-	-	-	-	-	-	-	-	-	+
Lymnaea peregra			1	+	-	-	-	-	-	-	+	-	-	+
Lymnaea stagnalis			1	-	-	-	-	-	+	-	-	-	-	-
Potamopyrgus jenkinsi			1	+	-	+	+	+	+	-	-	-	-	-
Shrimps and Slaters														
Asellus aquaticus			1	+	-	+	+	-	-	-	+	+	-	+
Crangonyx pseudogracilis			1	+	-	+	+	-	+	+	+	+	+	+
Gammarus pulex			1	+	-	+	+	-	-	-	-	-	-	-
Water spiders														
Argyroneta aquatica			1	+	-	-	-	-	+	-	+	-	+	-
Leeches														
Theromyzon tessulatum			1	+	-	-	-	+	-	-	-	-	-	-
Mayflies														
Caenis horaria	L		1	-	+	-	-	-	+	-	-	-	-	-
Caenis luctuosa		1	+	+	+	+	+	+	-	+	-	+	-	-
Caenis robusta		2	-	+	-	-	+	-	-	-	-	-	-	-
Centroptilum luteolum		1	-	-	-	-	-	-	-	+	-	-	-	-
Cloeon dipterum		1	+	+	+	-	+	+	+	+	+	-	+	+
Procloeon bifidum		1	-	-	-	-	-	+	-	+	-	-	-	-
Dragonflies														
Aeshna cyanea	L		1	-	-	+	-	-	-	-	+	-	-	+
Aeshna grandis		1	-	-	-	-	-	-	-	-	+	-	-	-
Anax imperator		1	+	+	+	-	-	+	-	+	-	+	-	-
Brachytron pratense		2	-	+	+	+	-	-	-	+	-	-	-	+
Coenagrion puella		1	+	-	-	-	+	+	-	+	-	+	-	-
Enallagma cyathigerum		1	+	+	+	-	+	+	-	+	-	-	-	-
Ischnura elegans			1	+	+	+	+	+	+	+	+	-	+	-
Lestes sponsa			1	-	-	-	-	+	-	-	-	-	-	-
Libellula quadrimaculata			1	+	+	+	+	-	+	-	+	-	+	+
Pseudagrion nymphula			1	-	+	+	-	-	-	-	-	-	-	-
Water bugs														
Corixa panzeri	L		2	+	-	-	-	-	-	-	-	-	-	-
Cymatia bonedoffi	L		2	-	-	-	-	+	+	-	-	-	-	-
Hesperocorixa linnei			1	+	-	+	+	+	+	-	+	+	-	-
Hesperocorixa sahlbergi			1	-	-	-	-	-	-	-	-	+	-	-
Hesperocorixa moesta			1	+	+	+	+	+	-	+	+	-	-	-
Hydrotetra stagnorum			1	+	+	+	-	+	+	-	+	-	-	+
Ilyocoris cimicoides			1	-	-	+	-	-	+	-	+	-	-	-
Microvelia reticulata			1	-	+	+	+	+	+	-	+	-	+	+
Nepa cinerea			1	-	-	+	-	-	+	-	+	-	-	-
Notonecta glauca			1	+	-	+	-	+	-	-	-	-	-	+
Notonecta marmorea			1	+	+	-	-	-	+	+	-	-	-	-
Plea leachi			1	+	+	+	-	-	+	+	+	-	-	-
Ranatra linearis	L		2	-	-	+	-	-	-	-	-	-	-	-
Sigara dorsalis			1	+	-	-	-	-	-	-	-	-	-	-
Sigara fassarium			1	+	+	+	-	+	-	-	+	-	-	-
Sigara nigrolineata			1	+	-	-	-	-	-	-	-	-	-	-
Water beetles														
Agabus bipustulatus		1	1	-	-	-	-	-	+	+	-	+	+	-
Agabus sturmi		1	1	-	-	-	-	-	-	-	-	-	-	+
Agabus unguicularis	N	4	4	-	-	-	-	-	-	+	-	-	-	-
Anacaena bipustulata	N	4	4	-	-	+	+	-	+	-	-	-	+	-
Anacaena globulus		1	1	-	-	-	+	-	-	+	-	+	+	+
Anacaena limbata		2	1	-	-	+	+	-	-	+	+	+	+	+
Anacaena lutescens		2	1	-	-	+	+	+	+	+	+	+	+	+
Berosus affinis	N	4	4	+	-	+	-	+	+	+	+	+	+	+
Berosus luridus	N	4	4	-	-	-	-	+	-	+	+	+	+	+
Berosus signaticollis	N	4	4	+	+	+	-	+	-	+	-	-	+	-
Coelambus impressopunctatus		2	1	-	-	-	-	-	-	-	-	-	-	+
Coelambus orbiculare		1	1	-	-	-	-	-	-	-	-	-	+	-
Coelambus parallelogrammus	N	2	4	+	-	-	-	-	-	-	-	-	-	-
Colymbetes fuscus		1	1	-	+	-	-	-	-	+	-	-	+	+
Copelatus haemorrhoidalis	L	2	2	-	+	-	-	-	-	+	+	+	-	+
Cymbiodyta marginella	L	2	2	-	-	-	+	-	-	-	-	-	-	+
Dryops luridus	RDB3	1	1	-	-	-	-	-	+	+	-	-	-	+
Dryops similis		8	8	-	-	-	-	-	-	+	-	+	+	+
Dytiscus marginalis		1	1	-	-	-	-	+	-	+	-	-	+	-
Enochrus coarctatus	L	2	2	-	-	-	-	-	-	-	+	+	+	+
Enochrus halophilus	N	4	4	+	+	-	+	+	-	+	+	+	+	-
Enochrus melanocephalus	N	4	4	-	-	-	-	+	-	-	-	-	-	-
Enochrus testaceus	L	2	2	-	-	+	+	+	+	+	-	-	+	+
Graptodytes granularis	N	4	4	+	-	+	-	+	-	+	+	+	+	+
Graptodytes pictus		2	1	+	+	+	+	+	+	-	+	+	+	-
Gyrinus substriatus		1	1	-	-	-	-	+	+	+	+	-	+	-

continued

continued

Species	Status	Foster & Eyre Score	Score	Waterbody										
				17g	19h	21o	34f	35n	36a	46a	53a	56d	61a	71l
<i>Haliphus confinis</i>	L	2	1	+	+	+	-	+	+	-	+	-	+	-
<i>Haliphus immaculatus</i>		2	1	+	-	+	-	-	-	-	-	-	-	-
<i>Haliphus lineatocollis</i>		1	1	+	-	+	-	-	-	+	-	-	-	+
<i>Haliphus obliquus</i>		4	2	+	+	+	-	+	+	+	+	-	-	-
<i>Haliphus ruficollis</i>		1	1	+	+	-	-	+	+	-	-	-	-	+
<i>Haliphus wehnckei</i>	N	2	1	+	-	-	-	-	-	-	-	-	-	-
<i>Helophorus brevipalpis</i>		1	1	-	-	-	-	-	-	-	-	+	-	-
<i>Helophorus grandis</i>		1	1	-	-	-	-	-	+	-	+	-	+	-
<i>Helochares lividus</i>		2	4	+	-	+	-	-	-	+	+	-	-	-
<i>Helophorus nanus</i>		4	4	-	-	-	-	-	-	-	-	+	-	-
<i>Helophorus obscurus</i>	RDB3	1	1	-	-	-	-	-	-	-	-	+	-	+
<i>Heteroceris fenestratus</i>		2	1	+	-	-	-	-	-	-	-	-	-	-
<i>Heteroceris obsoletus</i>		2	1	+	-	-	-	-	-	-	-	-	-	-
<i>Hydrochus elongatus</i>		8	8	-	-	-	-	-	-	+	+	+	-	-
<i>Hydroporus angustatus</i>		1	1	-	-	-	-	-	-	-	-	+	-	+
<i>Hydroporus discretus</i>	L	2	1	-	-	-	-	-	-	+	-	-	-	-
<i>Hydrobius fuscipes</i>		1	1	-	-	+	+	-	+	-	+	+	+	+
<i>Hydroporus memnonius</i>		2	2	-	+	+	-	+	-	-	-	+	-	+
<i>Hydroporus palustris</i>		1	1	+	-	+	-	-	-	-	-	-	-	-
<i>Hydroporus planus</i>		1	1	-	-	-	-	+	-	+	+	+	+	+
<i>Hydroporus pubescens</i>	N	1	1	-	-	-	-	-	+	-	+	+	+	-
<i>Hydroglyptus geminus</i>		2	4	-	-	-	-	-	-	-	+	+	-	-
<i>Hydroporus tessellatus</i>		1	1	-	-	-	-	+	-	+	-	+	-	+
<i>Hydraena testacea</i>		4	4	-	-	-	-	-	-	-	-	+	-	+
<i>Hygrotus inaequalis</i>		1	1	+	+	+	+	+	-	+	+	-	+	+
<i>Hyphydrus ovatus</i>	L	1	1	-	+	+	+	+	+	-	+	-	+	+
<i>Ilybius quadriguttatus</i>		4	1	-	-	+	-	-	-	-	+	+	-	-
<i>Laccobius minutus</i>		2	1	+	+	+	+	+	+	+	+	-	+	-
<i>Laccobius biguttatus</i>		2	2	+	+	+	-	+	-	-	+	-	+	-
<i>Laccobius bipunctatus</i>		1	1	-	+	+	+	+	+	-	-	-	+	+
<i>Laccobius sinuatus</i>	N	8	4	+	+	+	-	+	-	+	+	-	-	-
<i>Laccobius striatulus</i>		2	1	-	-	+	-	+	-	-	-	-	-	-
<i>Laccophilus minutus</i>		1	1	+	+	+	-	-	-	-	-	-	-	-
<i>Limnebius nitidus</i>		4	4	-	-	+	-	+	-	-	-	+	-	-
<i>Limnebius papposus</i>		4	4	-	-	+	+	+	+	+	-	+	+	-
<i>Noterus clavicornis</i>	L	2	1	+	+	-	+	+	+	+	+	+	+	+
<i>Ochthebius minimus</i>		1	1	+	+	+	+	+	-	+	-	+	+	+
<i>Porhydrus lineatus</i>		2	2	+	-	+	+	-	+	+	+	-	-	-
<i>Rhantus grapii</i>		8	4	-	-	+	-	-	-	-	+	+	-	+
Alderflies														
<i>Sialis lutaria</i>			1	+	+	+	-	-	+	+	-	-	-	-
Caddisflies														
<i>Agrypnia varia</i>	L		1	+	-	-	-	-	+	-	+	-	+	-
<i>Athripsodes aterrimus</i>			1	+	-	-	+	-	+	-	+	-	-	-
<i>Holocentropus dubius</i>			1	-	-	+	-	+	+	-	+	-	+	-
<i>Limnephilus decipiens</i>			2	+	-	-	-	-	+	+	-	-	-	+
<i>Limnephilus flavicornis</i>			1	-	+	+	-	-	-	-	+	+	+	+
<i>Limnephilus lunatus</i>	N		1	-	-	+	-	-	+	-	-	-	-	-
<i>Limnephilus marmoratus</i>			1	+	-	+	-	+	+	+	+	+	-	+
<i>Trienodes bicolor</i>			1	+	-	-	-	+	+	-	+	-	+	-
Moths														
<i>Nymphula nymphaea</i>			1	-	-	-	-	-	-	-	+	-	-	-
<i>Paraponyx stratiotata</i>			1	+	-	-	-	-	-	-	+	-	-	-
Total Number of species				55	36	58	29	48	46	43	54	38	44	46

Key: L = Local N = Nationally Scarce RDB3 = Red Data Book 3

	Waterbody										
	17g	19h	21o	34f	35n	36a	46a	53a	56d	61a	71l
Diptera											
<i>Ceratopogonidae</i>	-	+	+	-	+	-	-	+	-	+	-
<i>Chaoboridae</i>	-	+	+	-	+	-	-	+	-	+	-
<i>Chironomidae</i>	-	-	+	-	+	+	+	+	+	+	-
<i>Culicidae</i>	-	-	-	-	+	-	+	-	+	+	+
<i>Dixidae</i>	-	-	-	-	-	+	-	+	+	+	+
<i>Psychodidae</i>	-	-	-	-	-	-	-	-	-	+	-
<i>Ptychopteridae</i>	-	-	+	-	-	-	-	-	-	-	+
<i>Stratiomyidae</i>	-	-	-	-	+	+	+	-	-	+	+
<i>Tabanidae</i>	-	-	-	-	+	-	-	-	-	-	-
<i>Tipulidae</i>	+	+	-	-	+	-	+	-	-	-	+
Psidium species	-	-	-	-	-	-	-	-	+	-	-
Oligochaeta	-	-	-	-	+	-	-	-	-	-	-

Appendix 3 Macroinvertebrate Species List recorded for Orton Brickpits

Alderflies

Sialis lutaria

Caddisflies

Agrypnia varia

Athripsodes aterrimus

Holocentropus dubius

Limnephilus decipiens

Limnephilus flavicornis

Limnephilus lunatus

Limnephilus marmoratus

Triaenodes bicolor

Dragonflies

Aeshna cyanea

Aeshna grandis

Anax imperator

Brachytron pratense

Coenagrion puella

Enallagma cyathigerum

Ischnura elegans

Lestes sponsa

Libellula quadrimaculata

Pyrrosoma nymphula

Leeches

Theromyzon tessulatum

Mayflies

Caenis horaria

Caenis luctuosa

Caenis robusta

Centroptilum luteolum

Cloeon dipterum

Procloeon bifidum

Moths

Nymphula nymphaea

Paraponychia stratiotata

Freshwater shrimps

Crangonyx pseudogracilis

Gammarus pulex

Snails

Armiger crista

Hippeutis complanatus

Lymnaea peregra

Lymnaea stagnalis

Potamopyrgus jenkinsi

Water beetles

Agabus bipustulatus

Agabus sturmii

Agabus unguicularis

Anacaena bipustulata

Anacaena globulus

Anacaena limbata

Anacaena lutescens

Berosus affinis

Berosus luridus

Berosus signaticollis

Coelambus impressopunctatus

Coelambus orbiculare

Coelambus parallelogrammus

Colymbetes fuscus

Copelatus haemorrhoidalis

Cymbiodyta marginella

Dryops luridus

Dryops similis

Dytiscus marginalis

Enochrus coarctatus

Enochrus halophilus

Enochrus melanocephalus

Enochrus testaceus

Graptodytes granularis

Graptodytes pictus

Gyrinus substriatus

Haliplus confinis

Haliplus immaculatus

Haliplus lineatocollis

Haliplus obliquus

Haliplus ruficollis

Haliplus wehnckei

Helophorus brevipalpis

Helophorus grandis

Helochares lividus

Helophorus nanus

Helophorus obscurus

Heterocerus fenestratus

Heterocerus obsoletus

Hydrochus elongatus

Hydroporus angustatus

Hydroporus discretus

Hydrobius fuscipes

Hydroporus memnonius

Hydroporus palustris

Hydroporus planus

Hydroporus pubescens

Hydroglyphus geminus

Hydroporus tessellatus

Hydraena testacea

Hygrotus inaequalis

Hyphydrus ovatus

Ilybius quadriguttatus

Laccobius minutus

Laccobius biguttatus

Laccobius bipunctatus

Laccobius sinuatus

Laccobius striatulus

Laccophilus minutus

Limnebius nitidus

Limnebius papposus

Noterus clavicornis

Ochthebius minimus

Porhydrus lineatus

Rhantus grapii

Water bugs

Corixa panzeri

Cymatia bonndorffi

Hesperocorixa linnei

Hesperocorixa sahlbergi

Hesperocorixa moesta

Hydrometra stagnorum

Ilyocoris cimicoides

Microvelia reticulata

Nepa cinerea

Notonecta glauca

Notonecta marmorea

Plea leachi

Ranatra linearis

Sigara dorsalis

Sigara fossarum

Sigara nigrolineata

Water slaters

Asellus aquaticus

Water spiders

Argyroneta aquatica

True flies

Ceratopogonidae

Chaoboridae

Chironomidae

Culicidae

Dixidae

Psychodidae

Ptychopteridae

Stratiomyidae

Tabanidae

Tipulidae

Appendix 4 Uncommon macroinvertebrate species recorded at Orton Brickpits

Species	Status
Caddisflies	
<i>Limnephilus decipiens</i>	Local
Dragonflies	
<i>Brachytron pratense</i>	Local
Mayflies	
<i>Caenis robusta</i>	Local
Water beetles	
<i>Agabus unguicularis</i>	Nationally Scarce
<i>Anacaena bipustulata</i>	Nationally Scarce
<i>Berosus affinis</i>	Nationally Scarce
<i>Berosus luridus</i>	Nationally Scarce
<i>Berosus signaticollis</i>	Nationally Scarce
<i>Coelambus parallelogrammus</i>	Nationally Scarce
<i>Copelatus haemorrhoidalis</i>	Local
<i>Cymbiodyta marginella</i>	Local
<i>Dryops similis</i>	RDB3
<i>Enochrus coarctatus</i>	Local
<i>Enochrus halophilus</i>	Nationally Scarce
<i>Enochrus melanocephalus</i>	Nationally Scarce
<i>Enochrus testaceus</i>	Local
<i>Graptodytes granularis</i>	Nationally Scarce
<i>Haliplus obliquus</i>	Local
<i>Helochaeres lividus</i>	Nationally Scarce
<i>Helophorus nanus</i>	Nationally Scarce
<i>Hydraena testacea</i>	Nationally Scarce
<i>Hydrochus elongatus</i>	RDB3
<i>Hydroglyphus geminus</i>	Nationally Scarce
<i>Hydroporus memnonius</i>	Local
<i>Laccobius biguttatus</i>	Local
<i>Laccobius sinuatus</i>	Nationally Scarce
<i>Limnebius nitidus</i>	Nationally Scarce
<i>Limnebius papposus</i>	Nationally Scarce
<i>Porhydrus lineatus</i>	Local
<i>Rhantus grapii</i>	Nationally Scarce
Water bugs	
<i>Corixa panzeri</i>	Local
<i>Cymatia bonsdorffi</i>	Local
<i>Ranatra linearis</i>	Local

Appendix 5 Brief descriptions of uncommon macroinvertebrate species recorded at Orton Brickpits

Definitions:

RDB3 = 'Rare': species with small populations not at present endangered or vulnerable, but at risk. Not likely to occur in more than 15 10-km grid squares (or, in a few cases, more widespread but occupying small areas of especially vulnerable habitat).

Nationally Scarce = Species recorded from only 16 - 100 10-km grid squares in mainland Britain.

Local = Species not falling into any of the above categories, but usually either

- (a) confined to certain limited geographical areas within which, however, they may be present in large numbers;
- (b) widespread in distribution, but present only in small numbers where they occur; or
- (c) restricted to a very specialised habitat of which, however, the species may be a common component.

Note: References to 'Britain' in the following notes are to mainland Britain, and do not include Ireland.

***Limnephilus decipiens* (TRICHOPTERA: Limnephilidae). A caddis fly.**

Local. Found in ponds, lakes, canals, dykes and slowly flowing rivers: a species of rich waters with plenty of vegetation. Limited in distribution to southern England and East Anglia: north to north Lincolnshire and extreme south-east Derbyshire in the east, and the Cheshire Meres in the north-west (Wallace, 1991).

***Brachytron pratense* (ODONATA: Aeshnidae). The Hairy Dragonfly.**

Local. This species is most commonly found in Britain on the coastal levels and grazing marshes of Somerset, Sussex, Kent and Norfolk. It also occurs in the fens of Anglesey, the Cheshire meres and on the wetlands along the coast of South Wales and Suffolk. Breeds in mesotrophic ponds, lakes, including mature gravel pits, canals, ditches, and marshy fens where there is plenty of tall emergent vegetation (Merritt, Moore and Eversham, 1996).

***Caenis robusta* (EPHEMEROPTERA: Caenidae). A mayfly ('angler's curse' or 'white midge').**

Local. The larvae are locally common and widespread, both in running and still waters. Found in the pools and margins of rivers and in ponds and canals, chiefly in mud or silt that is rich in organic matter (Elliott, Humpesch and Macan, 1988).

***Corixa panzeri* (HEMIPTERA: Corixidae.) A lesser water boatman.**

Local. A local species with a widespread distribution throughout mainland Britain, but scarce where it occurs. Found at low altitudes, in ponds or pools with a moderate amount of aquatic or emergent plant cover (Savage, 1989).

***Cymatia bondsdorffi* (HEMIPTERA: Corixidae). A lesser water boatman.**

Local. A small carnivorous water bug occurring in still-water (often acidic and/or base-poor) habitats where there is plenty of aquatic and emergent plant cover. Distribution is scattered throughout Britain, but the species is somewhat more frequent in low-altitude areas of Wales and the north of England than in other regions (Savage, 1989).

***Ranatra linearis* (HEMIPTERA: Nepidae). The Water Stick Insect (or Thin-bodied Water Scorpion).**

Local. A frequent species in southern counties (particularly the south-east), but scarce in Wales and the Midlands, and absent from the rest of Britain. Prefers ponds and lakes, but is also occasionally found in slow-flowing sections at the margins of rivers and streams. Requires plenty of emergent plant cover, since floating dead stems of bur-reed (*Sparganium* spp.), bulrush (*Typha* spp.), etc. are utilised as egg-laying sites (Savage, 1989; Kirby, 1992; Whitfield, pers. obs.).

***Halplus obliquus* (COLEOPTERA: Haliplidae). A water beetle.**

Local. Widespread but not very common, occurring throughout Britain with the exception of the Scottish Highlands. Usually a species of permanent base-rich waters, it is often found in ponds or ditches where the aquatic vegetation includes *Chara* sp. (stonewort), with which it appears to be associated (although this is as yet incompletely studied) (Foster, 1981; Foster and Eyre, 1992).

***Agabus unguicularis* (COLEOPTERA: Dytiscidae). A diving beetle.**

Nationally Scarce. Although scarce, the distribution of this species is widespread throughout mainland Britain; it is much rarer, however, in the Midlands and the south of England and is more likely to be found in Scotland or the north. A species of marshy pools (Friday, 1988).

***Coelambus parallelogrammus* (COLEOPTERA: Dytiscidae). A diving beetle.**

Nationally Scarce. This species is also scarce but widespread in distribution, but is apparently absent from Scotland. Said to be a species preferring brackish water, but as with other 'brackish-water' species, it is sometimes found in fresh water, especially near coastal areas (Friday, 1988; Whitfield, pers. obs.).

***Copelatus haemorrhoidalis* (COLEOPTERA: Dytiscidae). A diving beetle.**

Local. A warmth-loving species: rather common in stagnant, often shaded ponds, ditches, drains, etc. in the southern half of Britain, and in particular in the south-east (Foster, 1983; Whitfield, pers. obs.).

***Graptodytes granularis* (COLEOPTERA: Dytiscidae). A diving beetle.**

Nationally Scarce. Another scarce species with widespread distribution, being found throughout Britain, though it is commoner in East Anglia and the extreme south of Scotland than elsewhere. Found in the swampy areas of ponds, fens and bogs (Friday, 1988; Foster, 1983).

***Hydroglyphus geminus* (formerly *pusillus*) (COLEOPTERA: Dytiscidae). A diving beetle.**

Nationally Scarce. Locally distributed in the south of England, where it is fairly common, and the Midlands. Said to inhabit heath pools, mossy ditches, and new, man-made ponds. The species is certainly very characteristic of the latter: it is often one of the earliest colonisers and may be present in considerable numbers, sometimes indeed being among the macroinvertebrate species occurring in greatest abundance (as at Pinkhill Meadows in Oxfordshire). However, *H. geminus* may be in the process of extending its habitat range, since in recent years there is hardly a water-body type (including rivers, streams, lakes, and old temporary ponds) where the species has *not* been recorded (Foster, 1981; Friday, 1988; Pond Action, 1994 *et al.*; Whitfield, pers. obs.).

***Hydroporus memnonius* (COLEOPTERA: Dytiscidae). A diving beetle.**

Local. Widely distributed around Britain, but 'rarely considered common': found in very shallow, stagnant ponds, ditches, etc. where there are large amounts of dead leaves. An interesting feature of this species is the fact that the female has two distinct forms which appear to be quite decisively separated geographically: 'shining' (occurring in Scotland, stopping almost at the Border), and dull or 'matt' (var.

castaneus) which is the only form known in Wales and nearly all of England. The reasons for this distribution of the female forms are not at present fully understood (Foster, 1984).

***Porhydrus lineatus* (COLEOPTERA: Dytiscidae). A diving beetle.**

Local. Scattered distribution throughout most of Britain, excluding the north of Scotland, west Wales, and Devon and Cornwall. The species is said to be characteristic of lowland 'Atlantic' lakes, and particularly favours muddy ponds and ditches (Foster, 1983; Friday, 1988; Foster and Eyre, 1992).

***Rhantus grapii* (COLEOPTERA: Dytiscidae). A diving beetle.**

Nationally Scarce. Scattered distribution in the south of England. Mainly found in fens, richly-vegetated drains in old fen areas, fen carr and shaded ponds (Foster, 1985).

***Anacaena bipustulata* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Nationally Scarce. Frequent in the south of England and the eastern part of the Midlands, with a few sites in the extreme south of Wales; apparently completely absent from the rest of Britain. Occurs in streams, rivers and pits (Friday, 1988; Foster, 1987).

***Berosus affinis* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Nationally Scarce. According to Foster, this species and the following, *B. luridus*, have often been confused in the past, so that some of the older records may be mistaken; the distribution of both species, therefore is not completely certain at present. *B. affinis* appears to be almost completely confined in distribution to coastal areas of southern England, excluding Cornwall, although it is occasionally recorded further north. 'Even in the deep south, any *Berosus* species makes the day a little more cheerful.' (G. N. Foster.) Prefers silt ponds and drains, sometimes brackish; possibly characteristic of grazing fen ditches (Friday, 1988; Foster, 1987).

***Berosus luridus* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Nationally Scarce. Apart from one small area of Scotland, this species is limited to the south and west of England, being scarce throughout its range. Generally restricted to marsh drains and ponds, but usually in more acidic water than *B. affinis* (Friday, 1988; Foster, 1987).

***Berosus signaticollis* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Nationally Scarce. As with *B. luridus*, scarce and apparently almost completely limited to the south and west of England. Typically found in shallow, muddy and silty ponds where it appears to be tolerant of intense fouling by livestock; Foster mentions a record for a builder's yard (Friday, 1988; Foster, 1987).

***Cymbiodyta marginella* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Local. Found in stagnant waters (ponds, ditches, etc.) with aquatic vegetation. Its range covers most of England (excluding the extreme south-west), eastern Wales and southern Scotland; it is only really common, however, in the south-east. Throughout its range, its distribution is very much concentrated in lowland areas (Friday, 1988; Foster, 1987).

***Enochrus coarctatus* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Local. Widespread distribution throughout England, but only very occasionally found in Scotland. Prefers pools with rich vegetation. This species has been recently 'demoted' in status; being formerly designated Nationally Scarce (Friday, 1988; Hyman and Parsons, 1992).

***Enochrus halophilus* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Nationally Scarce. Very scarce distribution in the southern half of England, and apparently absent altogether from the rest of Britain. A brackish-water species (Friday, 1988).

***Enochrus melanocephalus* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Nationally Scarce. Usually a coastal species frequenting brackish water in southern England (though it may occasionally be found in the north of England); in south-east England, however, it may occur, locally, inland (D. Bilton, pers. comm.; Friday, 1988).

***Enochrus testaceus* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Local. A 'coastal refugia' species, occurring in dykes and ponds from mid-Scotland southwards. Fairly common throughout eastern England, but in the west scattered, and only common in a few lowland areas with plenty of standing water (Foster, 1987).

***Helochares lividus* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Nationally Scarce. More likely to occur in the south-east than in other parts of Britain. Typically found in ponds and lakes where there is some plant cover. The species does not appear to be as scarce as some others with this designation, and may well have been under-recorded in the past since it is by no means always easy to distinguish from the very similar (also Nationally Scarce, but much more widespread) *H. punctatus* (with which it is, very occasionally, found) (Friday, 1988; Whitfield, pers. obs.).

***Helophorus nanus* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Nationally Scarce. Usually an acid water species; 'mainly found in the early spring in relict fens but also in some fenland drains and in fish ponds'. Although the species is not as scarce as was formerly thought, its range is limited to the south, and in particular East Anglia (Foster, 1987; Foster and Eyre, 1992).

***Hydraena testacea* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Nationally Scarce. More common in the south, but also found in Scotland and the north, where it is very much scarcer. Found in stagnant water or muddy streams (Friday, 1988).

***Hydrochus elongatus* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

RDB3. Very sparse distribution in the south of England, and apparently absent from the rest of mainland Britain. Found in ponds and drains, often among reeds (Foster, 1987; Friday, 1988).

***Laccobius biguttatus* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Local. Found in coastal drains, and also silt ponds inland. Local and scarce throughout Britain except in the south-east, where it is more common (Friday, 1988).

***Laccobius sinuatus*. (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Nationally Scarce. A species of slow-flowing drains and, often, of new ponds, where it may be an early coloniser, being particularly associated with muddy habitats (although it has been recorded from a variety of different water bodies and habitat types). Locally scarce in England but absent from Scotland, and nowhere common; it is, however, sometimes present in large numbers where it does occur, more often than not in company with other species of *Laccobius* (in particular, as here, *striatulus*) (Friday, 1988; Foster and Eyre, 1992; Whitfield, pers. obs.).

***Limnebius nitidus* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Nationally Scarce. Found in marsh drains and muddy streams and ponds throughout Britain; however, it is scarce everywhere except in southern England, where it is locally common (Friday, 1988).

***Limnebius papposus* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

Nationally Scarce. Absent from Scotland and rare in England and Wales, except for the south-east where it is somewhat commoner. A species normally associated with fen drains (Friday, 1988; Foster and Eyre, 1992).

***Dryops similaris* (COLEOPTERA: Dryopidae). A water beetle.**

RDB3. The British Dryopidae are not at present very well-known, and their distribution is not clear. Five species are at present considered to be rare and designated RDB3; however, this status may be revised in the future.