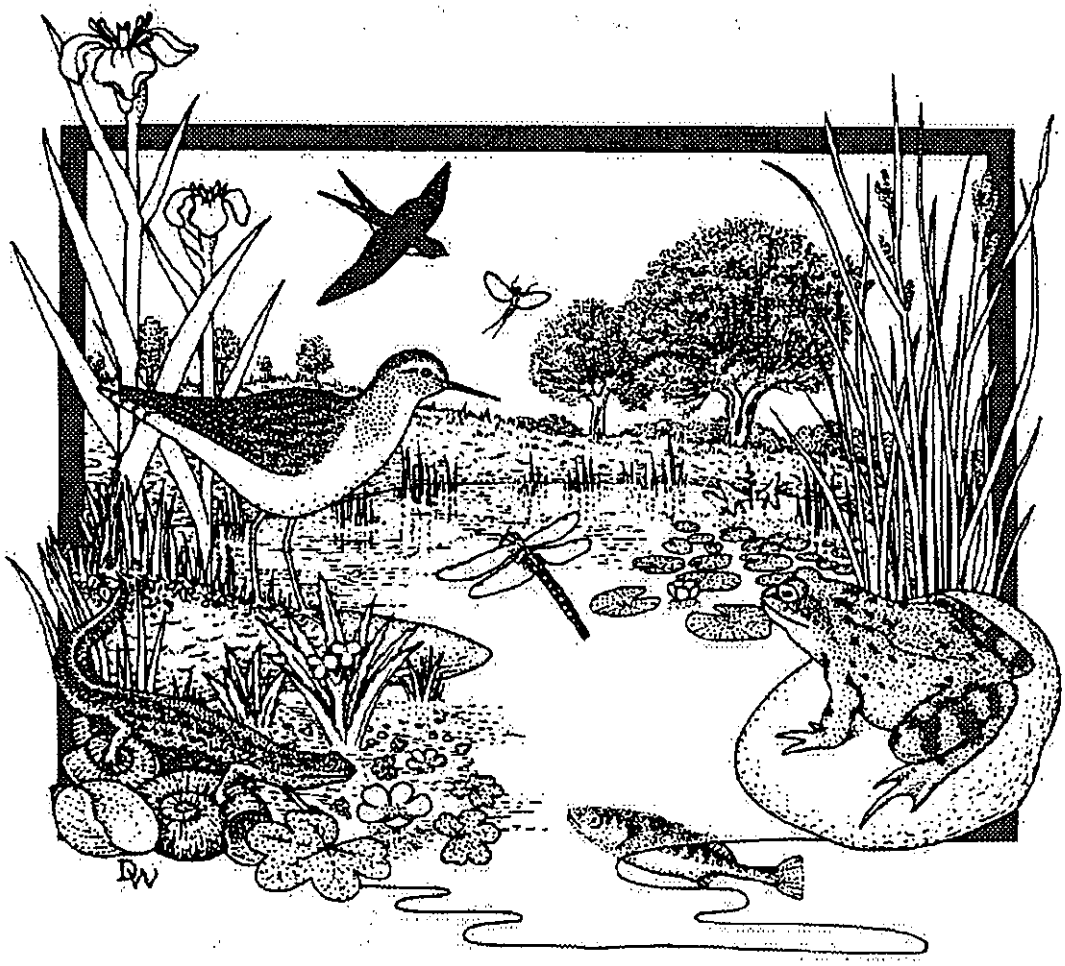
5282

Ecological Survey of the Rivelin Valley Ponds (Sheffield) and Sunny Bank Pond (Mirfield)



October 1999

Pond Action
Oxford Brookes University
Gipsy Lane

Headington
Oxford OX3 0BP
Tel: 01865 483249

CONTENTS

Ecological Survey of the Rivelin Valley Ponds (Sheffield) and Sunny Bank Pond (Mirfield)

Summary of findings

Surveys of Sunny Bank Pond (Mirfield) and 11 ponds in the Rivelin Valley (Sheffield) were undertaken in order to assess their ecological importance and provide information to guide future management.

The results of the survey of Sunny Bank Pond showed that it supported a moderately diverse plant community and was rich in aquatic macroinvertebrate species. The site also supported large amphibian populations. The site is already sensitively managed by the local community group and it needs little extra work to maintain its value.

Surveys of ponds in the Rivelin Valley indicated that the area had two main types of pond:

(i) Fishing ponds such as Rivelin Mill and Wolf Wheel, which had extensive areas of deep open water but often relatively little marginal vegetation.

(ii) Silted-up or drained ponds such as Swallow Wheel and Holme Head Wheel which were more-or-less filled with sediment and mainly supported marshland vegetation and/or willow carr.

Both pond types included sites of varying ecological quality: from moderately rich ponds supporting over 20 plant species to rather impoverished sites supporting as few as five plant species. Invertebrate surveys of three of deep water ponds showed that these sites were quite rich in species, but that most biodiversity was concentrated into relatively small areas of the ponds, particularly associated with dense stands of marginal plants.

It is recommended that the main aims for managing the Rivelin series as a whole should be to retain examples of the existing successional stages currently present in the pond series, but to modify some of the drier sites, such as New Dam, to create new areas of shallow water. Minor management to encourage greater habitat diversity could also be undertaken at each of ponds to enhance their existing conservation value.

ECOLOGICAL SURVEY OF THE RIVELIN VALLEY PONDS (SHEFFIELD) AND SUNNY BANK POND (MIRFIELD)

1. AIMS AND OBJECTIVES

This report describes the results of ecological surveys undertaken by Pond Action at Sunny Bank Pond (Mirfield) and 11 ponds in the Rivelin Valley (Sheffield).

The work was commissioned by the Ponds Conservation Trust in order to provide information about the ecological value of the ponds and to provide the basis for decisions about their future management. Archaeological information about the sites is available in a sister report produced by the Centre of Wetland Archaeology (Fletcher *et al.* 1999)[1].

1.1 Background

The current study forms part of the Ponds Conservation Trust's (PCT) 'Ponds for People' project. This project, which is currently running as a pilot centred in the NE of England, is a collaborative venture between the PCT, Environment Agency, Local Authorities, water companies and local community groups. Its overall objective is to help deliver local Biodiversity Action Plan objectives with respect to ponds.

The sites described in this report, were selected from a range of ponds in the Sheffield and Leeds areas, identified during a one day field visit by representatives of the Environment Agency, Local Authorities and Pond Action.

1.2 Structure of this report

The report is divided into three sections, each of which includes both ecological results and management recommendations. These are:

1. An overview of the Rivelin Valley pond series
2. Individual descriptions of the Rivelin Valley ponds
3. Sunny Bank Pond.

[1] Fletcher, W., R. Van de noort, H. Chapman and J. Bunting (1999). Archaeological desk-top assessment of Mirfield Motte, Sunny Bank Pond (Mirfield), Thornhill Moat (Kirklees, West Yorkshire), and Rivelin Mill Pond, New Dam and Havelock Dam (Sheffield, South Yorkshire). Centre for Wetland Archaeology, University of Hull.

2. AN OVERVIEW OF THE RIVELIN VALLEY PONDS

2.1 Background

Rivelin Valley is a narrow, steep sided valley which lies to the east of Sheffield. The valley and its river have a history of industrial use, dating back to at least the 17th century. This has included the creation of a series of mill wheels fed by water diverted from the River Rivelin into adjacent ponds.

The Rivelin ponds were all broadly similar in construction with, typically, an inflow at the western end, a stone or brick dam along the eastern margin, one other bank either stone or brick and the fourth side formed by the steep earth slopes of the valley itself.

Today, the ponds are in a varying state of preservation, with some partly drained or infilled by deep sediment, and others still more-or-less full of water.

2.2 Ponds surveyed

In total 18 ponds in the Rivelin Valley were visited for the current survey. Of these, 11 supported wetland vegetation of some sort; the remaining seven were dry.

Wetland plant surveys were undertaken at all 11 extant Rivelin Valley ponds. These sites were: Rivelin Mill, Paper Mill Dam, Frank Wheel, Wolf Wheel, Swallow Wheel, Hind Wheel, Nether Cut Wheel, Holme Head Wheel, Roscoe Wheel, New Dam and Havelock Mill.

Aquatic macroinvertebrate surveys were undertaken at three Rivelin Valley ponds: Frank Wheel, Nether Cut Wheel and Havelock Mill. These were selected to reflect a range of the pond types which retained open water.

The seven additional dry ponds which were not surveyed were: Upper Coppice Wheel, Second Coppice Wheel, Plonk Wheel, Upper Cut Wheel, Spooner Wheel, Walkley Bank Tilt and Crogram Wheel.

Table 2.1 Rivelin Valley ponds which were included in the survey

No.	*Name of pond*	*Grid reference*	*Invertebrate survey undertaken*	*Plant survey undertaken*
1	Rivelin Mill	(SK291873)		✓
2	Paper Mill Dam	(SK295874)		✓
3	Frank Wheel	(SK299874)	✓	✓
4	Wolf Wheel	(SK301875)		✓
5	Swallow Wheel	(SK303875)		✓
6	Hind Wheel	(SK309876)		✓
7	Nether Cut Wheel	(SK312878)	✓	✓
8	Holme Heal	(SK315880)		✓
9	Roscoe Wheel	(SK316882)		✓
10	New Dam	(SK318883)		✓
11	Havelock Mill	(SK324887)	✓	✓

2.3 Methods

Havelock Mill was surveyed for plants, invertebrates and amphibians by Pond Action on 17th July 1999. Other Rivelin valley ponds were surveyed on 16th August 1999.

The methods used for the survey were based on standard techniques used for the National Pond Survey. Data from the site were compared with other sites from the UK which were surveyed using the same methodology.

The methods used to undertake the survey are described in Appendix 1. In brief, invertebrates were surveyed by taking a standard hand-net sample from the main pond habitats. The habitat samples were then sorted in the laboratory to remove invertebrate species for identification. Wetland plants were surveyed by walking and wading the perimeter and, where possible, the open water areas of the ponds. Deeper areas were surveyed using a grapnel thrown from the bank. Amphibians were searched for around the edge of the pond and by hand netting in the water.

The pond's conservation value was assessed in terms of:

(i) the number of species of plants, invertebrates and amphibians recorded at the site,

(ii) the number of uncommon species found.

2.4 Results

Overall, the Rivelin Valley ponds could be broadly divided into two types:

(i) Fishing ponds which had extensive areas of deep open water but often relatively little marginal vegetation . These ponds were: Rivelin Mill, Wolf Wheel, Hind Wheel, Nether Cut Wheel and Havelock Mill.

(ii) Silted-up or drained ponds which were more-or-less filled with sediment and mainly supported marshland vegetation and/or willow carr. These ponds had little permanent open water, but temporary pools often occurred within the marsh. These ponds were: Paper Mill Dam, Swallow Wheel, Holme Head Wheel, Roscoe Wheel and New Dam.

The main exception to these two groups was Frank Wheel which, although it had extensive areas of relatively deep open water, appeared to have little fishing interest presumably because of its all margins were heavily shaded by trees.

2.4.1 Plant survey results

Across the pond series as a whole, 49 species of wetland plants were recorded. This is about 12% of the British wetland flora. Most wetland plants were common and widespread species, and no Nationally Scarce or rare plant species were recorded. However three plant species were of 'local' interest: Small Pondweed (*Potamogeton berchtoldii*), Yellow Loosestrife (*Lysimachia vulgaris*) and Square-stalked Willowherb (*Epilobium tetragonum*). Most wetland plants recorded were marginal species; few ponds had extensive stands of submerged aquatic plants.

The richest ponds for plants were Holme Head Wheel and Roscoe Wheel (which were both marsh ponds) and Nether Cut Wheel (a fishing pond). All of these waterbodies supported over 20 wetland plant species which is a moderate to good total (see Appendix 4). In each case, the reason the waterbody was rich was because it supported extensive areas of marsh vegetation, some or most of which, was unshaded by trees.

The ponds which were most impoverished were Frank Wheel, Wolf Wheel and New Dam which each supported only 5-8 species of wetland plant. In the case of Frank

Table 2.2 Number of wetland Plant species recorded from the Rivelin ponds

	Number of plant species recorded:			
	Submerged plants	*Floating plants*	*Marginal plants*	*All plants*
Rivelin Mill	0	2	16	18
Paper Mill Dam	2	0	15	17
Frank Wheel	2	0	3	5
Wolf Wheel	0	0	8	8
Swallow Wheel	2	0	11	13
Hind Wheel	0	1	17	18
Nether Cut Wheel	1	1	19	21
Holme Head Wheel	1	1	19	21
Roscoe Wheel	1	0	22	23
New Dam	0	0	5	5
Havelock Mill	0	1	12	13
TOTAL	**2**	**4**	**42**	**49**

and Wolf Wheels the reason the pond communities were poor was because the pond margins were heavily shaded or either steep and reinforced. In the case of New Dam, the pond was almost dry.

2.4.2 Invertebrate survey results

In the three Rivelin ponds surveyed for aquatic macroinvertebrates the invertebrate communities were moderately species-rich (Table 2.3 and Appendix 4). In the richest pond, Nether Cut Wheel, most species were recorded from the well vegetated areas around the inflow marsh rather than from the extensive open water areas of the pond. Species-richness in the other ponds was probably partly compromised by lack of good habitat, particularly the absence of marginal and submerged vegetation. In particular, the combination of reinforced and shaded banks meant that there were few opportunities for emergent plants to develop. This is particularly important in ponds with high fish densities, since many invertebrates will only survive if there is very dense cover which they can use to avoid fish predation.

All invertebrate species recorded in the three ponds were common, except for a single Nationally Notable beetle species (*Hydraena testacea*) recorded from Frank Wheel (the deep, shaded un-fished pond). Dragonflies were generally uncommon, with only one species recorded (*Aeshna cyanea*, the Southern Hawker), again from Frank Wheel.

2.4.3 Amphibians

No amphibians were recorded from the Rivelin ponds in the current survey. However, it should be noted that the timing of the surveys was late in the year for assessing amphibian populations. It is highly likely that ponds of this sort support Common Frog (*Rana*

temporaria), Common Toad (*Bufo bufo*) and Smooth and/or Palmate Newt (*Triturus vulgaris*, *T. helvetica*) populations.

2.4.4 Overall

Overall, the Rivelin ponds provided a good biodiversity resource, including a number of local plant species and a wide range of aquatic macroinvertebrate species. Additional invertebrate species will be inevitably present in the majority of ponds which were not surveyed.

Table 2.3 Number of invertebrate species recorded from the Rivelin ponds

	Number of species recorded in major invertebrate groups in:		
	Frank Wheel	*Nether Cut Wheel*	*Havelock Mill*
Flatworms and leeches	3	5	6
Snails and bivalves	7	12	6
Shrimps and slaters	3	2	2
Damselflies and dragonflies	1	0	0
Beetles	14	14	5
Caddis-flies	7	9	8
Alderflies	0	1	1
Bugs	4	5	10
Mayflies	0	2	1
Stoneflies	1	1	0
Water Spider	0	1	0
TOTAL	**40**	**52**	**39**

2.5 Management recommendations for nature conservation

The main recommendations for the Rivelin pond series as a whole are that:

(i) the best representatives of the existing successional stages currently present in the pond series are retained,

(ii) individual ponds are modified to increase their current conservation interest,

(iii) a small number of ponds undergo major renovation, creating if possible, extensive areas of shallow open water.

Recommendations for managing the fishing ponds and marsh ponds are discussed separately below.

2.5.1 The fishing ponds

Surveys of the fishing ponds showed that most parts of these ponds supported rather few plant or invertebrate species. This was usually due to one or more of four factors: (i) vertical stone banks which provided few habitats for animals or marginal plants (ii) the tendency for banks which were not reinforced to be heavily shaded by trees, reducing the potential for marginal plant growth (iii) the turbidity of the water, caused by high fish densities, which prevented submerged aquatic plants from flourishing (iv) heavy fish predation which reduced the abundance of invertebrate animals.

However, most fishing ponds also had smaller areas which were biodiversity hotspots. In the richest ponds (Hind Wheel and Nether Cut Wheel) these hotspots were associated with the sediment deltas at their inflow end. These delta areas had been colonised by a wide range of marsh plants which considerably increased the floristic value of the waterbodies. Invertebrate data (only available from Nether Cut Wheel and Havelock Mill) also showed that the richest areas of the pond for invertebrate animals were the very densely vegetated areas, presumably because here animals could escape intense fish predation.

Improving the conservation value of the fishing ponds

The most effective way to improve the conservation value of the fishing ponds would be to provide a greater area of well-vegetated shallow water where marginal plants can thrive and invertebrate animals can escape fish predation. Possible ways of doing this are:

1. Selected removal of trees from the edge of non-reinforced banks. This will give scalloped glades at the waters edge where marginal plants can develop (e.g. north bank of Wolf Wheel and south-east bank of Havelock Mill).
2. Habitat creation at the edge of non-reinforced banks to give marginal shallows and pools with a lower potential for fish predation (e.g. north bank of Wolf Wheel and SE bank of Havelock Mill).
3. Creation of marginal pools at the edge of the delta areas to give fish-free areas (e.g. Nether Cut Wheel).

In the long term there is a potential for conflict in the fishing ponds, between the need for open water for fishing and the biodiversty value of the sites, which generally increases with the gradual encroachment of the inflow sediment deltas.

In general, dredging-out of silt from the remaining *deepest* open water areas in these ponds would be likely to cause few problems to the current wildlife interest of the sites, since these areas appear to support relatively few species. Complete removal of the delta areas should, however, be avoided since this will also remove the main areas of conservation value at these ponds. The best option would be to maintain the deltas at between one fifth and one third of the total area of the pond, but to prevent further encroachment. More detailed recommendations for appropriate dredging of individual ponds are given in Section 3. A set of good practice guidance notes for maintaining both fishing and conservation interests in fish ponds is given in Appendix 5.

As noted above, one of the ponds in the Rivelin series, Frank Wheel, was unusual in that it had deep water but was not fished. Since it supported a distinctive plant and animal community it would seem worthwhile retaining this pond much as it is, or with a limited amount of tree clearance. Unfortunately, however, this pond also has a population of the invasive alien plant New Zealand Swamp-stonecrop (*Crassula helmsii*). Ideally an effort should be made to eradicate this species from the pond, particularly if any management is undertaken to decrease marginal shade at the site.

2.5.2 The marsh ponds

The aim with the marsh and willow carr-filled ponds should be to keep at least some examples of these late succession ponds in tact. They are valuable because some were amongst the richest of the pond series for wetland plants. They may also have an inherent value for some groups not looked at in the current survey - particularly semi-terrestrial invertebrates. Further survey work to establish their real value would be useful.

The best examples to retain are probably: Swallow Wheel, Roscoe Wheel and Holme Head Wheel. Swallow Wheel is of interest because it has one of the best willow carr communities. Roscoe Wheel and Holme Head Wheel were the richest plant sites in the series. To improve the value of these ponds further, a limited amount of selective tree felling could be undertaken. The creation of additional small open water pools within the marsh would add further value.

The two other marsh ponds, New Dam and Coppice Wheel, appear to have less inherent interest. New Dam in particular was more-or-less dry. The series as a whole would

probably benefit if these ponds were repaired and re-flooded to give additional areas of open water. ideally they should be maintained at a relatively shallow depth (too shallow to be suitable for fishing). this would create the sort of shallow water habitat which is often very rich and largely absent in the remaining pond series.

3. INDIVIDUAL DESCRIPTIONS OF RIVELIN VALLEY PONDS

This section gives specific descriptions and management recommendations for each of the Rivelin ponds surveyed.

3.1 Rivelin Mill

3.1.1 Location

Rivelin Mill (SK 291873) is the uppermost pond in the Rivelin Valley series and is located immediately north-east of the junction between the A57 and A6101 at Rivelin Mill Bridge.

3.1.2 Description

The pond is about 200 m in length but varies in width from 8 m to 20 m. The pond's northern margin is relatively natural with an earth and rock bank, and is heavily shaded by overhanging mixed deciduous woodland. A path runs along the southern edge of the pond. The bank here is vertical and edged by stone, but is far less shaded with only scattered clumps of scrub and trees.

At the time of the survey, the pond was locally very silty, particularly towards the western end where the inflow had deposited an extensive sediment delta.

3.1.3 Ecology

Overall the pond supported a moderate wetland flora (19 species recorded). The most diverse areas of the pond were associated with extreme eastern and western ends, particularly the sediment inflow delta at the western end. Over half of the plant species recorded from the pond were only found in these areas.

The remaining areas of the pond supported few plant stands or species. This was in part due to the shape and surrounds of the pond which were typically inhospitable to the development of wetland marginal plants. The northern border, in particular, was heavily shaded. The southern margin was bordered by stone walls which dropped vertically in to water depths of 0.2 m or more.

The site supported no submerged aquatic plant species. This was probably at least partly due to fish disturbance: at the time of the survey the water in Rivelin Mill was moderately turbid, whereas water clarity in unfished ponds was good. This suggests that the pond had a moderate to high fish biomass.

Two non-native plant varieties had been introduced to the pond: a cultivated waterlily (*Nymphea* sp.) and a cultivated variety of Marsh Marigold (*Caltha* sp.).

Wetland plant abundance (i.e. vegetation cover) across the pond as a whole was very low with less than 3% of the pond occupied by marginal wetland plants and no submerged aquatics. The most extensive emergent stand was associated with the western delta area, however, a large clump of Bulrush (*Typha latifolia*), about 8 m in diameter, had developed locally on a second sediment bar towards the western end of the pond.

3.1.4 Management recommendations

Rivelin Mill has a low abundance of wetland plant species, and this is also likely to compromise its potential for supporting diverse a invertebrate community, especially since the site appears to have a moderate to high fish biomass.

The current ecological value of the pond could be increased by encouraging the development of a greater abundance of marginal wetland plant species. This could be most easily achieved by scalloping the woodland edge along the northern boundary of the pond choosing, in particular, areas where bank slope angles are lowest.

There was on-site evidence that this pond may be dredged in the near future. If so, it is important that the existing vegetation stands at the eastern and western ends of the pond are left undisturbed to ensure that the existing botanical value of the site is retained.

It would also be useful if any coarse inorganic sediments dredged out from the site (e.g. sand and gravel from near the delta area) could be used to locally improve the edge profile of the pond, by for example, creating small marginal bars along the northern pond edge to create more opportunities for marginal plant species to colonise.

3.2 Paper Mill Dam

3.2.1 Location

Paper Mill Dam (SK295874) is the second highest pond in the Rivelin Valley series.

3.2.2 Description

The pond is triangular in shape, and relatively small: 400 m^2 in area. Most of the pond area is shaded by trees which grow around both margins, and locally within the pond as well.

At the time of the survey, the pond had almost completely silted-up. An extensive sediment bar had developed in the central-western area of the pond, occupying about a quarter of the total pond area. This bar largely supported terrestrial vegetation dominated by Stinging Nettle (*Urtica dioica*) and Alder (*Alnus glutinosa*). Most of the remaining area of the pond was occupied by either marsh vegetation, or a shallow stream channel (c.0.1 m deep) which ran down the southern border of the pond before opening up into a shallow pool in front of the eastern dam wall.

3.2.3 Ecology

The pond supported a moderately rich plant community (17 species). Despite the shade and extensive sediment bar, the abundance of wetland plants was moderately high, with about 30% of the total pond area covered by wetland species. This included a mosaic of emergent plant species developed on the wet marshy areas including extensive areas of Brooklime (*Veronica beccabunga*), Opposite-leaved Golden-saxifrage (*Chrysosplenium oppositifolium*) and Common Marsh-bedstraw (*Galium palustre*). Two aquatic plant species were also recorded, both Water-starworts (*Callitriche* spp.), associated with the shallow water and mud areas of the inflow and pool.

3.2.4 Management recommendations

Late succession ponds are of interest in their own right, and Paper Mill Dam supported good populations of a range of wetland plant species. However, the pond did not support unique

plant species, and the plant community comprised only a moderate diversity of common species. The lack of open water meant that the pond had relatively little potential for supporting rich aquatic invertebrate communities, and although it could potentially support interesting seasonal pond or semi-terrestrial invertebrate assemblages, other ponds in the series appeared to provide similar or better damp and seasonal ground habitats.

Overall, this waterbody could be a candidate for relatively extensive management to create areas of shallow water no more than approximately 0.5 m deep. The best option would be to focus on removing sediment from the eastern and central areas of the pond, but leave a more natural depth gradation at the western end to provide an area where marginal plants can develop.

3.3 Frank Wheel

3.3.1 Location

Frank Wheel is the fifth pond in the Rivelin Valley series, and is located to the south of the A6101 at SK299874.

3.3.2 Description

Frank Wheel is unusual amongst the Rivelin valley ponds in that it is a relatively open water pond but is not currently used for fishing.

The pond is about 900 m^2 in area. Its northern bank is natural earth and abuts the steep wooded slopes of the Rivelin Valley sides. The southern pond bank is edged by a stone wall which extends eastwards to create the pond's dam.

The perimeter of the pond is heavily shaded by trees - and one of these trees has fallen southwards across the middle of the pond almost spanning its width. At the time of the survey the pond was moderately silty with an average depth of 0.45 m of silt and water depths of about 0.5 m.

3.3.3 Ecology

Heavy shading around the margin of this pond ensured that Frank wheel supported very few marginal plants. Only three marginal species were recorded, and two of these were present in very low abundance. Unfortunately the third species was an unwelcome one - the alien exotic New Zealand Swamp-stonecrop (*Crassula helmsii*). Unusually, this very flexible and usually highly invasive species was only found growing in the central, open water areas of the pond. Undoubtedly this was because of the heavy shade around the pond margins prevented it from establishing here: poor light is one of the few natural factors which can inhibit *Crassula* growth.

Set against the poor marginal plant community, however, the pond supported the greatest abundance of submerged plants seen in any of the Rivelin ponds. This included good stands of the locally uncommon Small Pondweed (*Potamogeton berchtoldii*). The reason submerged plants were abundant is likely to be linked to water clarity and fish stocking rates. As noted above, Frank Wheel was not fished or stocked with fish (although stickleback were abundant). As a consequence, water clarity was much better than in other permanent water ponds - where bottom-feeding fish had increased turbidity by stirring up sediments.

Forty species of aquatic invertebrate were recorded from the pond. This is a moderate total, but is higher than might be expected given the absence of marginal plant habitat around the pond. The survey recorded the only dragonfly found in the Rivelin ponds. This was the Southern Hawker *Aeshna cyanea* - a species typical of woodland ponds. The only *uncommon* invertebrate recorded from the Rivelin ponds was also found in Frank Wheel, this was the Nationally Scarce water beetle *Hydraena testacea* a species of ponds and muddy streams.

Table 3.1 Number of invertebrate species recorded from Frank Wheel

	Habitats sampled:			
	Banks	*Roots*	*Submerged Plants*	*All*
Flatworms and leeches	3	0	0	3
Snails and bivalves	5	5	7	7
Shrimps and slaters	2	2	1	3
Damselflies and dragonflies	0	1	0	1
Beetles	11	4	6	14
Caddis-flies	2	1	4	7
Alderflies	0	0	0	0
Bugs	2	1	4	4
Mayflies	0	0	0	0
Stoneflies	1	0	0	1
Water Spider	0	0	0	0
TOTAL	**26**	**14**	**22**	**40**

3.3.4 Management recommendations

Frank Wheel supported a rather different plant and invertebrate community to the other Rivelin ponds. This included the only Nationally Scarce invertebrate species recorded in the ponds as well as a number of woodland or leaf-litter associated species such as the Southern Hawker dragonfly and a number of caddis-fly species. The absence of fish stocking also allowed good populations of Small Pondweed to develop. Overall, therefore, it would seem worth retaining the site much as it is in order to keep its distinctive characteristics.

If any management of Frank Wheel *is* planned, then it is important that the alien species *Crassula helmsii* is first eradicated from the site. It is particularly important not clear back trees to increase light to the pond margins without first removing *Crassula*, since the plant will quickly colonise cleared areas, suppressing other native plant growth and increasing long term management problems.

English Nature and the Institute of Freshwater Ecology have published a leaflet '*Crassula helmsii* Focus on Control' which describes options for eradicating this species. At Frank Wheel, the best method would probably be to draw the pond down briefly and to spray using the herbicide diquat. To avoid damage to other plants, it would be best to do this in winter.

3.4 Wolf Wheel

3.4.1 Location

Wolf Wheel is the sixth pond in the Rivelin Valley series and lies to the south of the A6101 at SK301875.

3.4.2 Description

This is one of the larger and deeper Rivelin Valley ponds, with an average area of c.3500m^2 and water depths in excess of 1.3 m.. A path runs along the southern edge of the pond. The bank here is vertical, edged by stone, and only moderately shaded by trees. To the north, the pond has a more natural earth and stone bank which is heavily shaded by deciduous trees.

In addition to the its western culverted inflow, a number of iron-rich seepages drain into the pond from the northern wooded hillside. The site is used by fishermen, but water clarity was greater than in most other fished ponds suggesting that fish biomass may have been relatively low.

3.4.3 Ecology

Although it is a relatively large site, Wolf Wheel was one of the most floristicaly impoverished of the Rivelin Ponds. It supported only eight marginal plant species, with no aquatic submerged or floating-leaved plants. The marginal plants that were present occurred in very low abundance. Most grew either in crevasses in the southern stone wall, or along the shaded northern margin where the seepages locally created tiny gravel deltas at the pond edge. The reasons for the poor flora are likely to be threefold:

(i) heavy shade along the north and west banks

(ii) vertical stone walls in the south and east banks

(iii) deep water combined with fish stocking giving open water conditions which are unsuitable for most submerged plant species.

3.4.4 Management recommendations

Wolf Wheel currently supports a poor wetland plant community. This is also likely to compromise its potential for supporting diverse a invertebrate community and, incidentally, almost certainly reduces the site's potential as a fishery (see Appendix 5).

The current ecological value of the pond could be locally increased by encouraging the development of a greater abundance of marginal wetland plant species. This could be most easily achieved by scalloping the woodland edge along the northern boundary of the pond choosing, in particular, areas where bank angles are currently the most gentle. Local reprofiling of bank areas could aid this process.

3.5 Swallow Wheel

3.5.1 Location

Swallow Wheel is the seventh pond in the Rivelin Valley series and is located south of the A6101 at SK303875.

3.5.2 Description

This is another silted-up pond which has been much overgrown by willow scrub. Originally the site appears to have been relatively large: probably over 2000 m^2, however it has become much infilled along its northern and eastern borders so that the original pond dimensions are difficult to determine.

As with the other mill pools in the upper reaches of the Rivelin valley, the pond's northern bank was natural earth and more-or-less continuous with the steeply wooded valley sides. The southern and eastern margins were bordered by a stone wall.

At the time of the survey, most of the pond was semi-dry with wet sediment exposed at the surface. However about 30% of the pond held shallow water (0.1 m - 0.2 m deep). The pond was heavily shaded mainly by low slanting willow branches growing across the pond from trees on its northern bank and by trees growing within the pond itself at its eastern end.

3.5.3 Ecology

The pond supported a moderate plant community (13 species), but heavy shade locally reduced its diversity. Wetland herbs such as Common Marsh-bedstraw (*Galium palustre*), Water Mint (*Mentha aquatica*) and Water Horsetail (*Equisetum fluviatile*) grew on the areas of semi-exposed mud wherever shade was lightest. Most emergent plant cover was, however, rather sparse and overall only about 5% of the pond had emergent vegetation of some sort.

Two aquatic plant species (both Water-starworts, *Callitriche* spp.) were recorded from the shallow pools. Their total cover in the pond was about 1%.

3.5.4 Management recommendations

Late succession ponds are of interest and value in their own right and although the pond had limited potential for aquatic invertebrates, it may support interesting semi-terrestrial invertebrates. In the upper part of the Rivelin Valley, this pond is one of only two sites that are silted-up but still retain a wetland community. It might, therefore, be valuable to retain Swallow Wheel in more-or-less its current state, or to restrict future management to enhancement measures such as trimming back a small number of trees and perhaps digging out slightly deeper pools in the sediment to create small areas of permanent or semi-permanent water. If possible, further surveys would be valuable in order to determine the value of the pond for semi-terrestrial invertebrates, since these could potentially include uncommon species.

3.6 Hind Wheel

3.6.1 Location

Hind Wheel (SK309876) is one of middle series ponds in the Rivelin Valley. It lies between two mill ponds which are no longer extant: Plonk Wheel and Upper Cut Wheel.

3.6.2 Description

Hind Wheel is a deep fishing pond with an extensive area of marsh at its western end. The pond is triangular in shape. Its northern edge is a steep sided earth bank which abuts the valley side. The other banks are stone and are topped by access paths.

Most pond margins are moderately shaded, mainly by mature deciduous trees growing on the far side of the path, or by young Alder growing out from crevices in the bank walls. However, the central area of the pond remain largely unshaded so that in total only about 8% of the pond as a whole is directly overhung by trees.

3.6.3 Ecology

Hind Wheel supported a moderately diverse wetland plant community with 18 species recorded from the site. By far the richest area was the marsh zone which had developed on inflow-borne silts in the western half of the pond. Almost all species recorded from the pond were growing here. Since large parts of this deep silty marsh area were inaccessible for survey work the species list for this part of the pond may also be incomplete.

Most of the marsh area was dominated by complex mosaics of wetland herbs including Water Mint (*Mentha aquatica*), Bog Stitchwort (*Stellaria uliginosa*), Floating Sweet-grass (*Glyceria fluitans*) and Water-cress (*Rorippa nasturtium-aquaticum agg.*). Two alien garden

plants were also common: Monkeyflower (*Mimulus guttatus*) and Musk (*Mimulus moschatus*). At the eastern end of the silt delta, where water depths began to increase, extensive stands of Water Horsetail (*Equisetum fluviatile*) dominated, occupying about 4 % of the pond in total.

Other parts of the pond, including the open water areas and stone banks supported few wetland plant species. It is likely that the absence of submerged aquatic plants was due to high fish biomass increasing water turbidity.

3.6.4 Management recommendations

Since this pond is used for fishing it is likely that it will need to be dredged at some point in the future. It is recommended that, when this is done, a portion of the existing marsh is retained. The most appropriate areas would be a triangular area in the western corner about 15 m maximum width, plus a 5m band along the northern edge of the pond incorporating some of the Horsetail marsh.

3.7 Nether Cut Wheel

3.7.1 Location

Nether Cut Wheel (SK312878) is one of middle series ponds in the Rivelin Valley, and lies immediately to the east of the A6101 bridge over the River Rivelin. A small area of car-parking lies adjacent to the pond, used by fishermen and other visitors.

3.7.2 Description

Nether Cut Wheel, is in many ways, similar to Hind Wheel just upstream. It is a fishing pond with an extensive area of marsh at its western end. The pond has a steep natural earth bank along its southern edge, whereas its northern and eastern banks are mainly stone. Most of the central areas of the pond are unshaded, but the northern and southern banks are locally overhung by trees and scrub.

3.7.3 Ecology

In terms of its wetland flora, Nether Cut Wheel is one of the richer ponds in the Rivelin Valley with a total of 21 species recorded. As with Hind Wheel upstream, most of the plant species were recorded in the extensive inflow marsh area which occupied around 50% of the pond area. Unlike Hind Wheel, however, areas of the stone bank were broken down in places along the northern bank providing opportunities for locally uncommon plant species such as Yellow Loosestrife (*Lysimachia vulgaris*) to grow at the marsh edge.

Unusually for the fished Rivelin ponds, Nether Cut Wheel supported small stands of the submerged species Small Pondweed (*Potamogeton berchtoldii*). This occurred in an area of relatively clear shallow water at the NE edge of the marsh, presumably because this area was less disturbed by fish.

The results of the invertebrate survey showed that Nether Cut Wheel was the richest of the three ponds surveyed for invertebrates in the Rivelin Valley, with total of 52 species recorded.

The main reason for its diversity was the provision of dense vegetation cover in the marsh area of the pond which provided sanctuary from fish predation. As Table 3.2 shows,

habitats which had an open structure or offered little shelter (such as the bare east bank, horsetail or wall areas) had comparatively low invertebrate richness.

Table 3.2 Number of invertebrate species recorded from Nether Cut Wheel

	Habitats sampled:						
	Marsh	*Horsetail and open water*	*Bare east Bank and open water*	*Wall*	*Rush Clumps*	*Overhanging Vegetation*	*All*
Flatworms and leeches	4	2	1	2	2	1	5
Snails and bivalves	8	6	1	5	6	6	12
Shrimps and slaters	2	1	2	1	2	2	2
Damsel and dragonflies	0	0	0	0	0	0	0
Beetles	7	2	1	1	8	4	14
Caddis-flies	4	1	1	5	3	4	9
Alderflies	1	1	1	1	1	1	1
Bugs	0	2	1	1	3	4	5
Mayflies	1	1	1	2	1	1	2
Stoneflies	1	0	0	0	0	0	1
Water Spider	0	0	0	0	1	0	1
TOTAL	**28**	**16**	**9**	**18**	**27**	**23**	**52**

3.7.4 Management recommendations

The areas of high invertebrate biodiversity at the site currently occupy a relatively small area of the pond mainly centred in the north-east corner of the marsh area. A greater area of this habitat could be created by digging out small areas of marsh vegetation towards the eastern end of the north bank. In addition, shade could be reduced along the southern bank by selectively trees and locally reprofiling the bank margins to give low angled slopes and encourage growth of marginal vegetation stands.

If dredging is undertaken at the site to increase the area of open water for fishing, care should be taken to focus mainly on dredging deeper water areas and removing only the southern and central parts of the delta. Ideally a band of the existing vegetation at least 8 m width should be retained along the length of the northern bank. Care should also be taken with wall repairs, so that existing vegetation next to the bank is not destroyed.

3.8 Holme Heal

3.8.1 Location

Holme Heal lies in the middle section of the Rivelin Valley and is located on the south side of the valley at SK315880.

3.8.2 Description

Holme Heal is a moderately large (c.4000 m^2) pond which is heavily silted-up. The north and eastern sides of the pond are walled, the southern bank is earth and grades into the steep wooded valley sides above.

All the pond margins are heavily shaded by overhanging trees. The central areas remain relatively open except at the western end where Alders grow in the pond itself.

3.8.3 Ecology

Although most of the pond is silted up, it retains a moderately rich wetland vegetation, with a total of 21 plant species recorded.

Almost all of the unshaded central areas of the pond are vegetated, so that overall about 85% of the pond is covered by wetland vegetation. The marsh's plant community is a mixed mosaic with changing species dominance; however the most abundant species are Great Willowherb (*Epilobium hirsutum*) in the central area of the pond, and Bulrush (*Typha latifolia*) and Water Horsetail (*Equisetum fluviatilis*) towards the generally rather wetter eastern end. Much of the area is still wet enough to support good stands the semi-aquatic Common Water-starwort (*Callitriche stagnalis*). Deeper pools, particularly along the pond's southern border locally had a surface cover of Common Duckweed (*Lemna minor*).

3.8.4 Management recommendations

The pond is currently rich in plant species and supports a complex plant mosaic. It would be worth retaining either this and/or Roscoe Wheel to the east, as examples of rich late succession ponds. If necessary, the site could be made more diverse for aquatic invertebrates by creating a small number of more permanent water pools within existing marsh areas. If possible, further surveys would be valuable in order to determine the value of the pond for semi-terrestrial invertebrates, since these could potentially include uncommon species.

3.9 Roscoe Wheel

3.9.1 Location

Roscoe Wheel is one of middle ponds in the Rivelin Valley series and is located on the northern side of the valley at SK316882.

3.9.2 Description

This is a large and rather complex pond, about 180 m in length, with boundaries that are now difficult to define. The northern bank is contiguous with the wooded valley sides, the southern bank is indeterminate and grades irregularly up into higher ground.

Much of the pond is overhung by trees growing within the pond itself so that, overall about 85% of the pond is shaded. The pond is wettest in its northern half, where water from its stream inflow is supplemented by a series of seepages running from the wooded valley slopes. These seepages have locally created a series of shallow pools overlying deep silt.

3.9.3 Ecology

Perhaps surprisingly, Wheel Roscoe supported the richest wetland flora of all the Rivelin valley ponds, with a total of 23 plant species. The most diverse plant stands grew in the more open glade areas between the trees, however, more shade-tolerant species such as Pendulous Sedge (*Carex pendula*), were a common occurrence beneath the willow scrub growing in both moderate and dense shade.

The reason this site was relatively rich is due partly to its relatively large size, and partly to the variety of habitats including a mosaic of shade densities and hydrological conditions, including the series of semi-permanent pools fed by seepages.

3.9.4 Management recommendations

Some local scrub clearance has already been undertaken at this site in the last few years. This management is welcome, since it provided pockets of light which were exploited by wetland plants. The clearance could perhaps be continued further to remove 10% - 15% more of the existing scrub (i.e. giving a total pond shade cover of 70% - 75%). Further clearance should however be avoided. Other than this the pond can be left it as it is.

3.10 New Dam

3.10.1 Location

New Dam is one of middle series ponds in the Rivelin Valley and is located on the north side of the valley at SK318883.

3.10.2 Description

New dam is now an almost completely dry site. The pond base is sunk down below stone banks 1 m - 1.5 m high and is heavily shaded throughout, both by mixed deciduous trees on the outer banks and by Alder which grow within the pond itself.

A shallow stream channel about 1 m in width runs through the pond, and probably temporarily floods the surrounding ground when the main river is in spate.

3.10.3 Ecology

In terms of its wetland plant community, New Dam was the most impoverished of the Rivelin ponds, with only five species recorded. The main reason for this was the dryness of the site: the pond base is now dominated by damp, more-or-less terrestrial soils which are probably only flooded for a short time in winter and spring. The site was also notable for its heavy shade, so that even terrestrial vegetation cover was low. Most of the site was bare ground with sparsely growing stands of Indian Balsam (*Impatiens glandulifera*).

3.10.4 Management recommendations

New Dam appears to have little inherent botanical interest and would appear to be a good candidate for management and renovation. In terms of the series as a whole, the best option might be to remove most of the marginal trees and reflood this site to create a *shallow* water pond, unsuitable for fishing, but with high biodiversity potential for wetland plants, invertebrates and amphibians.

3.11 Havelock Mill

3.11.1 Location

Havelock Mill is the lowest pond in the Rivelin Valley series and is located at SK324887 adjacent to a car parking area.

3.11.2 Description

The pond is a moderately large fishing pond which is just beginning to silt up at its southern inflow end. The north and western sides of the pond are reinforced with stone, the southern bank is earth and grades into wooded valley sides above.

The south-east and north-west pond banks are shaded by overhanging trees, but the north bank adjacent to the carpark and the central areas of the pond are more open.

3.11.3 Ecology

Havelock Mill supported a rather poor plant community for its size. Only 13 plant species were recorded, and over a third of these only occurred in a small area (c.8m^2) in the north-east corner where a minor seepage locally entered the pond.

The most abundant plant species was Water Horsetail (*Equisetum fluviatile*) which grew out from the southern bank in two large stands. Other plant species were extremely sparse. No aquatic plants were recorded. The paucity of vegetation was partly due to the reinforced and/or shaded banks, although disturbance from fish probably reduced the potential for growth of aquatic species.

A moderate total of 39 invertebrate species was recorded from the pond. The richest habitats were the stands of Water Horsetail and banks overhung with Ivy. Presumably this was because these provided the most complex habitat structure available. The proportion of beetle species recorded was rather low compared to most ponds. This is again likely to be the result of the poor bank structure, particularly the lack of emergent vegetation, and high fish predation.

Table 3.3 Number of invertebrate species recorded from Havelock Mill

	Habitats sampled:						
	North Bank	*Shaded bank with sedges*	*Willow Roots*	*South bank with ivy.*	*Stone Wall*	*Horsetail*	*All*
Flatworms and leeches	2	4	3	4	0	5	6
Snails and bivalves	4	4	5	4	2	6	6
Shrimps and slaters	2	2	2	2	2	2	2
Damsel and dragonflies	0	0	0	0	0	0	0
Beetles	2	1	1	3	0	0	5
Caddis-flies	0	3	2	5	4	6	8
Alderflies	0	0	0	0	0	1	1
Bugs	2	4	5	5	0	3	10
Mayflies	1	1	1	1	0	1	1
Stoneflies	0	0	0	0	0	0	0
Water Spider	0	0	0	0	0	0	0
TOTAL	**13**	**19**	**19**	**24**	**8**	**24**	**39**

3.10.4 Management recommendations

The current ecological value of the pond could be increased by encouraging the development of a greater abundance of marginal wetland plant species. This could be most easily achieved by scalloping the woodland edge along the northern boundary of the pond choosing, in particular, areas where bank slope angles are lowest.

4. SUNNYBANK POND

4.1 Site location and characteristics

Sunny Bank Pond is a small local nature reserve (SE 199216). The site is bordered by a small parkland to the east, with urban gardens to the north and south. On the western side, the pond is bordered by a thin belt of wood and scrub with grassland beyond.

The pond occurs within a sunken rectangular hollow bordered by steep (70-90 degrees) brick banks approximately 2 m high. The site as a whole covers an area of approximately 1400 m^2, and is divided in two by a low brick wall (approximately 0.4 m high) running ENE/WSW across the site.

When the pond was surveyed in July 1999, only the southern half of the site was wet, and the pond occupied approximately 75% of this southern area (c. 700 m^2). Ground levels in the northern half of the pond were at least 0.1 m higher than the southern basin. However it was clear that much of this area also floods in winter and spring, with only the north-west corner of the site remaining dry for most or all of the year.

Water depths in the pond averaged 0.43 m, and there was relatively little sediment (average depth of 0.21 m). Watermarks around the pond suggests that in winter and spring the standing water level in the pond is approximately 0.5 m deeper than at the time of the survey. Below the sediment, the base of the pond appeared to be artificial, composed of concrete and/or brickwork.

The pond appears to have a very small surface catchment, and to be mainly fed by a combination of direct precipitation and surface run-off within the brickwork basin area itself. Rising land to the north of the pond may provide a little extra surface water. An old pipe drain in the NE corner appeared to be blocked.

The quality of surface water is likely to be good since it mainly drains a semi-natural area within the reserve itself. A little rubbish: (bags, bottles, clothes) was present. Grass clippings which appeared to have blown in from the adjacent park area had brought with them a trace of oil.

4.2 Ecological results

4.2.1 Plant survey results

The pond supported a moderate diversity of wetland plants, with at total of 15 species recorded. The most interesting species was the locally common Dark Stonewort (*Nitella opaca*) which grew near to the front of the pond in an area which appeared regularly managed.

4.2.2 Invertebrate survey results

The pond was rich in macroinvertebrate species with almost 50 species recorded in the survey. All species were, however common and widespread taxa. MERICIA PLEASE ADD

4.2.3 Amphibians

The pond supported very good populations of Common Frog (*Rana temporaria*) with many hundreds of young metamorphs seen around the edge of the pond. Newt efts were also very common in the water. These were too young for thier species to be determined with certanty, but were either Smooth or Palmate (*Triturus vulgaris* or *Triturus helvetica*).

Table 4.1 Number of invertebrate species recorded from Sunny Bank Pond

	Habitats sampled:						
	Grassy Bank	*Chara*	*Chara with Algae*	*Grass*	*Bulrush and Iris*	*Trees*	*Total*
Flatworms and leeches	3	2	2	2	1	4	5
Snails and bivalves	3	4	3	3	3	5	5
Shrimps and slaters	2	2	1	2	2	1	2
Damselflies and dragonflies	0	1	0	0	1	0	1
Beetles	5	4	4	9	6	7	20
Caddis-flies	2	1	0	2	2	2	5
Alderflies	0	0	0	0	0	1	1
Bugs	0	1	6	0	3	3	8
Mayflies	0	0	1	0	0	0	1
Stoneflies	0	0	0	0	0	0	0
Water Spider	1	0	0	0	0	0	1
TOTAL	**16**	**15**	**17**	**18**	**18**	**23**	**49**

4.3 Management recommendations for nature conservation

There is no need for major change in the current management of Sunny Bank Pond. The site is has a good diversity of habitats including both permanent and seasonal waters. The area of carr is valuable for amphibians and nesting birds and the wetland vegetation structure is good. Overall, therefore, the local group are already doing a very good job looking after the site.

The only additional suggestion that might improve the diversity of the site a little would be to improve local habitat structure by:

(i) reducing some of the area of Yellow Flag where it lines the water's edge, in order to encourage better growth of low-growing grasses here. This will improve the marginal structure for invertebrates such as water beetles.

(ii) to create a number of small shallow pools (in the order of 1 m diameter and 10 - 15 cm deep) in the dry zone of the pond site. This would create an additional habitat which would, again, increase the biodiversity of the site by attracting a wider range of aquatic invertebrates.

APPENDICES

Appendix 1. Survey methods

The methods used to survey the pond were based on methods developed for the National Pond Survey initiated by Pond Action in 1989. National Pond Survey methods have subsequently been used as the basis for many other regional and national surveys including DETR's Lowland Pond Survey 1996 (Williams *et al.*, 1998) and Pond Action's national survey of degraded ponds. A full copy of the methodology is given in Pond Action 1994. Modified extracts which describe the field sampling protocol are given below.

Summary of pond survey procedure

The following list gives a broad outline of the information gathered at each pond.

- A description of the main physical features of the pond and its surroundings together with notes about the age, history and management of the pond.
- Water chemistry: pH and conductivity using field meters.
- A list of the wetland plant species found within the outer boundary of the pond, together with estimates of the abundance of species or major vegetation stands which occupy more than 5% of the pond.
- A list of the species of macroinvertebrates recorded from the pond with estimates of their abundance.
- Notes on the presence of amphibians and fish.

The methods used for collecting biological data are outlined in more detail below.

Recording wetland plants

The main aim of plant recording is to make a complete list of the *wetland plant species*[2] present within the *outer edge* of the pond[3]. Wetland plants are recorded by walking and wading around the margin and shallow water areas of the pond. In deep water aquatic plants are surveyed using a grapnel thrown from the bank and/or boat.

Sampling aquatic macroinvertebrates

The main aim of invertebrate sampling is to obtain, within the sampling time, as complete a species list as possible for the pond,

The pond is sampled, using a hand net, for a total of three minutes (net in the water time). During this time all of the major habitats in the pond are sampled. Examples of typical habitats are: stands of sedge; gravel- or muddy-bottomed shallows; areas overhung by willows, including tree-roots growing into the water; stands of submerged aquatics; flooded marginal grasses and inflow areas. The average pond contains 4-10 habitats. Habitats are identified by an initial walk around the pond examining vegetation stands and other relevant features.

Invertebrate sampling is based on the following protocol:

(i) The three minute sampling time is divided equally between the number of habitats recorded: e.g. with six habitats, each is sampled for 30 seconds. Where a habitat is extensive or covers several widely-separated areas of the pond, the sampling time allotted to that habitat is further divided in order to represent it adequately (e.g. into 6 x 5 second sub-samples).

(ii) Each habitat is netted vigorously to dislodge and collect animals. In stony or sandy ponds the substrates are kicked-up to disturb and capture inhabitants.

---

[2]The term 'wetland plant species' refers to species defined as wetland plants on the National Pond Survey field recording sheet list. Terrestial plant species are not recorded.

[3]The 'outer edge' of the pond is defined as the 'upper level at which water stands in winter'. In practice this line is usually readily distinguishable from the distribution of wetland plants or as a 'water mark' on surrounding trees or walls.

The three-minute sampling time refers only to 'net-in-the-water' time and does not include time moving between adjacent habitats.

(iii) A one minute search (total time, not net-in-the-water time) is made to find animals which may otherwise be missed in the main 3-minute sample. Areas which might be searched include the water surface (for whirligig beetles and pond skaters), hard substrates (for firmly-attached animals), the silty or sandy bottom sediments (for dragonflies and mayflies) and under stones and logs (for limpets, leeches, flatworms and Caddis-flies).

(iv) Amphibians or fish caught whilst sampling are noted on the field recording sheet and returned to the pond.

Sorting and identifying macroinvertebrate samples

The hand-net samples are sorted in the laboratory to remove invertebrates collected in the net. Samples are sorted 'live' and not frozen or preserved prior to sorting. Samples are sorted as soon as possible after collection, usually within three days of collection.

In general the aim of sorting the sample is to remove and identify all individual invertebrates. In samples where one or two species are present in large numbers (e.g. thousands of specimens), specimens of these species are counted in a subsample and numbers then extrapolated to the whole sample. All specimens of species which cannot be reliably identified in the sorting tray are removed and preserved in alcohol, with the exception of flatworms which are identified immediately. On average, sorting a pond sample to remove invertebrates takes approximately 6-8 hours. Samples containing a considerable amount of algae or duckweed may take considerably longer.

Species which are not immediately identifiable whilst sorting are identified using biological keys and a microscope with a magnification of at least x30. A list of guides is given in Pond Action (1998). Many species (especially the larval stages of insects) cannot be identified below certain sizes. Appropriate sizes are given in identification keys. After identification, invertebrates are returned to a labelled bottle and archived.

Appendix Table 1.1 Macroinvertebrate taxa included in pond surveys

Taxon	*Identification level*	*Notes*
Tricladida	Species	Identified live
Gastropoda	Species	As adults
Bivalvia	Species	Inc. *Sphaerium* spp., but not *Pisidium* spp.
Crustacea (Malacostraca)	Species	As adults
Hirudinea	Species	Identified live
Ephemeroptera	Species	As larvae
Odonata	Species	As larvae
Megaloptera (inc. spongeflies)	Species	As larvae
Hemiptera	Species	As adults
Coleoptera	Species	As adults
Plecoptera	Species	As larvae
Lepidoptera	Species	As larvae
Trichoptera	Species	As larvae
Oligochaeta	Class	As adults
Diptera	Family	As larvae

Note: watermites, zooplankton and other microarthropods are not included in the survey.

Appendix 2. Wetland plants recorded

Latin binomial	English name	Rivelin Mill	Paper Mill	Frank Wheel	Wolf Wheel	Swallow Wheel	Hind Wheel
Submerged plants							
Callitriche stagnalis	Common Water-starwort	-	+	-	-	+	-
Callitriche hamulata/brutia agg	Intermediate Water-starwort	-	+	+	-	+	-
Nitella opaca	Dark Stonewort	-	-	-	-	-	-
Potamogeton berchtoldii	Small Pondweed	-	-	+	-	-	-
Floating-leaved plants							
Lemna minor	Common Duckweed	-	-	-	-	-	+
Lemna trisulca	Ivy-leaved Duckweed	-	-	-	-	-	-
Nymphaea sp.	Water-lily exotic variety	+	-	-	-	-	-
Persicaria amphibia	Amphibious Bistort	+	-	-	-	-	-
Emergent plants							
Agrostis stolonifera	Creeping Bent	+	+	+	+	+	+
Alopecurus geniculatus	Marsh Foxtail	-	-	-	-	-	-
Angelica sylvestris	Wild Angelica	+	+	-	-	-	+
Apium nodiflorum	Fool's-water-cress	-	-	-	-	-	-
Caltha palustris (cultivated variety)	Marsh-marigold	+	-	-	-	-	-
Cardamine amara	Large Bitter-cress	-	-	-	-	-	+
Cardamine pratensis	Cuckooflower	-	+	-	-	-	-
Carex pendula	Pendulous Sedge	-	-	-	-	-	-
Chrysosplenium oppositifolium	Opposite-leaved Golden-saxifrage	+	+	-	+	+	-
Cirsium palustre	Marsh Thistle	-	-	-	-	-	-
Crassula helmsii	New Zealand Pigmyweed	-	-	+	-	-	-
Deschampsia cespitosa	Tufted Hair-grass	+	-	-	-	-	-
Epilobium ciliatum	American Willowherb	-	-	-	+	+	-
Epilobium hirsutum	Great Willowherb	+	-	-	+	-	+
Epilobium palustre	Marsh Willowherb	-	-	-	-	-	-
Epilobium parviflorum	Hoary Willowherb	-	-	-	-	-	-
Epilobium tetragonum	Square-stalked Willowherb	-	-	-	-	-	-
Equisetum fluviatile	Water Horsetail	-	+	-	-	+	+
Equisetum palustre	Marsh Horsetail	-	+	-	-	-	-
Filipendula ulmaria	Meadowsweet	+	-	-	-	-	-
Galium palustre	Common Marsh-bedstraw	+	+	-	-	+	+
Glyceria fluitans	Floating Sweet-grass	-	-	-	-	-	+
Hypericum tetrapterum	Square-stalked St Johns-wort	-	-	-	-	-	-
Impatiens capensis	Orange Balsam	+	+	-	-	-	+
Impatiens glandulifera	Indian Balsam	+	-	-	-	-	-
Iris pseudacorus	Yellow Iris	+	-	-	-	-	+
Juncus articulatus	Jointed Rush	-	-	-	-	-	-
Juncus effusus	Soft Rush	+	+		+	-	-
Lysimachia vulgaris	Yellow Loosestrife	-	-	-	-	-	-
Mentha aquatica	Water Mint	+	-	-	-	+	+

Mimulus guttatus	Monkeyflower	-	-	-	-	-	+
Mimulus moschatus	Musk	-	-	-	-	-	+
Myosotis scorpioides	Water Forget-me-not	-	-	-	-	-	+

Appendix 2. Wetland plants recorded (continued)

Latin binomial	English name	Rivelin Mill	Paper Mill	Frank Wheel	Wolf Wheel	Swallow Wheel	Hind Wheel
Emergent plants (continued)							
Myosotis secunda	Creeping Forget-me-not		+			+	
Petasites hybridus	Butterbur	-	-	-	-	-	-
Phalaris arundinacea	Reed Canary-grass	+	-	-	-	-	-
Ranunculus flammula	Lesser Spearwort	-	-	-	-	+	-
Ranunculus sceleratus	Celery-leaved Buttercup	-	-	-	-	-	-
Rorippa nasturtium-aquaticum agg.	Water-cress	-	+	-	-	+	-
Scutellaria galericulata	Skullcap	-	+	-	+	-	+
Solanum dulcamara	Bittersweet	+	+	-	-	+	+
Stellaria uliginosa	Bog Stitchwort	+	-	+	+	-	+
Typha latifolia	Bulrush	+	-	-	-	-	-
Veronica beccabunga	Brooklime	-	+	-	+	+	+
Unknown exotic		-	+	-	-	-	-
Submerged plants		0	2	2	0	2	0
Floating plants		2	0	0	0	0	+
Marginal plants		17	15	3	8	11	17
TOTAL		**19**	**17**	**5**	**8**	**13**	**18**

Appendix 2. Wetland plants recorded (continued)

Latin binomial	English name	Nether Cut Wheel	Holme Head Wheel	Roscoe Wheel	New Dam	Havel-ock Mill	Sunny Bank Pond
Submerged plants							
Callitriche stagnalis	Common Water-starwort	-	+	+	-	-	+
Callitriche hamulata/brutia agg	Intermediate Water-starwort	-	-	-	-	-	-
Nitella opaca	Dark Stonewort	-	-	-	-	-	-
Potamogeton berchtoldii	Small Pondweed	+	-	-	-	-	-
Floating-leaved plants							
Lemna minor	Common Duckweed	+	+	-	-	-	+
Lemna trisulca	Ivy-leaved Duckweed		-	-	-	+	-
Nymphaea (exotic)	Water-lily exotic variety	-	-	-	-	-	-
Persicaria amphibia	Amphibious Bistort	-	-	-	-	-	-
Emergent plants							
Agrostis stolonifera	Creeping Bent	+	-	+	+	+	+
Alopecurus geniculatus	Marsh Foxtail	-	-	-	-	-	+
Angelica sylvestris	Wild Angelica	+	+	+	-	-	-
Apium nodiflorum	Fool's-water-cress	-	-	+	-	+	-
Caltha palustris	Marsh-marigold (cultivated)	-	-	-	-	-	-
Cardamine amara	Large Bitter-cress	+	+	-	+	-	-
Cardamine pratensis	Cuckooflower	-	-	+	-	+	-
Carex pendula	Pendulous Sedge	-	-	+	-	-	-
Chrysosplenium oppositifolium	Opposite-leaved Golden-saxifrage	+	+	+	+	-	-
Cirsium palustre	Marsh Thistle	-	+	-	-	-	-
Crassula helmsii	New Zealand Pigmyweed	-	-	-	-	-	-
Deschampsia cespitosa	Tufted Hair-grass	-	-	-	-	+	+
Epilobium ciliatum	American Willowherb	+	-	+	-	-	-
Epilobium hirsutum	Great Willowherb	+	+	+	-	+	+
Epilobium palustre	Marsh Willowherb	+	+	-	-	-	-
Epilobium parviflorum	Hoary Willowherb	-	-	-	-	-	+
Epilobium tetragonum	Square-stalked Willowherb	-	-	-	-	-	+
Equisetum fluviatile	Water Horsetail	-	+	-		+	-
Equisetum palustre	Marsh Horsetail	+	-	+	+	-	-
Filipendula ulmaria	Meadowsweet	-	-	-	-	-	-
Galium palustre	Common Marsh-bedstraw	-	+	+	-	+	-
Glyceria fluitans	Floating Sweet-grass	-	+	+	-	+	+
Hypericum tetrapterum	Square-stalked St Johns-wort	+	-	-	-	-	-
Impatiens capensis	Orange Balsam	-	-	+	-	-	+
Impatiens glandulifera	Indian Balsam	+	-	+	+	-	-
Iris pseudacorus	Yellow Iris	-	+	+	-	+	+
Juncus articulatus	Jointed Rush	-	-	-	-	+	-
Juncus effusus	Soft Rush	+	+	+	-	+	+
Lysimachia vulgaris	Yellow Loosestrife	+	-	-	-	-	-
Mentha aquatica	Water Mint	+	+	+	-	-	-
Mimulus guttatus	Monkeyflower	-	-	-	-	-	-
Mimulus moschatus	Musk	+	-	-	-	-	-
Myosotis scorpioides	Water Forget-me-not	-	+	-	-	-	+

Myosotis secunda	Creeping Forget-me-not	-	-	-	-	-	-
Petasites hybridus	Butterbur	-	-	+	-	-	-

Appendix 2. Wetland plants recorded (continued)

Latin binomial	English name	Nether Cut Wheel	Holme Head Wheel	Roscoe Wheel	New Dam	Havel-ock Mill	Sunny Bank Pond
Emergent plants (continued)							
Phalaris arundinacea	Reed Canary-grass	-	-	-	-	-	-
Ranunculus flammula	Lesser Spearwort	-	-	-	-	-	-
Ranunculus sceleratus	Celery-leaved Buttercup	-	-	-	-	-	-
Rorippa nasturtium-aquaticum agg.	Water-cress	+	+	+	-	-	-
Scutellaria galericulata	Skullcap	+	+	-	-	-	-
Solanum dulcamara	Bittersweet	-	-	+	-	+	+
Stellaria uliginosa	Bog Stitchwort	+	+	+	-	-	-
Typha latifolia	Bulrush	+	+	+	-	-	+
Veronica beccabunga	Brooklime	+	+	+	-	-	-
Unknown exotic							
Submerged plants		1	1	1	0	0	2
Floating plants		1	1	0	0	1	1
Marginal plants		19	19	22	5	12	13
TOTAL		**21**	**21**	**23**	**5**	**13**	**16**

Appendix 3. Aquatic macroinvertebrate species recorded

Appendix 3.1 Invertebrate species recorded from Frank Wheel

	Number of individuals recorded in each habitat:			
Habitat sampled	Banks	Roots	Submerged Plants	All
Flatworms				
Polycelis tenuis	1	-	-	1
Leeches				
Glossiphonia complanata	4	-	-	4
Helobdella stagnalis	8	-	-	8
Snails				
Armiger crista	86	3	2	91
Gyraulus albus	150	1	20	171
Hippeutis complanatus	114	43	22	179
Lymnaea peregra	5	5	13	23
Lymnaea stagnalis	-	-	5	5
Potamopyrgus antipodarum	180	46	11	237
Bivalves (freshwater cockles)				
Sphaerium corneum	-	-	2	2
Shrimps and slaters				
Asellus aquaticus	-	-	1	1
Asellus meridianus	45	1	-	46
Crangonyx pseudogracilis	190	4	-	194
Damselflies and dragonflies				
Aeshna cyanea	-	1	-	1
Water beetles				
Anacaena globulus	1	-	-	1
Gyrinus substriatus	5	-	-	5
Haliplus lineatocollis	-	-	1	1
Haliplus ruficollis	9	4	8	21
Haliplus wehnckei	5	1	3	9
Helophorus brevipalpis	16	-	1	17
Helophorus minutus	1	-	1	2
Helophorus obscurus	1	-	-	1
Hydraena testacea	1	-	-	1
Hydrobius fuscipes	-	1	-	1
Ilybius fuliginosus	2	-	1	3
Limnebius truncatellus	2	-	-	2
Ochthebius minimus	1	-	-	1
Platambus maculatus	-	3	-	3
Caddis-flies				
Anabolia nervosa	-	-	2	2
Athripsodes aterrimus	1	-	-	1
Chaetopteryx villosa	-	1	-	1
Glyphotaelius pellucidus	-	-	1	1
Halesus digitatus	2	-	-	2

Limnephilus lunatus	-	-	1	1
Phryganea bipunctata	-	-	1	1

(continued)

Appendix 3.1 Invertebrate species recorded from Frank Wheel (continued)

Habitat sampled	Number of individuals recorded in each habitat: Banks	Roots	Submerged Plants	All
Bugs				
Gerris lacustris	10	-	1	11
Hesperocorixa sahlbergi	1	3	1	5
Notonecta glauca	-	-	1	1
Sigara dorsalis	-	-	8	8
Stoneflies				
Nemoura cinerea	1	-	-	1
TOTAL	**26**	**14**	**22**	**40**

Appendix 3.2 Invertebrate species recorded from Nether Cut Wheel

	Number of individuals recorded in each habitat:						
Habitat sampled	*Inflow*	*Equisetum*	*West Bank*	*Wall Bank*	*Juncus*	*Overhanging Bank*	*All*
Flatworms							
Polycelis tenuis	-	-	-	-	1	-	1
Leeches							
Erpobdella octoculata	1	4	-	1	3	-	9
Glossiphonia complanata	2	-	1	1	-	3	7
Helobdella stagnalis	1	7	-	-	-	-	8
Theromyzon tessulatum	2	-	-	-	-	-	2
Snails							
Acroloxus lacustris	1	1	-	-	3	-	5
Ancylus fluviatilis	1	3	-	2	-	-	6
Armiger crista	1	-	-	-	-	-	1
Gyraulus albus	4	5	-	-	2	11	22
Hippeutis complanatus	2	-	-	-	-	1	3
Lymnaea auricularia	-	-	-	1	-	-	1
Lymnaea peregra	2	-	-	-	-	3	5
Lymnaea stagnalis	-	16	-	-	5	11	32
Planorbarius corneus	-	-	-	1	5	-	6
Planorbis carinatus	1	3	-	1	10	13	28
Potamopyrgus antipodarum	62	29	31	-	96	23	241
Bivalves (freshwater cockles)							
Sphaerium corneum	-	-	-	1	-	-	1
Shrimps and slaters							
Asellus aquaticus	20	4	16	22	53	12	127
Crangonyx pseudogracilis	200	-	12	-	144	3	359
Water beetles							
Anacaena globulus	1	-	-	-	4	3	8
Gyrinus substriatus	-	-	-	-	8	-	8
Haliplus lineatocollis	1	-	-	-	-	-	1
Haliplus ruficollis	-	-	-	-	1	2	3
Haliplus wehnckei	9	-	3	-	-	-	12
Helophorus brevipalpis	-	-	-	1	2	-	3
Helophorus minutus	1	-	-	-	-	1	2
Hydrobius fuscipes	1	-	-	-	-	-	1
Hydroporus palustris	-	-	-	-	2	-	2
Hydroporus striola	1	-	-	-	-	-	1
Ilybius fuliginosus	-	2	-	-	3	-	5
Laccobius bipustulatus	1	-	-	-	2	-	3
Laccophilus minutus	-	-	-	-	1	-	1
Platambus maculatus	-	1	-	-	-	3	4

Appendix 3.2 Invertebrate species recorded from Nether Cut Wheel (cont.)

	Number of individuals recorded in each habitat:						
	Inflow	*Equisetum*	*West Bank*	*Wall Bank*	*Juncus*	*Overhanging Bank*	*All*
Caddis-flies							
Athripsodes aterrimus	-	-	-	-	-	5	5
Beraeodes minutus	1	1	-	-	8	1	11
Cyrnus trimaculatus	-	-	-	1	-	-	1
Limnephilus lunatus	1	-	-	-	1	-	2
Limnephilus vittatus	-	-	-	-	1	3	4
Molanna angustata	2	-	-	8	-	-	10
Mystacides azurea	1	-	1	9	-	5	16
Phryganea bipunctata	-	-	-	1	-	-	1
Tinodes waeneri	-	-	-	1	-	-	1
Alderflies							
Sialis lutaria	5	3	1	7	7	1	24
Bugs							
Gerris lacustris	-	-	-	-	1	2	3
Hydrometra stagnorum	-	3	1	2	6	7	19
Notonecta glauca	-	-	-	-	1	1	2
Notonecta obliqua	-	1	-	-	-	-	1
Velia caprai	-	-	-	-	-	12	12
Mayflies							
Cloeon dipterum	1	7	1	2	7	4	22
Ephemerella ignita	-	-	-	2	-	-	2
Stoneflies							
Nemoura cinerea	3	-	-	-	-	-	3
Water Spiders							
Argyroneta aquatica	-	-	-	-	6	-	6
TOTAL NUMBER OF SPECIES	**28**	**16**	**9**	**18**	**27**	**23**	**52**

Appendix 3.3 Invertebrate species recorded from Havelock Mill

	Number of individuals recorded in each habitat:						
	North Bank	Sedge Bank	Willow Roots	Ivy Banks	Stone Wall	Equisetum	All
Flatworms							
Polycelis tenuis	3	-	3	24	-	2	32
Dendrocoelum lacteum	-	1	-	-	-	-	1
Dugesia polychroa	-	2	-	-	-	1	3
Leeches							
Helobdella stagnalis	50	16	10	19	-	13	108
Theromyzon tessulatum	-	2	2	3	-	2	9
Piscicola geometra	-	-	-	2	-	1	3
Snails							
Acroloxus lacustris	2	1	3	8	-	50	64
Gyraulus albus	2	1	2	-	-	7	12
Lymnaea stagnalis	-	-	-	-	-	8	8
Planorbis carinatus	-	-	60	54	1	3	118
Potamopyrgus antipodarum	8	7	9	25	-	10	59
Bivalves (freshwater cockles)							
Sphaerium corneum	1	1	2	32	4	5	45
Shrimps and slaters							
Asellus aquaticus	133	146	440	445	17	205	1386
Crangonyx pseudogracilis	52	380	365	540	1	192	1530
Water beetles							
Acilius sulcatus	-	-	-	1	-	-	1
Haliplus ruficollis	-	-	-	1	-	-	1
Helophorus brevipalpis	1	1	-	-	-	-	2
Hyphydrus ovatus	-	-	1	-	-	-	1
Ilybius fuliginosus	1	-	-	1	-	-	2
Caddis-flies							
Athripsodes aterrimus	-	-	1	2	-	1	4
Cyrnus flavidus	-	-	-	-	1	1	2
Glyphotaelius pellucidus	-	-	-	1	-	1	2
Limnephilus lunatus	-	1	4	6	1	2	14
Lype reducta	-	-	-	-	-	2	2
Molanna angustata	-	5	-	1	7	3	16
Mystacides longicornis	-	-	-	-	2	-	2
Phryganea bipunctata	-	1	-	1	-	-	2
Alderflies							
Sialis lutaria	-	-	-	-	-	2	2
Bugs							
Callicorixa praeusta	1	2	1	4	-	1	9
Corixa punctata	-	-	1	-	-	-	1
Gerris lacustris	-	1	-	4	-	-	5
Hesperocorixa sahlbergi	-	1	-	-	-	-	1
Hydrometra stagnorum	1	-	-	-	-	-	1
Notonecta glauca	-	-	-	1	-	-	1
Sigara distincta	-	-	1	-	-	-	1
Sigara dorsalis	-	6	17	39	-	6	68
Sigara falleni	-	-	19	8	-	-	27

Sigara nigrolineata	-	-	-	-	-	1	1
Mayflies							
Cloeon dipterum	22	23	33	33	-	30	141
TOTAL	**13**	**19**	**19**	**24**	**8**	**24**	**39**

Appendix 3.4 Invertebrate species recorded in Sunny Bank Pond

	Number of individuals recorded in each habitat:						
	Grassy Bank	Chara and Algae	Grass	Typha and Iris	Trees	Chara	All
Flatworms							
Polycelis nigra	900	12	10	460	74	22	1478
Polycelis tenuis	9	-	-	-	12	-	21
Leeches							
Erpobdella octoculata	-	-	1	-	-	-	1
Helobdella stagnalis	-	-	-	-	1	-	1
Theromyzon tessulatum	1	1	-	-	1	3	6
Snails							
Acroloxus lacustris	-	-	-	-	1	-	1
Armiger crista	70	735	176	1680	107	26	2794
Lymnaea peregra	110	705	2	8	8	90	923
Bivalves (freshwater cockles)							
Musculium lacustre	172	23	13	10	225	108	551
Sphaerium corneum	-	-	-	-	3	24	27
Shrimps and slaters							
Asellus aquaticus	35	9	102	228	8	90	472
Crangonyx pseudogracilis	4	-	48	8	-	23	83
Damselflies and dragonflies							
Pyrrhosoma nymphula	-	-	-	1	-	1	2
Water beetles							
Acilius sulcatus	-	-	-	1	-	-	1
Agabus bipustulatus	-	-	1	-	-	1	2
Agabus sturmii	-	-	2	1	1	-	4
Anacaena globulus	-	-	-	-	1	-	1
Enochrus testaceus	-	2	-	-	-	-	2
Gyrinus substriatus	-	1	-	-	2	-	3
Haliplus lineatocollis	-	-	1	-	-	-	1
Haliplus obliquus	-	-	-	-	-	1	1
Haliplus ruficollis	-	1	2	1	-	-	4
Haliplus wehnckei	-	-	1	-	-	-	1
Helophorus aequalis	1	-	1	-	-	-	2
Helophorus brevipalpis	-	-	-	2	1	15	18
Hydrobius fuscipes	10	1	6	2	-	3	22
Hydroporus angustatus	3	-	3	-	-	-	6
Hydroporus incognitus	-	-	-	-	1	-	1
Hygrotus inaequalis	-	-	-	2	1	-	3
Hyphydrus ovatus	-	-	-	-	1	-	1
Ilybius ater	2	-	-	-	-	-	2
Ilybius fuliginosus	-	-	2	-	-	-	2
Laccobius bipustulatus	1	-	-	-	-	-	1
Caddis-flies							
Agraylea multipunctata	-	-	-	-	-	2	2
Glyphotaelius pellucidus	-	-	-	-	1	-	1

Limnephilus flavicornis	1	-	3	1	6	-	11
Limnephilus lunatus	1	-	-	-	-	-	1
Limnephilus vittatus	-	-	1	1	-	-	2

(continued)

Appendix 3.4 Sunny Bank Pond (continued)

	Number of individuals recorded in each habitat:						
	Grassy Bank	Chara and Algae	Grass	Typha and Iris	Trees	Chara	All
Alderflies							
Sialis lutaria	-	-	-	-	2	-	2
Bugs							
Corixa punctata	-	6	-	5	1	5	17
Gerris lacustris	-	1	-	2	-	-	3
Hesperocorixa sahlbergi	-	5	-	-	2	-	7
Hydrometra stagnorum	-	-	-	-	1	-	1
Notonecta glauca	-	2	-	-	-	-	2
Notonecta marmorea	-	2	-	-	-	-	2
Notonecta obliqua	-	-	-	1	-	-	1
Sigara dorsalis	-	1	-	-	-	-	1
Mayflies							
Cloeon dipterum	-	5	-	-	-	-	5
Water Spiders							
Argyroneta aquatica	1	-	-	-	-	-	1
TOTAL	**16**	**17**	**18**	**18**	**23**	**15**	**49**

Appendix 4. Methods for assessing pond conservation value

The following information gives range of data about the conservation value of *other* ponds in Britain. This information indicates the *typical* species richness of ponds in Britain. The data are based on standard National Pond Survey samples of both plant and invertebrate communities in ponds.

Plant data

Appendix Table 4.1. Number of plant species recorded from UK ponds

		Number of species:		
		Marginal plants	Aquatic plants	**Total plants**
National Pond Survey (high quality ponds mostly located in nature reserves*)	Average	18	5	**23**
	Range	(1-42)	(0-14)	(1-46)
Wider countryside ponds (DETR Lowland Pond Survey, Williams *et al.*)	Average	8.0	2	**10**
	Range	(0-30)	(0-10)	(0-35)
Wider countryside ponds (ROPA Survey*)	Average	11	3	**14**
	Range	(1-32)	(0-11)	(1-38)

*The ROPA survey was undertaken by Pond Action with funding from the Natural Environment Research Council.

Invertebrate data

Appendix Table 4.2 Number of aquatic macroinvertebrate species recorded from other UK ponds

		Number of invertebrate species*
National Pond Survey (All ponds were high quality i.e. located in semi-natural areas).	Average	**32**
	Range	(6-98)
Wider countryside ponds (ROPA Survey)	Average	**26**
	Range	(2-64)

* All results are from a single season 3 minute hand-net sample surveys undertaken by, Pond Action.

Appendix 5. Features of fishing ponds

This table summarises features which are valuable in stillwater fisheries, and describes additional features that can increase a fishing pond's value for other wildlife.

Factors important for freshwater fisheries

- Shelter provided by bankside trees.
- Addition of large dead branches in shallow water to provide shelter for carp and creation of deadwood reefs to protect fish from predation.
- Adequately oxygenated water (though dissolved oxygen concentrations are much more critical for salmonids than for the coarse fish of still waters).
- Creation of spits, bays and islands to make natural swims for each rod.
- Areas of deep water (1 - 3 m) which may be used by trout in summer and carp in winter to find comfortable water temperatures.
- Some deep water near to the bank to make landing fish easier.

- Creating shallow edges to create areas where dense plant stands can provide good habitat for coarse fish spawning and feeding.
- Creating shallow marsh areas, which are inaccessible to adult fish, to provide good fry habitats.
- Making/clearing swims to improve angling enjoyment and create open water for casting.
- Encouraging marginal plants to provide cover and spawning areas for fish such as carp.
- Encouraging growth of submerged aquatic plants and lilies.
- Netting out excess fish (e.g. excess carp, bream, roach, rudd and perch to reduce competition and produce bigger specimen fish.
- Desilting to maintain open water for fishing.
- No go areas during the bird breeding season and during the winter to provide sanctuaries for fish spawning and respite from angling pressure for species such as carp or pike.

Enhancing fisheries for wildlife

What to avoid:

- *Avoid runoff from roads*, carparking or other urban areas entering the pond.
- *Avoid introducing non-natural substances* which will add to pollutant levels as they degrade e.g. creation of 'reefs' from old tyres.
- *Stocking of fish beyond natural densities.* Most fishing waters will be stocked to provide large numbers of fish for angling. Fish are a natural part of most permanent freshwater ponds and pools and about 30-50% of freshwater plants and animals co-exist with fish. The remainder prefer or require freedom from fish predation. Waters with a moderate fish density (up to about 100 kg per hectare) with a mixed population of fish, can be good wildlife habitats. However, unnaturally high densities of fish, greater than 100 kg/ha will have a strongly detrimental impact on the rest of the aquatic ecosystem (loss of aquatic plants, increased turbidity) and will reduce diversity of 'fish compatible' wildlife.
- *Fertilising or neutralising (raising the pH) of waters.* In waters with naturally low nutrient status, or naturally acid (or acidified) waters, fishery managers sometimes fertilise water to increase fish productivity. This is likely to damage naturally acid and low nutrient status waters. Fertilising ponds is perhaps the single most undesirable activity that fishery managers could undertake.
- *Releasing fish in Scotland which are not part of the natural fauna.* In upland Scotland fish have been introduced to many small, permanent upland lochans comparatively recently. Deliberate and accidental release of fish that don't occur naturally is highly undesirable.

Appendix 5. Features of fishing ponds (continued)

- *Avoid adding any non-native plants.* Plant only native species of local provenance. Avoid garden centre plants which are often contaminated with alien plant seeds. This is vital to avoid non-native plants from being released into the wild and decreasing the conservation value of some of our mot beautiful and valuable waterbodies and wetlands.

What to encourage

Areas of very shallow water with very dense plant cover where even young fish find it difficult to penetrate. These will provide sanctuaries for invertebrate animals. In the long term the fish will also benefit from the production of invertebrates food as they move out into other areas more accessible to fish.

Isolated shallow pools, some seasonal, around the edge of ponds which are completely separated from the main waterbody. These provide completely fish-free areas where a wider range of dragonflies, water beetles and other wildlife can thrive.

Ponds with a mosaic of habitats that will encourage a range of species. This could include: complexes of emergent, trees growing in and near the water (providing leaf litter, rotting dead wood for dragonflies, tree roots growing into the water for invertebrate habitat).