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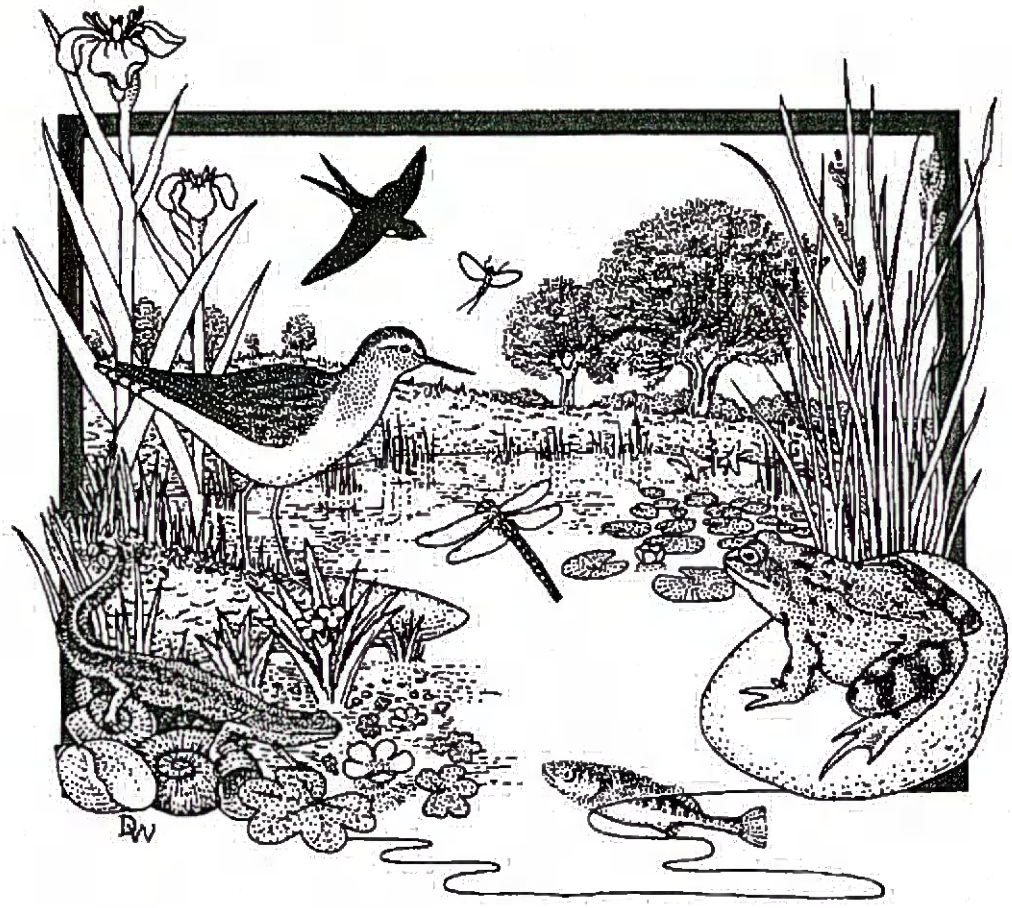
Survey of the wetland plants and aquatic macroinvertebrates of Littleworth Pond (Buckinghamshire)



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Summary

This report describes the results of a survey of the wetland plants and aquatic macroinvertebrates from the main pond (SU93658635) on Littleworth Common, Buckinghamshire. The methods used for the survey were based on standard techniques developed by the Ponds Conservation Trust: Policy & Research (PCTPR[1]) for the National Pond Survey. Plant and invertebrate data were compared with data from other sites in the UK collected using the same methodology.

The survey showed that the pond supported a wetland plant community of moderate quality with 13 plant species recorded. This is just above the average for ponds in the wider countryside, but lower than would be expected for most ponds located in semi-natural areas. No rare or Nationally Scarce plant species were found at the pond, but one species that could be considered local (the floating liverwort *Riccia fluitans*) was recorded.

Overall, the site supported a very high quality macroinvertebrate community, with a total of 56 species being recorded (of which four were Nationally Scarce). However, 55 of these species were recorded from a relatively small area at the edge of the *Glyceria maxima* (reed sweet-grass) stand in the central-south-eastern area of the pond, the rest of the pond appearing more or less impoverished.

Approximately 60 larval and newly metamorphosed newts were netted, all but one of which were found in the invertebrate-rich area. All individuals that were sufficiently adult to be identified were palmate newts (*Triturus helveticus*).

It is recommended that if management is undertaken at the pond, the invertebrate-rich area of reed sweet-grass is left undisturbed. Some clearance of marginal willows and overhanging woodland trees from other parts of the pond would be unlikely to be damaging and could help to increase marginal plant diversity.

[1]Pond Action merged with the Ponds Conservation Trust in January 2001 to become the policy and research division of the Trust.

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Survey of the wetland plants and aquatic macroinvertebrates of Littleworth Pond (Buckinghamshire)

1. Aim of the report

This report describes the results of an ecological survey of the largest of three ponds present on Littleworth Common, Buckinghamshire (Grid Reference SU93658635, Vice county 24). The survey was carried out for Plantlife by the Ponds Conservation Trust: Policy and Research (PCTPR) in order to provide information about the aquatic macroinvertebrate, wetland plant and amphibian assemblages present in the pond. The report also gives management recommendations for the pond, made in the light of previous site records for the Biodiversity Action Plan species starfruit (*Damasonium alisma*).

2. Methods

The pond was surveyed on 14th September 2001 by Mericia Whitfield (invertebrate surveyor) and Penny Williams (plant surveyor). The methods used were based on standard techniques developed for the National Pond Survey (see Appendix 1). Data from the site were compared with information from other UK ponds collected using the same methodology (see Appendix 4).

3. Results of the survey

3.1 Pond description

The survey site (called here "Littleworth Pond") lies at the eastern edge of Littleworth Common. Most of the pond is surrounded by mature, mixed deciduous secondary woodland, but its eastern edge is bounded by an area of willow scrub and rank grassland (c.10 m – 15 m wide) with a minor road and housing beyond.

The pond is moderately large (c.0.2 ha), and relatively shallow. At the time of the survey the average water depth was 0.6 m. However other on-site evidence (tree root growth, water marks etc.) suggest that in winter and spring water depths increase to approximately 1 m. The pond had relatively little bottom sediment with mean silt depths of only 0.09 m.

The margins of the pond are heavily shaded with 98% of the edges directly overhung by deciduous trees from the surrounding woodland. Shading also occurs within the pond itself from stands of grey willow (*Salix cinerea*) which grow in a semi-continuous band up to 7 m wide in the water and drawdown areas around the pond perimeter. Overall, therefore, around 50% of the pond area is directly overhung by trees.

The geological strata underlying the pond could not be determined from the site visit. However the 1:50,000 scale geology map for the area indicates that surface geology comprises glacial sands and gravels. The pond base may, or may not, also extend into the Reading Beds (mainly sands and clays) which lie beneath the glacial deposits in this area.

The main water sources for the pond are unclear. However, if, as suggested by the regional geology map, the site is underlain by sands and gravels, the pond is likely to be at least partly fed by groundwater. The pond has no permanent inflows, although an overflow links

the survey pond with a second temporary pond to the west. At the time of the survey both this second pond and its overflow were dry.

3.2 Plant community

Littleworth Pond supported a relatively poor plant community with a total of 13 species of wetland plant recorded (see Appendix 2). This is considerably lower than the average of 23 species recorded in the National Pond Survey, a survey which included only sites located in semi-natural landscapes (see Appendix 4 for comparative data). However, the pond had just above average richness compared to ponds in the wider countryside. For example, the most recent DETR (now DEFRA) survey recorded an average of 10 plant species per pond (Williams *et al.* 1998) (Appendix 4). Note, however, that this latter survey included a high proportion of polluted and degraded ponds.

Most of the plants recorded in Littleworth Pond were common and widespread species. However, one species, the floating liverwort *Riccia fluitans* can be described as "local" in that it has been recorded from fewer than 700 10 x 10 km grid squares in the UK.

In terms of plant cover the most abundant species in the pond were *Riccia fluitans* and the non-native species least duckweed (*Lemna minuta*) (Figure 1). Both occurred as a floating raft which covered 85% of the unshaded areas of the pond. *Riccia* was mainly present towards the outer edges of the pond, and was often found growing terrestrially in the drawdown zone. *Lemna minuta* dominated most of the rest of the unshaded pond surface covering around 35% of the pond area in total.

The dominant emergent macrophyte in the pond was reed sweet-grass (*Glyceria maxima*) which occurred mainly as two floating rafts on the inner edge of the willow swamp: one large stand (100m^2) towards the eastern margin and a smaller stand 20m^2 towards the western edge. A third stand of *Glyceria* was also present in the drawdown zone, close to the road, on the eastern edge of the pond. The only other major stand-forming plant was bulrush (*Typha latifolia*) which occurred in a 15m^2 raft adjacent to the main stand of *Glyceria*. *Typha* is known to have grown more extensively in the central areas of the pond in recent years, but has undergone a natural die-back for unknown reasons.

Other plant species recorded from the pond generally occurred in two main areas, either:

(i) sparse plants growing around the pond edge in the drawdown zone, particularly where there was least shade e.g. soft rush (*Juncus effusus*), bittersweet (*Solanum dulcamara*), marsh pennywort (*Hydrocotyle vulgaris*), lesser spearwort (*Ranunculus flammula*), or

(ii) forming an understory on the floating rafts of *Glyceria* and *Typha* e.g. common marsh-bedstraw (*Galium palustre*), gipsywort (*Lycopus europaeus*), bulbous rush (*Juncus bulbosus*).

Starfruit (*Damasonium alisma*) was not recorded from the pond during the current survey.

Comparison of Littleworth Pond with other ponds in the area where starfruit has been found in relatively recent times (e.g. ponds at Gerrards Cross, Naphill Common, West End Common) suggests that Littleworth has a flora that is rather depauperate by comparison. Specifically, Littleworth Pond has:

(i) an absence of any submerged aquatic plant species

(ii) a sparse, species-poor marginal plant flora

(iii) an absence of the plant species which appear to characterise "higher quality" starfruit sites e.g. smooth stonewort (*Nitella flexilis*), lesser marshwort (*Apium inundatum*), alternate water-milfoil (*Myriophyllum alterniflorum*).

(iv) a dominance of plant species that are characteristic of relatively eutrophic waters.

(v) very few species characteristic of mesotrophic waters, or where they are present (e.g. *Juncus bulbosus*, *Ranunculus flammula*) the plants occur only at very low abundance.

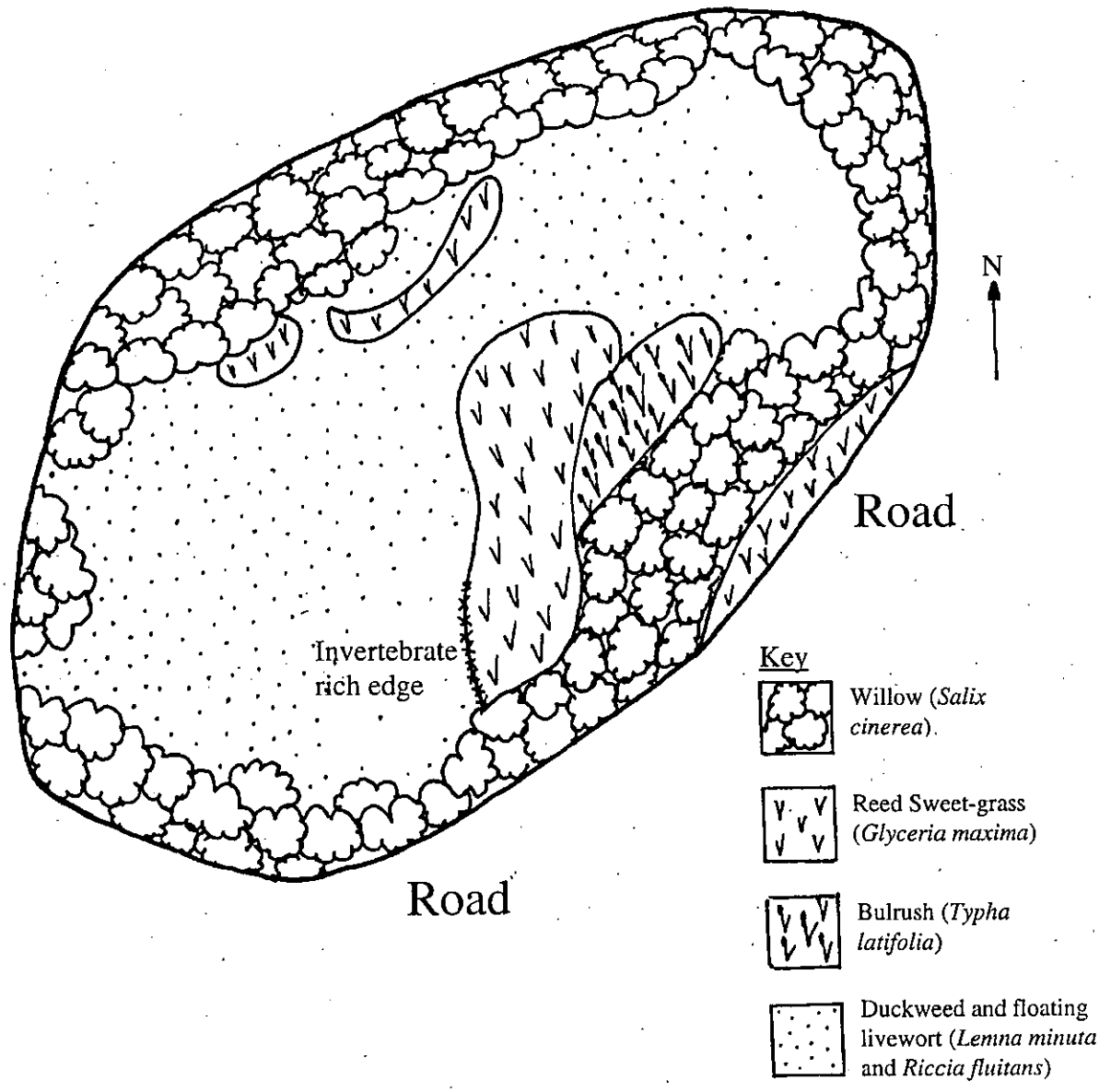

Figure 1. Sketch map of vegetation distribution in Littleworth Pond

3.3 Invertebrate community

Richness and rarity

Overall, Littleworth Pond supported a rich invertebrate community, with a total of 56 invertebrate species recorded from the site (see Appendix 3). This is well above average, even for high quality National Pond Survey sites (see Appendix 4). The animals recorded included four Nationally Scarce invertebrate species, again a good total (see Table 1 and Appendix 5). In practice, however, by far the majority of these species, and uncommon species, were recorded from a very limited area of the site (see below), and most parts of the pond proved to be relatively species-poor.

Distribution of species across the pond

In order to provide information about the distribution of invertebrate species across the pond, the four main habitat types present at the site were sampled separately. These were: (i) the large, semi-submerged bundles of *Salix* roots; (ii) the *Typha latifolia* stands; (iii) the large floating mat of *Riccia fluitans* and *Lemna minuta*; and (iv) the stands of *Glyceria maxima*.

The numbers of invertebrate species, and individuals, recorded in the *Typha, Riccia* and *most* of the *Glyceria* habitats was low (0-7 species) and no Nationally Scarce species were recorded in these areas (see Table 2). The submerged willow roots proved to be a moderately rich habitat with 15 species recorded, including the Nationally Scarce diving beetle *Hydroglyphus geminus*, which was found nowhere else in the pond.

By far the richest area of the pond, however, was a small area of *Glyceria maxima* (c.10m^2) located on the southern edge of the main eastern stand of *Glyceria* (see Figure 1 for location). This small part of the pond proved to be so different from other areas that it was retained as a separate (fifth) habitat. In total, this area supported 55 of the 56 macroinvertebrate species recorded at the site and two-thirds (68%) were found only in this small area. Invertebrates were also most *abundant* in this small area, in marked contrast to the rest of the pond (including the rest of the *Glyceria*), where, typically, only one or two individuals of each species recorded were found (Appendix 3). In addition, three of the four Nationally Scarce species were limited to this area: specifically, the diving beetles *Hydaticus seminiger* and *Hygrotus decoratus* and the water scavenger beetle *Helochares punctatus*. Appendix 5 gives more information about individual Nationally Scarce species.

The restriction of most invertebrate species to a very limited area of a particular vegetation stand in an otherwise rather impoverished site is, in our experience, almost unprecedented, and the reason for its occurrence in Littleworth Pond is not clear (given that the rest of the *Glyceria* – including all the rest of the same *Glyceria* stand – was the second most impoverished habitat surveyed (see Table 2.). On-site observations suggest that the part of the pond immediately adjacent to the rich area of the *Glyceria* stand may have had slightly clearer water (possibly due to a groundwater inflow at this point), and a more limited surface cover of *Lemna minuta* than other areas. Apart from this, however, this area appeared similar to other parts of the *Glyceria* stand.

Table 1. Nationally Scarce invertebrate species recorded from Littleworth Pond

Helochares punctatus	A water scavenger beetle
Hydaticus seminiger	A diving beetle
Hydroglyphus geminus	A diving beetle
Hygrotus decoratus	A diving beetle

Table 2. Numbers of invertebrate species and Nationally Scarce species recorded from five habitats in Littleworth Pond

	Habitats sampled:					
	Riccia	*Typha*	*Salix* roots	*Glyceria* (most)	*Glyceria* (rich edge)	***Total***
Number of species	0	7	15	4	55	**56**
No. of Nationally Scarce species	0	0	1	0	3	**4**

Invertebrate ecological preferences and comparison with other starfruit ponds

As with the majority of the starfruit ponds surveyed by PCTPR for Plantlife, a significant proportion of the species recorded at Littleworth are characteristic of acid water: for example, the freshwater limpet *Ferrisia wautieri*, the diving beetle *Hydroporus gyllenhalli*, the water scavenger beetle *Anacaena lutescens* and the Nationally Scarce water scavenger beetle *Helochares punctatus* are all characteristic of acid waters. Conversely other species are either non-specialists or characteristic of base-rich conditions in shaded or woodland habitats: for example, the diving beetles *Hydroporus incognitus*, *Hydroporus striola*, *Copelatus haemorrhoidalis* and *Hydaticus seminiger* (Nationally Scarce) and the water scavenger beetle *Anacaena globulus*.

This indicates that Littleworth is, in terms of its invertebrate assemblage, broadly similar to the other starfruit sites supporting a mixture of acid and base-rich associated species. This in part goes to explain the richness of the site. Littleworth did differ from other locations in that its invertebrates were strangely restricted in the distribution at the time of the survey: whether this is a permanent feature of the site, or simply a short-term phenomenon is impossible to say without further survey data.

3.4 Amphibians

Amphibians were searched for by hand netting at the same time as the invertebrate survey. This is not the optimum method for amphibian surveying but does provide information about the occurrence of the smaller newts and of larvae and metamorphs.

Approximately 60 newts were netted whilst collecting the 3-minute invertebrate sample. All except one of these were recorded in the invertebrate-rich edge of the *Glyceria* stand. The remaining individual was found amongst submerged willow roots in an area adjacent to the *Glyceria* stand. Most were larval or new metamorphs. Where these could be identified they appeared to be palmate newts (*Triturus helveticus*).

3.5 Waterfowl

A single pair of mallard (*Anas platyrhychos*) and coot (*Fulica atra*) were seen at the pond. Nests and loafing areas were also recorded amongst the tall emergent stands.

3.6 Summary: overall conservation value

Information about the number and rarity of plant and invertebrate species present in a pond can be used to give the pond a conservation rating (see Appendix 4).

The results of the current survey suggest that, for macrophytes, the pond should be considered to be of Moderate conservation value (on a four-point scale: Low, Moderate, High, Very High), on the basis of both the richness and rarity of its plant community.

For invertebrates the site should be considered to be of Very High conservation value, both on the basis of the species-rich community and the presence of four Nationally Scarce species.

4. Management recommendations

Littleworth Pond is an unusual site in that, although most of the site appears to be relatively impoverished, at least part of the pond locally retains a high diversity of aquatic invertebrates.

In the light of this finding, the main management recommendation for the site is that the invertebrate-rich area within, and adjacent, to the *Glyceria* stand is left undisturbed.

More broadly, however, there would seem little necessity to manage other parts of the *Glyceria maxima* or *Typha latifolia* stands. This is partly because they occupy a relatively small proportion of the pond (<10%) and support a range of plant species not found elsewhere on the site. In addition however, in the absence of explanation for the localised invertebrate-rich area it would be prudent to retain a wider area of the *Glyceria* habitat in the event that these areas are also used periodically.

It is assumed that, if the site is managed in future to encourage (re)growth of starfruit, this is likely to require one or more of the following:

(i) clearance of some swamp willow stands from the edge and water areas of the pond

(ii) clearance of adjacent secondary woodland trees on the upper bank which currently overhang the margins increasing shade and leaf-litter inputs in the drawdown zone. (NB leaf litter from these "terrestrial" trees breaks down more slowly than willow, so their contribution to the leaf-litter layer is proportionally greater).

(iii) removal of surface layers of leafy organic matter in some areas of shallow water and the drawdown zone to give a less organic-rich substrate.

From the current evidence none of these actions, if undertaken in moderation, is likely to damage the existing pond plant flora or aquatic invertebrate fauna. Indeed, some clearance could be beneficial: both through regeneration of relict flora from the seed bank, and by providing a greater diversity of edge vegetation for invertebrates.

The extent of clearance that would be advisable is debatable, partly because the effect of tree clearance at wooded ponds has proven very difficult to predict and changes at some sites (e.g. rapid growth of bulrush, colonisation by unwanted alien species) has proven undesirable. The safest option would be, therefore, to clear no more than 25% of the wooded pond edge over one or two years, and then to observe the effect on the site for at least another three years before continuing further management. Ultimately perhaps 50% of the pond edge could be cleared to make it more open, with a focus on the "terrestrial" trees on the upper bank as much as the willow swamp. It is particularly important to retain at least some areas of swamp willow, especially where their branches and roots are *submerged*, since these provide a useful invertebrate and amphibian habitat for a range of species.

Finally, the *Lemna minuta* cover present across much of the open water areas of the pond in the current survey is likely to be less than ideal for starfruit growth. The previous historic and seasonal occurrence of *Lemna minuta* at the pond is not known, and it would be worthwhile looking at its development through late autumn, spring and early summer in order to assess its likely impact on starfruit germination and growth. Management of this alien *Lemna* has been little documented, but in general, removal of nutrient-rich sediment from the pond base is probably the most sustainable means of reducing duckweed coverage.

5. References

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APPENDICES

Appendix 1. Survey methods

The methods used to survey the ponds followed the 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 (1998). 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.
- 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 water-bound tree-roots; stands of submerged aquatics; flooded marginal grasses and inflow areas. The average pond contains 5 or 6 habitats; however, there may be as few as 2, or as many as 10. 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:

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[2]The term 'wetland plant species' refers to species defined as wetland plants on the National Pond Survey field recording sheet list. Terrestrial 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 vegetation or structures.

(i) The three-minute sampling time is divided equally between the number of habitats recorded: e.g. if there are six habitats, each will be sampled for a total of 30 seconds. Generally the sampling time will be further subdivided (especially where a habitat is extensive or covers several widely-separated areas of the pond) in order to represent each habitat adequately. The three-minute sampling time refers only to 'net-in-the-water' time, and does not include time moving between habitats.

(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. The sample thus collected is placed in a bucket to be returned to the laboratory for sorting and identification.

(iii) Finally an additional one-minute search is undertaken for animals which may have been missed by the 3-minute sample: for example, those which may be especially well camouflaged (e.g. dragonflies, caddis fly larvae, mayflies); or which may be firmly attached to the substrate or plants (e.g. limpets, flatworms, leeches, snails); or which are particularly hard to catch with a pond-net (e.g. whirligig beetles, pond skaters)

(iv) All amphibians or fish caught in the course of sampling are noted on the field recording sheet and returned to the pond.

Sorting and identifying macroinvertebrate samples

After return to the laboratory, macroinvertebrate samples are always sorted 'live' (not frozen or preserved), as soon as possible after collection (usually within three days).

In general, the aim of sorting is to remove from the sample, and identify to species-level, ALL individual invertebrates. In samples where one or two species are present in very large numbers (e.g. thousands of specimens), these species may be sub-sampled and numbers then extrapolated to the whole sample. However, all specimens which cannot be reliably identified in the sorting tray (i.e. those which require microscopic examination for species-level identification) are removed and preserved in alcohol (except for flatworms and leeches, which must be identified immediately). On average, sorting a pond sample to remove invertebrates takes approximately a day, but samples containing a considerable amount of silt, algae, duckweed or other vegetation may take considerably longer.

Species which were not immediately identifiable whilst sorting are identified using biological keys and a microscope with a magnification of at least x40. A list of keys used is given in Pond Action (1998). After identification, a species list for the site is compiled and the 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	
Bivalvia	Species	Unionidae/Sphaeriidae
Crustacea (Malacostraca)	Species	
Hirudinea	Species	Identified live
Ephemeroptera	Species	As larvae
Odonata	Species	As larvae
Megaloptera and Neuroptera	Species	As larvae
Hemiptera	Species	As adults; where possible larvae are identified
Coleoptera	Species	As adults; where possible larvae are identified
Plecoptera	Species	As larvae
Lepidoptera	Species	As larvae
Trichoptera	Species	As larvae
Oligochaeta	Class	
Diptera	Family	As larvae

Note: watermites, zooplankton and other micro-arthropods are not included in the survey.

Appendix 2. Wetland plants recorded in the survey

Scientific name	*English name*	*National status (e.g. whether the species is uncommon or non-native)*
Floating-leaved species		
Lemna minor	Common Duckweed	Common
Lemna minuta	Least Duckweed	Introduced
Riccia fluitans	A floating liverwort	Local[2]
Emergent species		
Epilobium hirsutum	Great Willowherb	Common
Galium palustre	Common Marsh-bedstraw	Common
Glyceria maxima	Reed Sweet-grass	Common
Hydrocotyle vulgaris	Marsh Pennywort	Common
Juncus bulbosus	Bulbous Rush	Common
Juncus effusus	Soft Rush	Common
Lycopus europaeus	Gipsywort	Common
Ranunculus flammula	Lesser Spearwort	Common
Solanum dulcamara	Bittersweet	Common
Typha latifolia	Bulrush	Common
Number of submerged species	**0**	
Number of floating species	**3**	
Number of emergent species	**10**	
Total number of species	**13**	

Notes

1. Local' species are defined here as species which occur in less than about a quarter of all 10 x 10 km squares in Great Britain (i.e. less than 700 10 x 10 km squares).

Appendix 3. Macroinvertebrate species recorded in the survey

Species	Number of individuals recorded in each habitat				
	Riccia & Lemna	*Typha*	*Salix* roots	*Glyceria* (most)	*Glyceria* (rich edge)
Hirudinea (Leeches)					
Helobdella stagnalis (a leech)		1		1	2
Gastropoda (Snails & limpets)					
Ferrissia wautieri (a freshwater limpet)		7	105	4	500+
Ephemeroptera (Mayflies)					
Caenis horaria (a white midge or 'anglers' curse')			2		9
Caenis robusta (a white midge or 'anglers' curse')					2
Cloeon dipterum (Pond Olive)			44		18
Odonata (Dragonflies & damselflies)					
Aeshna cyanea (Southern Hawker)					2
Anax imperator (Emperor Dragonfly)					1
Coenagrion puella/pulchellum† (Azure/Variable Damselflies)			32		96
Enallagma cyathigerum (Common Blue Damselfly)			7		22
Ischnura elegans (Blue-tailed Damselfly)			25		28
Pyrrhosoma nymphula (Large Red Damselfly)			9		8
Hemiptera (Water Bugs)					
Callicorixa praeusta (a lesser waterboatman)					6
Corixa punctata (a lesser water boatman)			1	2	2
Gerris odontogaster (a pond skater)					1
Hesperocorixa sahlbergi (a lesser waterboatman)			1	1	1
Ilyocoris cimicoides (Saucer Bug)					4
Microvelia reticulata (a pygmy water cricket)			4		7
Notonecta glauca (a greater waterboatman)					35
Notonecta marmorea (a greater waterboatman)					20
Sigara distincta (a lesser waterboatman)			1		2
Coleoptera (Beetles)					
Acilius sulcatus (a diving beetle)					2
Agabus bipustulatus (a diving beetle)					4
Agabus sturmi (a diving beetle)					2
Anacaena globulus (a water scavenger beetle)					1
Anacaena limbata (a water scavenger beetle)					1
Anacaena lutescens (a water scavenger beetle)					4
Coelambus confluens (a diving beetle)					1
Coelambus impressopunctatus (a diving beetle)					3
Coelostoma orbiculare (a diving beetle)					3

Cont.

Appendix 3. Macroinvertebrate species recorded in the survey

Species	Number of individuals recorded in each habitat				
	Riccia & Lemna	*Typha*	*Salix* roots	*Glyceria* (most)	*Glyceria* (rich edge)
Colymbetes fuscus (a diving beetle)					14
Copelatus haemorrhoidalis (a diving beetle)					3
Dytiscus marginalis (a great diving beetle)					1
Enochrus coarctatus (a water scavenger beetle)					4
Enochrus testaceus (a water scavenger beetle)					4
Haliplus ruficollis (a crawling water beetle)			1		2
Helochares lividus (a water scavenger beetle)		2			1
*Helochares punctatus** (a water scavenger beetle)					3
Helophorus brevipalpis (a water scavenger beetle)					2
Helophorus grandis (a water scavenger beetle)					1
*Hydaticus seminiger** (a diving beetle)					1
Hydraena riparia					1
Hydrobius fuscipes (a water scavenger beetle)		1			1
*Hydroglyphus geminus** (a diving beetle)			1		
Hydroporus angustatus (a diving beetle)					6
Hydroporus gyllenhalli (a diving beetle)					2
Hydroporus incognitus (a diving beetle)					1
Hydroporus planus (a diving beetle)					10
Hydroporus pubescens (a diving beetle)					1
Hydroporus striola (a diving beetle)					2
Hydroporus tesselatus (a diving beetle)					3
Hygrobia hermanni (Screech or Squeak Beetle)					1
*Hygrotus decoratus** (a diving beetle)					3
Hygrotus inaequalis (a diving beetle)		5	2		7
Hyphydrus ovatus (a diving beetle)		2	2		41
Ilybius fuliginosus (a diving beetle)					1
Noterus clavicornis (a diving beetle)		1			7
Number of species per habitat:	**0**	**7**	**15**	**4**	**55**
Number of Nationally Scarce species per habitat:	**0**	**0**	**1**	**0**	**4**
Total number of species recorded: 56					
Additional taxa recorded:					
Oligochaeta (segmented worms)	0	3	3	3	3
Ceratopogonidae (biting midges)	0	0	3	0	3
Chaoboridae (phantom midges)	3	0	3	0	3
Chironomidae (plumed gnats or non-biting midges)	3	3	3	3	3
Culicidae (mosquitoes)	0	0	0	0	3
Ptychopteridae (phantom crane-flies)	0	0	0	0	3
Tipulidae (crane-flies or daddy-long-legs)	0	0	0	0	3

†Note that these two species are not distinguishable as larvae.

*Nationally Scarce species.

Appendix 4. Methods for assessing pond conservation value

1. Assessment of conservation value

The conservation value of plant and invertebrate communities can be assessed on the basis of:

- species richness (the number of plant and invertebrate species recorded from the site).
- the presence of uncommon species measured as Rarity Scores and Indices.

The species richness and rarity totals are usually recorded separately for plants and invertebrates.

2. Method for assessing species rarity

Species rarity can be quantified for a site by allocating a numerical rarity score to each plant and invertebrate species. The scores used for plants and invertebrates and their definition is given in Table 1 and 2 below.

Appendix table 4.1 Invertebrate species rarity terms and scores

Status	Score	Status
Common	1	Species generally regarded as common.
Local	2	Species not falling into any of the categories 'Rare' (i.e. RDB) or 'Scarce', 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. (Wallace 1991)
Nationally scarce	4	Recorded from 16-100 10x10 km grid squares in mainland 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).

Calculation of the Species Rarity Index

The Species Rarity Index (SRI) is the average rarity value of the species at a site. It is calculated in the following way:

1. All species present are given a numerical value depending on their national rarity status in Table 1.
2. The values of all the species present are added together (to give a total rarity score).
3. The total rarity score is divided by the number of species present at the site to give the SRI.

Appendix table 4.2 Macrophyte species rarity terms and scores

Status	Score	Status
Common	1	Species generally regarded as common. For wetland plants, these are species recorded from >700 10x10 km grid squares in Britain.
Local	2	Local species recorded from between 101 and 700 10x10 km grid squares in Britain.
Nationally notable A	4	Nationally Scarce. Recorded from 16-29 10x10 km grid squares in Britain.
Nationally notable B	8	Nationally Scarce. Recorded from 30-100 10x10 km grid squares in Britain.
RDB3	16	Red Data Book: Category 3 (low risk).
RDB2	32	Red Data Book: Category 2 (vulnerable).
RDB1	64	Red Data Book: Category 1 (endangered and critically endangered).

Note: exotic species are given a score of 1, as are uncommon native species (e.g. Water Soldier, *Stratioides aloides*) which are known to have been introduced to a site.

3. Method for assessing conservation value

The conservation value of plant and invertebrate assemblages can be assessed using Table 3 (plants) and Table 4 (invertebrates) below. These simply allow ponds to be placed in one of four conservation value categories (Very High, High, Moderate and Low).

When assessing conservation value put the pond into the *highest* conservation category it can go into using *any* of the measures. In other words if a plant assemblage had only six species but an SRI of 1.2 (because it had a rare plant), it would have a HIGH conservation value.

Appendix table 4.3 Wetland plants: provisional categories for assessing the conservation value of ponds

Low	Few wetland plants (≤8 species) and no local species (i.e. SRI = 1.00).
Moderate	Below average number of wetland plant species (9-22 species) or SRI of 1.01-1.19.
High	Above average number of wetland plant species(≥23 species) or a SRI of 1.20-1.49. No Nationally Scarce or Red Data Book (RDB).
Very High	Supports one or more Nationally Scarce or RDB species or a SRI of 1.50 or more, or ar exceptionally rich plant assemblage (≥40 species).

4. Comparison with other sites

The following information gives range of data about the conservation value of <u>*other*</u> 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.

Appendix table 4.4 Aquatic macroinvertebrates: provisional categories for assessing conservation value of permanent and semi-permanent lowland ponds (single season 3 minute sample).

Low	Few invertebrate species (0-10 species) and no local species (i.e. SRI = 1.00).
Moderate	Below average number of invertebrate species (11-32 species) or a SRI of 1.01-1.19.
High	Above average number of invertebrate species (33-49 species) or a SRI of 1.20-1.49. No Nationally Scarce or Red Data Book (RDB).
Very High	Supports one or more Nationally Scarce or RDB species or a SRI of 1.50 or more, or an exceptionally rich invertebrate assemblage (≥50 species).

Plant data

Appendix Table 4.5 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)	*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)

Invertebrate data

Appendix Table 4.6 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.

Appendix 5. Notes on Nationally Scarce macroinvertebrate species recorded in Littleworth Pond

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

Although more likely to occur in the south than in other parts of Britain, this species is much more widespread, and ranges further north, than the very similar (also Nationally Scarce) species *H. lividus*; however, it is considered to be less numerous, and therefore more 'deserving' of the Nationally Scarce designation. In addition, the species inhabits wet heathland and lowland bogs, and there is some evidence that there could be a risk of habitat loss (more specifically, loss of required breeding areas) through urban and industrial development. (Friday, 1988; Foster, 1987; Foster, 2000.)

Hydaticus seminiger **(COLEOPTERA: Dytiscidae). A diving beetle.**

Since the middle of the 20th century this species' range appears to have declined somewhat: it was once scattered throughout England and Wales, but its distribution now 'falls into three main areas, the Cheshire Plain, northern East Anglia and the Home Counties plus Dorset...it is unknown from Wales and Scotland' (Foster 2000) Particularly favours lowland fen pools, usually with dense vegetation and often in shade. (It also occurs in coastal ditches, but is restricted there, as Foster points out, to areas shaded by reedbeds.) Again, this species may be under threat due to loss of habitat through development. (Friday, 1988; Foster, 1985; Foster, 2000.)

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

Locally distributed in the south of England, where it is usually fairly common, and the Midlands; the northernmost record for this species is in Northumberland. Said to inhabit heath pools, mossy ditches, and new, man-made ponds, being 'characteristic of recently created still water sites with a clay or mud substratum' (Foster 2000). 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. (According to Foster, the species tends to disperse widely during years when the weather is mild, but may contract to pockets in southern England when there is a succession of severe winters.) (Foster, 1981; Friday, 1988; Pond Action, 1994 *et al.*; Foster, 2000.)

Hygrotus decoratus **(COLEOPTERA: Dytiscidae). A diving beetle.**

A species of ponds, drains, fens and bogs, mainly found in the eastern half of southern England. According to Foster statistical analysis suggests that, although the species may be on the increase in certain areas, overall it is declining, having apparently lost many sites in northern England and the Midlands where it was recorded during the first half of the last century. (Foster, 1981; Friday, 1988.)