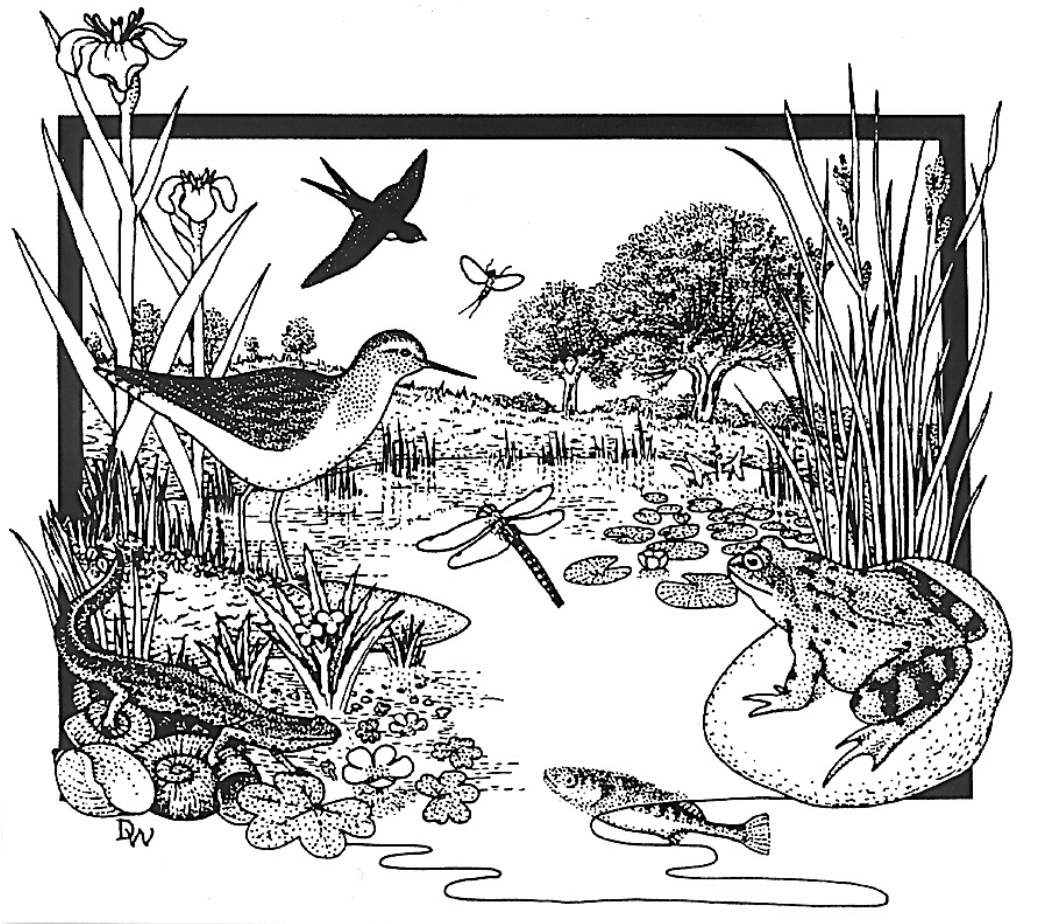
Survey of the wetland plants and aquatic macroinvertebrates in two ponds on

Naphill common

with notes on their management



April 2000

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Naphill Common Ponds: ecological survey results and management recommendations

1. Aim of the report

Naphill Common in Buckinghamshire has two ponds that are known to have supported the Red Data Book plant starfruit (*Damasonium alisma*) in the recent past. These are Mannings Pond (SU 847962) and Daisy Pond (SU845967).

This report describes the results of an ecological survey of both ponds undertaken for Plantlife in August 1999. The report provides:

(i) information about the wetland plant, aquatic macroinvertebrate and amphibian communities of the ponds;

(ii) a summary of the agreed future management proposals for the ponds.

2. Methods

The ponds were surveyed for wetland plants, aquatic invertebrates and amphibians on 30th August 1999. The methods used for the survey were based on standard techniques used for the National Pond Survey (see Appendix 1). Data from the site were compared with other sites from the UK surveyed using the same methodology. The plant species lists are also compared with data gathered from the ponds by Alan Showler in 1988, 1990 and 1993 (Showler 1994).

Management priorities for the ponds were agreed at a site meeting held on 3/12/99 and attended by: Jeremy Biggs (Pond Action), Ruth Davis (Plant Life) Andy McVeigh (Buckinghamshire County Council); Alan Showler; Graham Steven (English Nature); Belinda Wheeler (Plantlife); Tim Wilkins (Plantlife) and Penny Williams (Pond Action). Ruth Davis minuted the results of the meeting.

3. Mannings Pond

Mannings Pond is a small waterbody about 650 m^2 in area, surrounded by secondary woodland. The pond comprises two pools of about equal area divided by a low causeway approximately 1 m in width.

The two pools differed considerably in depth. The north-western pool was much the deeper with, at the time of the survey, an average water depth of 0.4 m, and a silt layer which varied from 0.25 m deep in the east (adjacent to the causeway) to a maximum of 0.6 m at the western end of the pond. The south-eastern pool was more uniform in depth, with an average water depth of just 0.06 m and an average sediment depth of 0.15 m.

Both ponds were moderately shaded, with approximately 50% of the banks and 10% of the water area, directly overhung by trees. Water samples collected on site and tested in the laboratory showed that the pond had a low conductivity (65µs) and was rather acidic (pH 6.0).

Additional water chemistry measurements made by the Environment Agency in 1998/99 (Wheeler 2000, Table 2) suggest that the pond is low in calcium (average 7.7 mg/l) but is relatively nutrient-rich. When compared to National Pond Survey (NPS) sites (i.e. high quality semi-natural ponds), Mannings Pond has nitrate levels that are at the top end of the range for NPS ponds, and phosphate levels which are considerably higher than is typical (see Table 1).

Table 1. Nutrient levels recorded in Mannings Pond compared to typical values for National Pond Survey sites

Survey	*Nitrate as N (mg/l)*	*Phosphate as P (mg/l)*
Mannings Pond*[1]	Average: c. 0.10 Range: <0.01 – 0.10	Average: 0.24 Range: 0.06 – 0.42
National Pond survey sites*[2] (i.e. high quality ponds located in semi-natural areas)	Range: 0 - 0.10	Range: 0 - 0.10

*[1] Environment Agency data, average of 1-3 samples taken in 1998/99 (Wheeler 2000)

*[2] Pond Action data from the National Pond Survey (in: Williams *et al*. 1999).

3.1 Plant community

Overall the Mannings Pond plant community was moderately rich with a total 16 plant species recorded from the two pools (listed in Appendix 2). This is just below the average recorded for the National Pond Survey i.e. for high quality ponds located in semi-natural areas (see Appendix Table 6.1).

Starfruit was actively searched for, but was not seen at Mannings Pond. No other rare or nationally scarce plant species were recorded. However, four plant species occurred which currently have a moderately restricted distribution in Britain and can be regarded as 'local'[1] at a national level. These 'local' species were *Spirodela polyrhiza*, *Nitella opaca*, *Callitriche obtusangula* and *Lythrum portula*.

Comparing the two pools, which make up Mannings Pond, it was clear that they differed markedly in both plant structure and species composition. The south-eastern pool, although very shallow, supported much the richest flora. Its vegetation consisted of a complex inter-growing mixture of wetland plants, which filled c.90% of the pool. The most abundant species (i.e. those with a cover >10%) included: the stonewort *Nitella opaca*, emergent grasses particularly *Glyceria fluitans*, and free floating plants particularly *Lemna minor* and *Spirodela polyrhiza*.

The deeper north-western pool had lower plant richness. The pool was fringed by a narrow marginal band of emergents dominated by *Glyceria fluitans* and *Carex riparia*, with most of the open water areas dominated by a thick surface mat of *Lemna minor* and *Spirodela polyrhiza*. Submerged aquatics (e.g. *Callitriche*, *Ranunculus* and *Nitella*) were absent from this half of the pond.

A comparison of the pond's current wetland plant list (1999) with Alan Showler's records for the pond in 1989 and 1990 (Showler 1994), suggests that the plant richness of the pond has declined a little over the last 10 years. Species recorded in 1989/90 but not 1999 include: *Myriophyllum alterniflorum*, *Apium inundatum*, *Zannichellia palustris* and *Potamogeton natans*. Set against this, *Spirodella polyrhiza* and *Nitella opaca* were recorded in 1999 but not in the earlier surveys.

3.2 Invertebrate community

The invertebrate community of Mannings Pond was moderately species rich, with a total of 37 species recorded (listed in Appendix 4). This is just above the average for the National Pond Survey (see data in Appendix Table 6.2).

Five Nationally Scarce species were recorded from the pond - a good total. All were water beetles (Table 2). As with the plants, the very shallow, well-vegetated south-eastern pool was by far the richest area for invertebrate species. It also supported most of the uncommon species. Thus, whereas the south-eastern pool supported all five Nationally Scarce species, only one of these occurred in the deeper north-western section of the pond.

[1] Nationally 'local' species are defined here as species which occur in less than about a quarter of all 10 x 10 km squares in the UK (i.e. less than 700 10 x 10 km squares).

Table 2. Nationally Scarce invertebrate species recorded from Mannings Pond

Species	*Invertebrate type*
Cercyon convexiusculus	A water scavenger beetle
Haliplus heydenni	A crawling water beetle
Haliplus laminatus	A crawling water beetle
Helochares punctatus	A water scavenger beetle
Rhantus suturalis	A diving beetle

3.3 Amphibians

Newt larvae, either Smooth *Triturus vulgaris* or Palmate *T. helveticus* (they were too small to determine) were common in areas where emergent or submerged plants were present. They were particularly abundant in the shallow south-eastern pool. Young frog metamorphs were recorded frequently around the pond edge.

3.4 Management recommendations for Daisy Pond Mannings Pond

3.4.1 Management aims

At the site management meeting held on 3rd December 1999 (see Section 2) it was agreed that, over the next few years, the management of Mannings Pond should aim to fulfil two main objectives:

i) cautious encouragement of starfruit germination,

ii) protection of the existing populations of invertebrates, amphibians and other plants of conservation interest at the pond.

The following section summarises the management rational and actions that were agreed on site.

3.4.2 Management to encourage starfruit germination

Starfruit was last recorded at Mannings Pond in 1994 (Wheeler 1999). This suggests that, if a viable starfruit seed-bank still exists, the conditions that currently prevail at the pond are not conducive to the plant's germination and/or growth. A range of factors may help to explain this.

1. *Competition*: young starfruit plants do not compete well with other aquatic or submerged plants (Birkinshaw 1994). The dense submerged and marginal plant growth which currently dominates Mannings Pond is, therefore, likely to be unsuitable for the species. A particular worry is the presence of duckweed, because these plants are difficult to manage. When the pond was surveyed in August 1999 a thick layer of duckweed covered much of the surface of the Mannings Pond. If duckweed cover is high when starfruit plants are growing in spring and summer, this would almost certainly suppress growth of starfruit plants.
2. *Trees*: The margins of the Mannings Pond are moderately overhung by trees. In addition to reducing light levels, Birkinshaw (1994) observed that where tree leaves fell on top of young starfruit plants, this was sufficient to kill them. Both factors may, therefore, inhibit starfruit growth at Mannings Pond.
3. *Disturbance*: Starfruit plants last germinated at Mannings Pond after pond clearance and dredging work between 1989 and 1993 (Wheeler 1999). Sediment disturbance may well be a factor which favours germination at the site but this sort of management has not recently been carried out at the site.
4. *Organic soils/sediments*: Starfruit is typically found growing in mineral soils (sand, gravel or clay) with a low proportion of organic matter (Birkinshaw 1994, Wheeler 1999). It is not clear if soil

type is itself a key factor in starfruit growth. However, the soils at Mannings Pond are almost certainly highly organic.

5. *Bank profile*: The south-eastern pool of Mannings Pond is very shallow and likely to give a good drawdown zone, particularly in dry years. The northern bay is deep and, with the exception of the causeway edge, the banks are steep sided so that these areas provide a poor habitat for Starfruit germination.

3.4.3 *Protection of other biota*

The most valuable part of Mannings Pond for species other than starfruit was the shallow south-eastern pool which supported abundant newts, all of the uncommon water beetles and the most diverse range of wetland plants. In order to protect these species it would be valuable if intensive starfruit management was restricted to only part of this basin i.e. no more than 15% of this part of the south-eastern pond was heavily managed in any one year and ideally no more than 25% over a five year period.

The southern basin of Mannings Pond was much less species-rich. Its quality was also inhibited by the predominance of steep banks and by the occurrence of a thick cover of duckweed over moderately deep water and sediment. If duckweed continues to persist at the pond in the long term it might be worth dredging the pond to remove the nutrient-rich sediments which will be contributing to its relatively high current nutrient status. If management work *is* carried out to the southern basin it is recommended that the opportunity is taken to lower the bank slopes and extend the drawdown zone.

3.4.4 Management actions for 2000

Bearing in mind the points outlined above, the following actions were agreed:

i) Monitor duckweed cover of the pond at regular (monthly) intervals through spring and summer 2000. Note particularly the extent of duckweed cover around the causeway area where management may be undertaken.

ii) Clear vegetation from trial areas either side of the causeway in late summer 2000. Include some mechanical ground disturbance.

iii) Avoid damage to the majority (three-quarters) of the shallow northern pond basin i.e. avoid dumping of spoil, clearance or *excessive* disturbance by people or machines to most of this area.

iv) In addition, it may well be worthwhile examining the area managed for starfruit in spring 2000 to ensure that the cleared area is not covered by fallen tree leaves or by rapidly colonising aquatics which could suppress growth of young starfruit plants.

Note: if duckweed cover is high in the area of the causeway in the period April 2000 – June 2000, the decision to undertake management in the causeway area may need to be reconsidered. The risk is that disturbance will encourage successful starfruit germination, but that the heavy surface cover of duckweed during the late spring and summer could inhibit the starfruit plants' growth, flowering and fecundity.

In the longer term, consideration will be given to:

- The reintroduction of grazing to Naphill.
- Tree and scrub removal to increase light and leaf input to the pond edges.
- Modification of the bank profile of the southern pool.
- Dredging of the northern pond, if appropriate.

4. Daisy Pond

Daisy Pond is a triangular shaped pool about 350 m^2 in area. The pond is moderately shaded, with approximately 25% of the banks and 10% of the water area directly overhung by trees. The pond's water depth averaged 40 cm deep (range 15 cm - 48 cm). Sediment depths were typically 5 cm - 15 cm.

Water samples showed that the pond's chemistry was similar to Mannings Pond with a conductivity of 32µs and a pH of 6.2. Environment Agency water chemistry measurements indicate that the pond was also low in calcium (average 7 mg/l). Nitrate concentrations were lower than in Mannings Pond, but phosphate readings were still higher than is typical of high quality ponds (see Table 3).

Table 3. Nutrient levels recorded in Daisy Pond compared with the typical values for National Pond Survey sites

Survey	*Nitrate as N mg/l*	*Phosphate as P mg/l*
Daisy Pond*[1]	Average: <0.10 Range: all <0.10	Average: 0.23 Range: 0.10 – 0.36
National Pond survey sites*[2] (i.e. high quality ponds located in semi-natural areas)	Range: 0 - 0.10	Range: 0 - 0.10

*[1] Environment Agency data, average of 1-3 samples taken in 1998/9 (Wheeler 2000)
*[2] Pond Action data from the National Pond Survey (in Williams *et al*. 1999).

4.1 Plant community

The plant community in Daisy Pond was slightly richer than Mannings Pond with a total of 20 plant species recorded (Appendix 3). This included 4 locally uncommon species *Apium inundatum, Spirodela polyrhiza, Nitella opaca* and *Lythrum portula.* Starfruit was not recorded.

Emergent vegetation filled approximately 75% of the pond, forming a dense fringe around the pond edge and occupying most of the southern half of the waterbody. These 'emergent' areas were dominated by *Glyceria fluitans*, but free-floating duckweed species, particularly *Lemna minor* and *Spirodela polyrhiza* were also common.

The remaining 25% 'open water' area of the pond supported extensive stands of *Nitella opaca*, with *Elodea nuttallii* common around the perimeter.

Comparison of current wetland plant list with Alan Showler's 1993 records suggests that Daisy Pond is currently rather richer in species than it was in the early 1990s. However a number of species have been both gained and lost from the pond during this time. The main species to have been lost were *Myriophyllum alterniflorum, Alopecurus geniculatus* and *Catabrosa aquatica*. Alan Showler reports, however, that *Catabrosa* still occurs in areas nearby. The main species to be been gained over the last few years are: *Nitella opaca, Elodea nuttallii, Potamogeton natans, Lemna minor, Eleocharis palustris, Potentilla erecta* and *Ranunculus flammula*.

4.2 Invertebrate community

Daisy Pond's invertebrate community was slightly richer than Mannings Pond's, with a total of 43 species recorded (listed in Appendix 5). However, rather fewer uncommon taxa were found (three Nationally Scarce water beetle species). All were species also recorded from Mannings Pond (Table 4).

Table 4. Nationally Scarce invertebrate species recorded from Daisy Pond

Species	*Invertebrate type*
Cercyon convexiusculus	A water scavenger beetle
Haliplus heydenni	A crawling water beetle
Rhantus suturalis	A diving beetle

4.3 Amphibians

The amphibians recorded at Daisy Pond were interesting. A small number of Great Crested Newts (c.10) were recorded around the western and northern edges of the pond. Smooth/palmate newt larvae were common in all aqautic areas with emergent plants. Young frog metamorphs were also seen around the pond.

An unusual find was a large metamorposing tadpole which was caught in the water along the western bank. This was clearly a non-native species and was sent to Jim Foster (English Nature) for confirmation. Amphibian tadpoles can be difficult to identify with confidence, but his determination was that it was either a North American Bullfrog or one of the green frog group.

If the former, this would be of some interest. 1999 was the first year in which Bullfrogs have been recorded breeding in the wild in Britain. Jim Foster or a colleague may visit the site in future to gather more information.

4.4 Management recommendations for Daisy Pond

At the site management meeting it was agreed that the future management of the pond should focus on trial clearance to encourage starfruit growth combined with careful maintenance of the existing conservation interest of the pond.

Management to encourage starfruit growth will include hand removal of vegetation from portions of the margin of the pond in the areas where starfruit was previously recorded, together with some mechanical disturbance by vehicles, if access to these areas is possible. In the long term the aim will be to clear small patches of vegetation each year and to observe the results.

Management for starfruit will aim to leave undisturbed areas of the pond that are significant for other species. In particular, areas supporting great crested newts or plants which have a restricted distribution at the pond.

There pond currently has a good habitat composition and structure for great crested newts, particularly (i) an abundance of *Glyceria fluitans* which is a favoured aquatic habitat and egg-laying substrate, and (ii) areas of open water which are used during courtship. There is also excellent terrestrial habitat for adult newts in the surrounding woodland.

Because of the occurrence of great crested newts at the pond, it will be necessary to obtain a licence form English Nature before management for starfruit can be undertaken. In, practice, however, clearance of small portions of vegetation at the edge of the pond for starfruit in early autumn is unlikely to be deleterious to the pond's great crested newt populations, particularly since the work will be undertaken on the opposite side of the pond to the one apparently favoured by the newts.

In terms of protecting other species, the survey showed that there were a small number of plant species which had a relatively limited distribution at the pond, particularly species such as *Apium inundatum* and *Potamogeton natan*s. These species were particularly concentrated in the southern corner of the pond (the corner furthest from adjacent paths). Since this area is relatively near to areas of the pond which may be managed for starfruit in future years, care should be taken to avoided too much disturbance and damage to this area.

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.
- Water chemistry: a range of chemical determinands are measured. In the present study only data on pH and conductivity were collected as a range of chemical data were already available from the Environment Agency.
- 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 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).

[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.

(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 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 undertaken for animals that 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).

(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 sub-sample 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 (1994). 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 micro-arthropods are not included in the survey.

Appendix 2. Wetland plants recorded in Mannings Pond

Scientific name [1]	***English name***	***National status*** *(i.e. whether the species is uncommon or non-native)*
Aquatic Plants: submerged		
*Callitriche obtusangula** [1]	Blunt-fruited Water-starwort	Local
*Nitella opaca** [2]	Charophyte species	Local
*Ranunculus sp.** [3]	Water-crowfoot species	
Aquatic Plants: floating-leaved		
Lemna minor	Common Duckweed	Common
Spirodela polyrhiza	Greater Duckweed	Local
Emergent plants		
Agrostis stolonifera	Creeping Bent	Common
*Carex riparia** [4]	Greater Pond-sedge	Common
Epilobium ciliatum	American Willowherb	Common
Glyceria fluitans	Floating Sweet-grass	Common
Iris pseudacorus	Yellow Iris	Common
Juncus articulatus	Jointed Rush	Common
Juncus effusus	Soft Rush	Common
Lythrum portula	Water-purslane	Local
Persicaria hydropiper	Water-pepper	Common
Ranunculus flammula	Lesser Spearwort	Common
Solanum dulcamara	Bittersweet	Common
Stellaria uliginosa (S. alsine)	Bog Stitchwort	Common

Number of submerged plant species:	**3**
Number of floating plant species:	**2**
Number of emergent plant species:	**12**
Total number of plant species:	**17**
Number of "local"* [5] **species:**	**4**

*1. Identified from leaf characteristics alone.

*2. Identified using oogonium characteristics *cf.* NF Stewart, *in* Rich and Jermy (1998). *The plant crib*. BSBI.

*3. Many small plants, but each with only 1-2 pairs of capilliary leaves present. *R.peltatus*

*4. The sedge stands in Mannings Pond were identified in 1989 & 1993 by A.Showler as *Carex acutiformis*. In the current survey (1999) the ligules and fruit of all major *Carex* stands were checked: all were *C. riparia*.

*5. Nationally 'local' species are defined here as species which occur in less than about a quarter of all 10 x 10 km squares in the UK (i.e. less than 700 10 x 10 km squares).

Appendix 3. Wetland plants recorded in Daisy Pond

Scientific name [1]	***English name***	***National status*** *(i.e. whether the species is uncommon or non-native)*
Aquatic Plants: submerged		
Apium inundatum	Lesser Marshwort	Local
*Callitriche sp.** [1]	Water-starwort sp.	
Elodea nuttallii	Nuttall's Waterweed	Introduced
*Nitella opaca** [2]	Charophyte species	Local
*Ranunculus sp.** [3]	Water-crowfoot species	
Aquatic Plants: floating-leaved		
Lemna minor	Common Duckweed	Common
*Nymphaea sp.** [4]	Waterlily	
Potamogeton natans	Broad-leaved Pondweed	Common
Spirodela polyrhiza	Greater Duckweed	Local
Emergent plants		
Agrostis stolonifera	Creeping Bent	Common
Eleocharis palustris	Common Spike-rush	Common
Epilobium ciliatum	American Willowherb	Introduced
Glyceria fluitans	Floating Sweet-grass	Common
Iris pseudacorus	Yellow Iris	Common
Juncus effusus	Soft Rush	Common
Lythrum portula	Water-purslane	Local
Persicaria hydropiper	Water-pepper	Common
Potentilla erecta	Tormentil	Common
Ranunculus flammula	Lesser Spearwort	Common
Solanum dulcamara	Bittersweet	Common

Submerged plant number:	**5**
Floating plant number:	**4**
Emergents plant number:	**11**
Total number of plant species:	**20**
Number of "local"*[5] species:	**4**

*1. *C. stagnalis*/*platycarpa*/*obtusangula* group. No fruits present.

*2. Identified using oogonium characteristics *cf.* NF Stewart, *in* Rich and Jermy (1998). *The plant crib*. BSBI.

*3. A few small plants with 1 -2 pairs of capilliary leaves present, possibly *R.peltatus*.

*4. Introduced non-flowering plant, possibly an exotic var.

*5. Nationally 'local' species are defined here as species which occur in less than about a quarter of all 10 x 10 km squares in the UK (i.e. less than 700 10 x 10 km squares).

Appendix 4. Macroinvertebrate species recorded from Mannings Pond

Species	***Number recorded***	***English name*** *(if one exists)*	***National status*** *(i.e. if the species is uncommon)*
Tricladida (Flatworms)			
Dugesia polychroa	28	A flatworm species	
Hirudinea (Leeches)			
Erpobdella testacea	235	A Leech species	
Helobdella stagnalis	11	A Leech species	
Crustacea (Crustaceans)			
Asellus aquaticus	1	A water slater	
Crangonyx pseudogracilis	425	A freshwater shrimp	
Bivalvia (Mussels)			
Musculium lacustre	8	An orb mussel or freshwater cockle	
Gastropoda (Snails/limpets)			
Lymnaea peregra	13	Wandering Snail	
Planorbarius corneus	205	Great Ramshorn	
Ephemeroptera (Mayflies)			
Cloeon dipterum	21	Pond Olive	
Odonata (Dragonflies and Damselflies)			
Aeshna cyanea	6	The Southern Hawker	
Aeshna mixta	6	Migrant Hawker	
Coenagrion puella agg.[1]	41	The Azure/Variable Damselfly	
Pyrrhosoma nymphula	8	Large Red Damselfly	
Hemiptera (Water bugs)			
Gerris gibbifer	3	A pondskater	
Gerris lacustris	1	A pondskater	
Hesperocorixa sahlbergi	1	A lesser waterboatman	
Coleoptera (Beetles)			
Agabus bipustulatus	1	A diving beetle	
Agabus nebulosus	2	A diving beetle	
Agabus sturmii	3	A diving beetle	
Anacaena limbata	19	A water scavenger beetle	
Cercyon convexiusculus	2	A water scavenger beetle	Nationally Scarce
Coelambus impressopunctatus	1	A diving beetle	
Haliplus fulvus	2	A crawling water beetle	
Haliplus heydenni	61	A crawling water beetle	Nationally Scarce
Haliplus laminatus	1	A crawling water beetle	Nationally Scarce
Haliplus ruficollis	7	A crawling water beetle	
Helochares punctatus	5	A water scavenger beetle	Nationally Scarce
Hydraena riparia	1	A water scavenger beetle	
Hydrobius fuscipes	11	A water scavenger beetle	

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[1] *Coenagrion puella* and *Coenagrion puella* are largely indistinguishable as larvae.

Appendix 4. Macroinvertebrate species recorded from Mannings Pond (continued)

Species	*Number recorded*	*English name*	*National status*
Hydroporus angustatus	4	A diving beetle	
Hydroporus palustris	1	A diving beetle	
Hydroporus planus	3	A diving beetle	
Hydroporus tesselatus	1	A diving beetle	
Hygrotus inaequalis	3	A diving beetle	
Ilybius ater	1	A diving beetle	
Laccophilus minutus	1	A diving beetle	
Rhantus suturalis	1	A diving beetle	Nationally Scarce

Total number of invertebrate species recorded: 37

Total number of nationally scarce invertebrate species recorded: 5

Appendix 5. Macroinvertebrate species recorded from Daisy Pond

Species	***Number recorded***	***English name*** *(if one exists)*	***National status*** *(i.e. if the species is uncommon)*
Tricladida (Flatworms)			
Dugesia polychroa	9	A flatworm species	
Hirudinea (Leeches)			
Erpobdella testacea	275	A Leech species	
Glossiphonia heteroclita	1	A Leech species	
Helobdella stagnalis	33	A Leech species	
Theromyzon tessulatum	1	A Leech species	
Crustacea (Crustaceans)			
Asellus aquaticus	500+	A water slater	
Crangonyx pseudogracilis	500+	A freshwater shrimp	
Bivalvia (Mussels)			
Musculium lacustre	179	An orb mussel or freshwater cockle	
Gastropoda (Snails/limpets)			
Ferrissia wautieri	54	A freshwater limpet	
Hippeutis complanatus	1	Flat Ramshorn	
Lymnaea palustris	1	Marsh Snail	
Lymnaea peregra	3	Wandering Snail	
Lymnaea stagnalis	34	Great Pond Snail	
Planorbarius corneus	279	Great Ramshorn	
Planorbis planorbis	500+	The Ramshorn	
Ephemeroptera (Mayflies)			
Cloeon dipterum	21	Pond Olive	
Odonata (Dragonflies and Damselflies)			
Aeshna cyanea	3	The Southern Hawker	
Aeshna mixta	5	Migrant Hawker	
Coenagrion puella agg.[1]	3	The Azure/Variable Damselfly	
Ischnura elegans	1	Blue-tailed Damselfly	
Pyrrhosoma nymphula	5	Large Red Damselfly	
Hemiptera (Water bugs)			
Corixa punctata	3	A lesser waterboatman	
Gerris gibbifer	2	A pondskater	
Gerris lacustris	4	A pondskater	
Hesperocorixa sahlbergi	2	A lesser waterboatman	
Microvelia reticulata	3		
Nepa cinerea	10	Water Scorpion	
Notonecta glauca	2	A greater waterboatman	
Notonecta marmorea	1	A greater waterboatman	
Notonecta obliqua	1	A greater waterboatman	

(Continued over page)

[1] *Coenagrion puella* and *Coenagrion puella* are largely indistinguishable as larvae.

Appendix 5. Macroinvertebrate species recorded from Daisy Pond (continued)

Species	*Number recorded*	*English name*	*National status*
Coleoptera (Beetles)			
Acilius sulcatus	1	A diving beetle	
Agabus nebulosus	1	A diving beetle	
Agabus sturmii	2	A diving beetle	
Anacaena limbata	21	A water scavenger beetle	
Anacaena lutescens	17	A water scavenger beetle	
Cercyon convexiusculus	2	A water scavenger beetle	Nationally Scarce
Dytiscus circumflexus	1	A diving beetle	
Haliplus heydenni	166	A crawling water beetle	Nationally Scarce
Haliplus ruficollis	7	A crawling water beetle	
Helophorus grandis	1	A water scavenger beetle	
Hydrobius fuscipes	4	A water scavenger beetle	
Hydroporus angustatus	3	A diving beetle	
Rhantus suturalis	1	A diving beetle	Nationally Scarce

Total number of invertebrate species recorded: 43

Total number of nationally scarce invertebrate species recorded: 3

Appendix 6. 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 6.1. 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)	*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 6.2 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.