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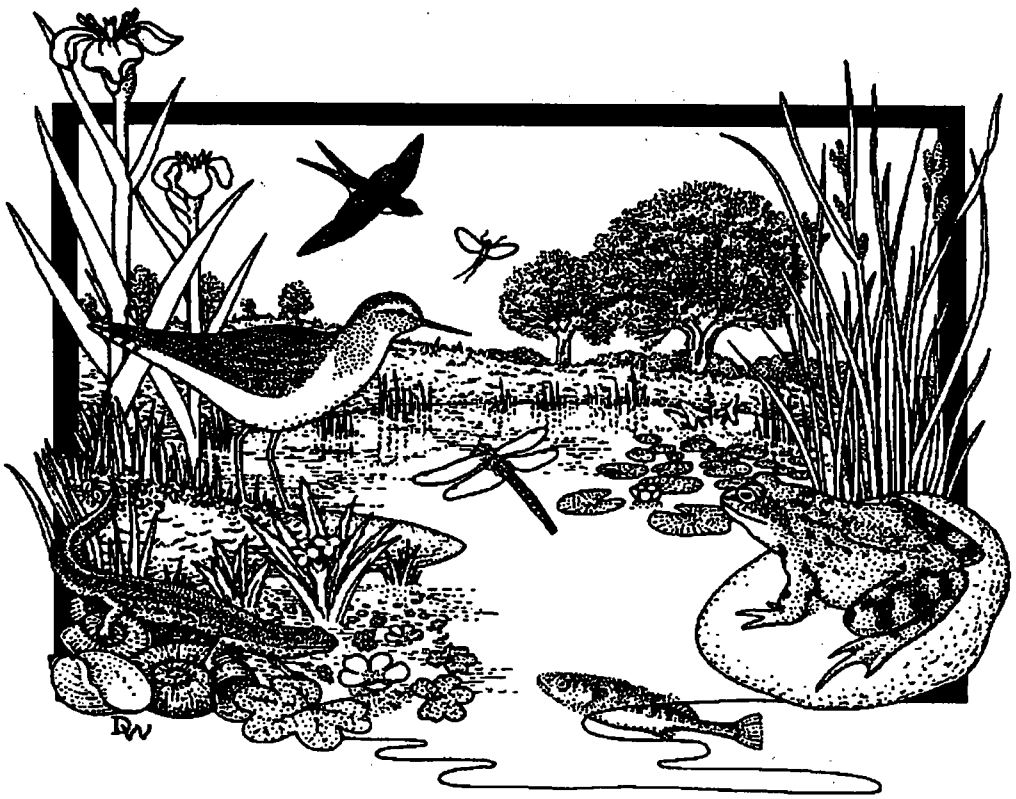
A survey of Stanford Quarry and the Frogmore Brook



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Summary

Background

This report describes the results of ecological survey work undertaken by Pond Action at Stanford Quarry and on the Frogmore Brook, near Stanford-in-the-Vale, Oxfordshire.

The main objectives of the work were:

i) To evaluate the present conservation value of Stanford Quarry in terms of its terrestrial and wetland plants, aquatic macroinvertebrates and amphibians.

ii) To highlight areas of the site, and habitats, of particular importance for wildlife.

iii) To investigate the water quality of the Frogmore Brook above and below Stanford-in-the-Vale, by analysis of aquatic macroinvertebrate community data.

Stanford Lake

Water quality

A limited amount of chemical water quality data was available for the main lake. Concentrations of most determinands measured were fairly typical for standing waters in Oxfordshire. However, ammoniacal nitrogen concentrations were, occasionally, rather high. There is an indication from the biological data that nutrient enrichment is occurring, but chemical measurements of the relevant determinands (i.e. nitrogen compounds and phosphorus compounds) are not currently available.

Terrestrial plants

A total of 143 terrestrial plant species was recorded at the site. Overall, the terrestrial plant community was of moderate, rather than exceptional, interest, the disturbed ground supporting most species because of the variety of 'weed' species occurring in this habitat.

A number of species were of local interest, including Small Toadflax, Black Mustard, Vervain and Small Mouse-ear. The least common plant recorded was Bee Orchid, which was found in grassland near to the main entrance.

Wetland plants

The main lake supported a rich wetland flora, with a total of 45 wetland species recorded. Of these, 33 were marginal/emergent and 12 aquatic (i.e. floating or submerged) plant species.

Most of the lake was only sparsely colonised by marginal/emergent plants, the most densely vegetated area being in the north-western corner. The shallow-water areas of the lake, mainly on the western side, were richest in aquatic plants (10%-20% cover); the rest of the lake did not appear to support any aquatic species. Reasons for this could include turbidity in the deeper water, physical disturbance, the (presumably) recent origin of this section of the lake or the influence of runoff from the adjacent tip.

Since the main waterbody is intermediate in size between a pond and a lake, an assessment of its species richness was made by comparing the results of this study with data from both pond and lake surveys. Taking both assessment methods into account, the site may be regarded as supporting an above-average number of wetland and aquatic plant species for its size.

No nationally rare wetland plants were recorded from the main lake, but seven nationally 'local' species were found. Six of the seven species were aquatics and only one a marginal plant species.

Species Rarity Index (SRI) calculations indicated that the plant community as a whole at Stanford Lake was of moderate conservation value (on a four point national scale). However, a large proportion (50%) of the aquatic (submerged and floating-leaved) species recorded are nationally 'local' species, making the aquatic flora alone, with an SRI of 1.41, of high conservation value.

Aquatic invertebrates

The site has two important aquatic invertebrate habitats: (i) the main lake and (ii) the small grassy pool north-west of the main lake.

- The main lake

The main lake supported a macroinvertebrate community which was of high conservation value (on a four point national scale: low, moderate, high or very high value). Microhabitats in the lake (areas of different substrate and vegetation) varied in the quality of their invertebrate communities. Edge habitats where plants provided cover (especially the grassy banks) were the most valuable areas, with open water areas with sandy substrate of less value.

Of the 64 invertebrate species recorded in the lake, four were Nationally Notable B species and three were nationally 'local' species.

- The small grassy pool

The small grassy pool also supported a high conservation value macroinvertebrate community. 31 macroinvertebrate species were recorded, including four Nationally Notable B species: three of these notable species were different to those recorded in the main lake, and were species which are generally typical of shallow grassy pools with some leaf-litter.

Amphibians

No amphibians were recorded during evening visits in the spring and early summer or during extensive hand-netting for invertebrates. However, Mark Garrett recorded recently-metamorphosed Common Frogs on 25 June 1994 and it seems likely that the site supports small breeding populations of both Common Frog and Smooth Newt, even though none were recorded in the main period of survey.

Birds

Although birds were not specifically included in the survey programme several species of interest were recorded during the course of the work. Little Ringed Plover were seen in both spring and summer and the site appears to provide suitable breeding habitat for this species. Redshank and Common Sandpiper were also recorded during spring, and Little Grebe bred at the site during 1994.

Frogmore Brook

Invertebrates were surveyed in the Frogmore Brook up- and downstream of Stanford-in-the-Vale. Biological Monitoring Working Party scores (the standard biological water quality assessment technique used by the NRA) were calculated.

All samples indicated that water quality was good (technically, samples fell into Band A of the NRA's 5M banding system). However, despite the fact that both sites were in the top water quality band, there was a slight indication of a reduction in water quality between the two sites. Further monitoring is recommended to determine whether this trend is significant.

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A Survey of Stanford Quarry and the Frogmore Brook

1. Report aims

This report describes the results of ecological survey work undertaken by Pond Action on Stanford Quarry and the Frogmore Brook during spring and summer 1994.

The work had four main components:

i) To evaluate the present conservation value of Stanford Quarry in terms of its terrestrial and wetland plants, aquatic macroinvertebrates and amphibians.

ii) To highlight areas of the site, and habitats, of particular importance for wildlife.

iii) To provide information for a future site management plan.

iv) To investigate the water quality of the Frogmore Brook above and below Stanford-in-the-Vale, by analysis of aquatic macroinvertebrate community data.

The report is divided into two sections: the first describes the results of surveys in Stanford Quarry and the second describes the survey of the Frogmore Brook.

2. Stanford Quarry

2.1 Background information about Stanford Quarry

Stanford Quarry (SU326941) is situated half a mile north-west of Stanford-in-the-Vale, to the east of the junction of the B4508 and A417. The site consists of the remaining open area of an old quarry, most of which has been backfilled with domestic refuse. It is bordered on three sides by agricultural land, with landfill bordering the remaining, south-eastern, edge of the site. The banks of the quarry rise steeply to the surrounding land, and the northern edge is marked by a low cliff line.

The site is approximately 2.5 hectares in area, of which the majority (approximately 2ha) is taken up by a small lake. The remainder of the area, bordering the lake, is either grassland or bare ground sparsely colonised by waste and disturbed ground plants. Part of the site, including the northern cliff face, is a geological SSSI.

2.1.1 Hydrology and drainage

The main source of water for the lake is probably groundwater. However, near-surface water flow from the adjacent land, including drainage from both the arable fields and the landfill, may also be important. Deposits of fine silt on the bed of the quarry may also impede drainage (it is perceived by visiting geologists that the site is wetter now than when originally designated as a geological SSSI). At periods of low water, flushes are evident along the western edge of the site.

Data on water levels in the lake is available from aerial surveys and site monitoring from 1986 onwards. Water levels in the lake have varied considerably, partly as a result of pumping (the most recent period of pumping was in May 1994, Mark Garrett pers. comm.). It is therefore difficult to gauge, from existing field observations, what the normal water regime for the lake will eventually be. This accepted, it is likely that, whatever the average water depth, water levels at the site are likely to fluctuate naturally during the year by 0.3-0.5m.

2.1.2 Water quality

A limited amount of chemical water quality data was available for the site from Oxfordshire County Council. The data available suggests that water quality in the main lake is fairly typical of standing waters in Oxfordshire (see Table 1). Concentrations of metals were generally below detection limits, suggesting little current pollution from these elements. However, ammoniacal nitrogen concentrations were, occasionally, rather high. Biological data from the site (particularly the composition of the aquatic plant community) suggests that nutrient enrichment may be occurring, but chemical measurements of the relevant determinands (i.e. nitrogen compounds and phosphorus compounds) have not been made. Observations of water colour made during 1994 site visits suggest that the water was turbid during most periods of the year.

Table 1. Selected water quality data for Stanford Lake

Date	pH	Conductivity (µS/cm)	Ammoniacal Nitrogen (mg/l)	Chloride (mg/l)	BOD (mg/l)	Suspended Solids (mg/l)
11.11.91	7.8	593	0.14	81	-	-
27.11.92	7.51	708	0.30	-	<2.0	9.0
19.02.93	8	701	0.27	70	c. 2	6.5
22.04.94	8.5	365.5	<0.05	46.5	3.6	-

Note: data provided by Oxfordshire County Council

2.2 Terrestrial plants

The aim of the terrestrial plant survey was to list all plant species seen, and to provide notes on regionally and nationally uncommon species where present.

2.2.1 Methods

Two terrestrial plant surveys were undertaken, in early July and mid September 1994. Both survey visits took about 3.5 hours, during which all terrestrial habitats present on site were investigated. A single species list was compiled from the results of the two surveys. With two site visits made it is likely that about 90% of the species present on the site were recorded (Dr. T. Rich, pers. comm.).

2.2.2 Results of terrestrial plant survey

The quarry had only partly recolonised with vegetation, with much of the southern perimeter largely bare of vegetation. In the remaining areas, four main terrestrial habitat types were identified. These were: (i) waste and disturbed ground; (ii) grassland; (iii) hedges; and (iv) quarry banks (Figure 1).

Overall, the terrestrial plant community was of moderate, rather than high, interest. In total, 143 terrestrial plant species were recorded at the site (see Appendix 2). All four habitat types on site were fairly poor in vascular plant species, with the most species-rich communities in areas of waste/disturbed ground, reflecting the variety of 'weed' species occurring in these areas.

A number of plants were of local interest, including *Chaenorhinum minus* (Small Toadflax), *Brassica nigra* (Black Mustard), *Verbena officinalis* (Vervain) and *Cerastium semidecandrum* (Little Mouse-ear). The most uncommon plant recorded was *Ophrys apifera* (Bee Orchid), of which one fruiting plant was found in grassland near the entrance. It should be noted, however, that Bee Orchids are not uncommon in Oxfordshire as a whole, occurring mainly in long grass on calcareous soils. The single plant recorded at Stanford Quarry is only of local (i.e. within the surrounding 2-3 parishes) importance.

2.3 Aquatic plants

2.3.1 Methods

The wetland plant survey of Stanford Lake was undertaken in mid-July. Species which are considered here to be 'wetland' rather than terrestrial are listed in the Pond Action Wetland Plant List (see Appendix 1). This list was based originally on the NCC Wetland Plant List, with modifications suggested by Margaret Palmer and Dr. Tim Rich.

The wetland plant survey took approximately four hours. During this time the perimeter of the lake, including all wet margins and islands, was walked. Approximately 70% of the lake was shallow enough to survey by wading; deeper areas were surveyed using a grapnel. Critical taxa (e.g. *Chara* and *Potamogeton* spp.) were returned to the laboratory for confirmation using a binocular microscope.

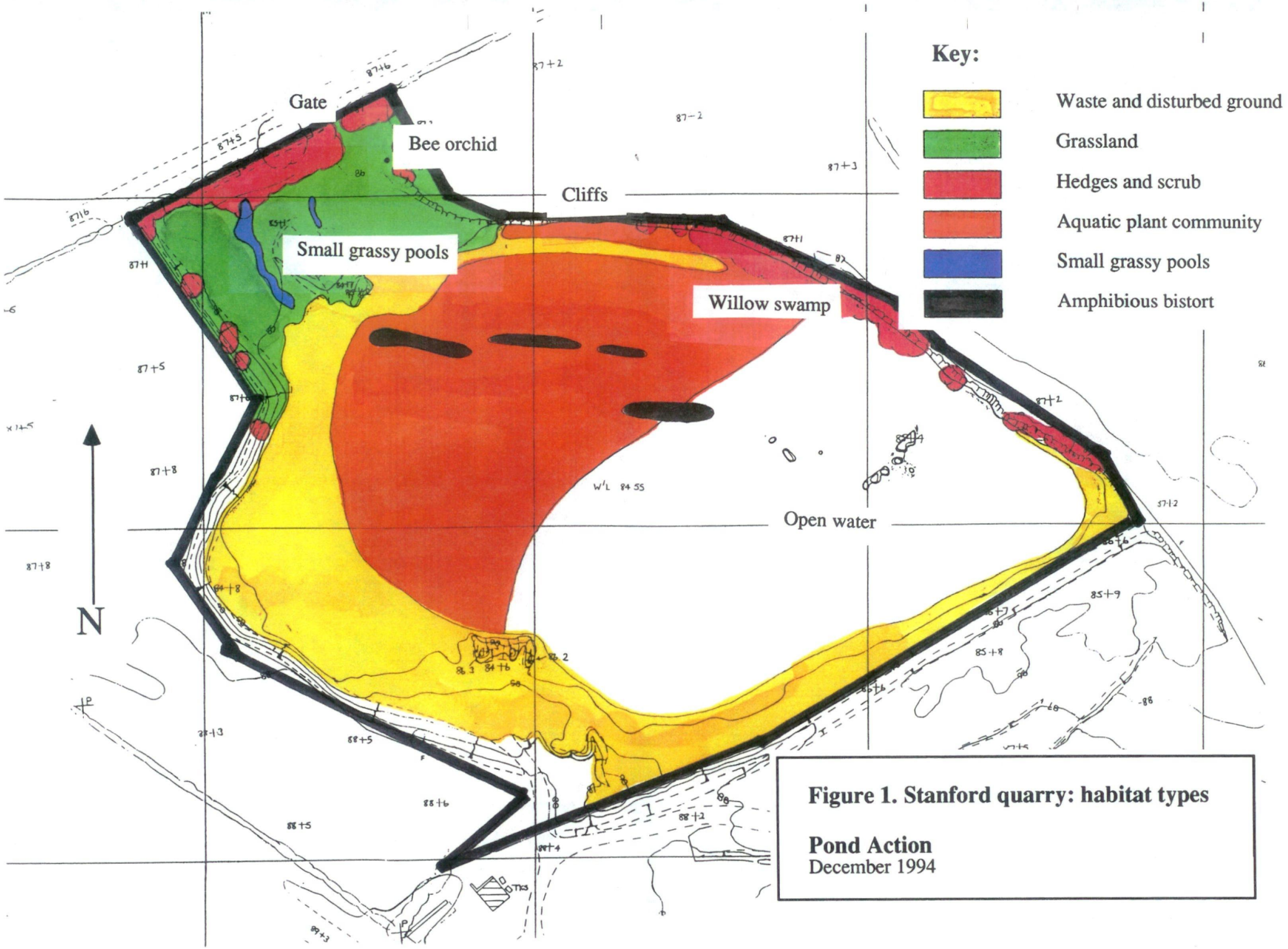

Figure 1. Stanford quarry: habitat types

Pond Action
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2.3.2 Results of wetland and aquatic plant surveys

Stanford Lake supports a rich wetland flora, with a total of 45 plant species recorded. Of these, 33 were marginal/emergent and 12 aquatic (i.e. floating or submerged) plant species. Amongst the aquatic plants, pondweeds (*Potamogeton* spp.) were relatively well-represented, with three species present.

The greater part of the lake's edges, including the southern half of the pond and the islands, were very sparsely colonised by marginal emergent plants, presumably because of recent disturbance. The most densely vegetated area of the site was the north-western corner, including the area of small grassy pools, which had dense stands of *Agrostis stolonifera* (Creeping Bent). The north-eastern edge of the lake was largely cliff-lined, but to the east this graded into seasonally-flooded willow swamp (see Figure 1).

The shallow-water areas of the lake (occupying approximately a third of the western side) were much the richest part of the site for aquatic plant species. Total aquatic plant cover in this area was in the order of 10%-20%, but diversity was quite high and included mixed stands of *Potamogeton berchtoldii* (Small Pondweed), *Potamogeton pectinatus* (Fennel Pondweed), *Ranunculus* sp. (Water-crowfoot species), *Zannichellia palustris* (Horned Pondweed), *Elodea canadensis* (Canadian Waterweed) and *Myriophyllum spicatum* (Spiked Water-milfoil). *Potamogeton crispus* (Curled Pondweed) occurred more locally near to the base of the cliff face along the northern edge of the lake, whilst *Chara vulgaris* var. *hispidata* (a stonewort species) appeared to be restricted to the very shallow water along the most westerly edges of the lake. To the north-west, the lake bottom was characterised by a marked ridge-and-furrow topography, on which stands of *Polygonum amphibium* (Amphibious Bistort) had developed (see Figure 1).

Other parts of the lake, including the southern and eastern margins, the areas around the islands and the deeper open water areas, did not appear to support any aquatic plants. The reasons for this were not immediately evident, but it is possible that turbidity was a controlling factor in deeper water. In the shallows, the lack of plants could have been due to disturbance due to seasonal water level fluctuations or the (presumably) recent origin of this section of the lake. Alternatively, it is possible that runoff from the adjacent tip was in some way affecting the vegetation in these areas.

Overall the aquatic plants were generally species characteristic of nutrient enriched water. Since the lake is still relatively young and its catchment largely composed of limestone strata, it would have been expected that more species characteristic of mesotrophic (i.e. less enriched) conditions would have been recorded. Their absence suggests some enrichment from surface or near-surface runoff - probably from the adjacent waste-tip, though possibly from the surrounding agricultural land.

Uncommon plants

No nationally rare wetland plants were recorded from the Stanford Lake, but seven 'local'[1] species were found (see Table 2 below). Of the local plant species, only *Potamogeton berchtoldii* (Small Pondweed) could be described as abundant at the site. Further information about the national distribution of local species is given in Appendix 7.

Table 2. Nationally uncommon plants recorded from Stanford Lake

Aquatic species (submerged and floating plants):	
Potamogeton berchtoldii	Small Pondweed
Potamogeton crispus	Curled Pondweed
Potamogeton pectinatus	Fennel Pondweed
Ranunculus sp	Water-crowfoot species
Zannichellia palustris	Horned Pondweed
Chara vulgaris var. *hispidata*	A stonewort species
Marginal/emergent species:	
Epilobium tetragonum	Square-stalked Willow-herb

[1] Note: see Appendix 9 for definition of terms describing species distribution patterns.

It was noticeable that whereas very few - less than 3% - of the marginal/emergent plant species recorded were 'local' (in terms of national distribution), for the aquatic species, over 50% of the total were 'local'. This may, in part, reflect general under-recording of aquatic species (making them seem more uncommon than they really are); however, it is also likely to reflect the scarcity in Britain of unpolluted freshwater habitats.

2.3.3 Conservation value of the plant community

Methods of assessing conservation value

Assessment of the conservation value of Stanford Lake is based on:

(i) Numbers of species present. The Stanford Lake wetland plant survey data can be compared with the results of a number of other surveys of ponds and lakes. The difficulty with these comparisons, however, is that the number of plants recorded from any water body is related to its size. Stanford (at approximately 2 ha) falls into an intermediate category, coming somewhere between the maximum size limit for a pond and the minimum limit for a lake (Pond Conservation Group 1993). Comparisons have therefore been made with both waterbody types. For ponds, direct comparisons have been made with the results of other regional pond surveys (see Table 3). Comparisons with lakes were made by classifying the Stanford site using the English Nature Lake Classification (Palmer 1989).

(ii) The occurrence of uncommon or rare species. Sites supporting uncommon or rare species are generally regarded as more valuable, in nature conservation terms, than those which support only common and widespread species. To make consistent comparisons between sites, rarity is assessed using an index of 'average rarity' of species recorded - the Species Rarity Index (SRI). The Species Rarity Index is described in more detail in Appendix 10.

The SRI is calculated in the following way:

(i) All species present are given a numerical value, depending on their national rarity status (see Appendix 9).

(ii) The values of all the species present are added together to give a total rarity score.

(iii) The total rarity score is divided by the number of species present to give the Species Rarity Index.

Numbers of plant species

As noted above, the number of plant species present at a site is highly size-related. The Stanford waterbody is intermediate in size between a pond and a lake, so the number of species is best compared with both pond and lake assessment systems. Comparison with the results of other pond surveys indicates that the Stanford site supports a very rich plant community (45 species), exceeding, for example, the maximum number of species recorded from any other Oxfordshire pond for which data is available (see Table 3). For the lake surveys, only comparisons with numbers of aquatic plants can be made. The Lake Classification suggests that the site is a eutrophic waterbody typical of southern Britain: for this waterbody type, the Stanford site has an average number of aquatic species, however it should be noted that most of the sites assessed for this classification were far larger than Stanford Lake. Comparing both sets of results suggests, therefore, that the site may be regarded as supporting an above-average number of wetland and aquatic species for its size.

Uncommon species and Species Rarity Index

Relatively little of the data from pond surveys undertaken in other parts of Britain is presented in a way which allows direct comparison of the number of uncommon plant species per pond. The data which are currently available are shown in Table 4. As with species numbers, the results indicate that Stanford Lake supports a large number of uncommon species compared to the ponds in other surveys. National lake data describing the number of rarities is not available from Palmer's classification.

Table 5 shows the Species Rarity Index calculations for the plant community at Stanford Lake, and a description of the conservation categories used in this report is given in Table 6. The plant community as a whole falls into the moderate conservation value category. However, since a large proportion of the aquatic flora (submerged and floating-leaved species) have a 'local' status (50% of all aquatic species recorded were 'local'), this gives the aquatic flora alone an index of 1.41, suggesting it has a high conservation value.

Table 3. The number of plant species recorded from Stanford Lake: comparison with pond surveys in other parts of Britain

County and Author	Number of ponds	Total no. of spp.		No. of aquatic spp.		No. of marginal spp	
		Average	Range	Average	Range	Average	Range
Oxfordshire Pond Action 1994	36	17.7	1-44	4.4	0-11	13.3	1-33
Dorset Friday 1988	16	8	2-15	3	1-7	5	1-9
Cheshire[1] Brian et al. 1987	153	9	0-23	2	-	7	-
Clwyd[1] Day 1991	406	14	0-30	2.5	-	11.5	-
Milton Keynes[1] Ridge and Furniss 1986	117	7.5	-	1.5	-	6	-
Stanford Lake	1	46	-	12	-	34	-

[1]Species list modified to be consistent with Pond Action Wetland Plant List

Table 4. The number of uncommon plant species recorded from Stanford Lake: comparison with pond surveys in other parts of Britain

County and Author	Total no. of uncommon plant spp.		Total no. of uncommon aquatic plant species		Total no. of uncommon marginal plant species	
	Average	Range	Average	Range	Average	Range
Oxfordshire Pond Action 1994	2.3	(0-9)	1.2	(0-6)	1.1	(0-5)
Dorset Friday 1988	0.81	(0-2)	0.25	(0-2)	0.56	(0-2)
Stanford Lake	7	-	6	-	1	-

Table 5. Calculation of Species Rarity Index for Stanford Lake

	All Wetland Plants	Aquatic Plants	Marginal Plants
Number of plant species	45	12	33
Species National Rarity Score	51	17	34
Species National Rarity Index	1.13	1.41	1.03
National Conservation Rating	Moderate	High	Moderate

Table 6. Provisional system for assessing the nature conservation value of plant and aquatic macroinvertebrate communities

CATEGORY	DESCRIPTION OF TYPE OF COMMUNITY
VERY HIGH	Typically supporting a very rich community of plant and/or macro-invertebrate species, including local and rare (RDB) species (though note that some sites with rare species can be relatively species-poor). Sites in this category would normally have Species Rarity Indices in excess of 1.5.
HIGH	Supporting a rich community of common plants and/or macro-invertebrate species. Generally an above-average number of local species recorded. No RDB species. Sites in this category would normally have Species Rarity Indices between 1.2 and 1.5.
MODERATE	Supporting a moderately-rich or rich community of common plant and/or macroinvertebrate species with at least one local species. Sites in this category would normally have Species Rarity Indices between 1.01 and 1.19.
LOW	Supporting a species-poor community of common plants and macro-invertebrates. No rare or local species. Sites in this category will have Species Rarity Indices of 1.00.

2.4 Aquatic macroinvertebrates

The aim of the aquatic macroinvertebrate survey was:

(i) to obtain a list of species recorded at the site;

(ii) to assess the importance for invertebrates of different microhabitats; Microhabitats are areas within a site which appear to provide discernibly different habitats, e.g. different substrates or vegetation structures - see Table 7.

(iii) to assess the nature conservation value of the macroinvertebrate community.

During the preliminary examination it was noted that, adjacent to the main lake (on the north-western side), the site also included a small grassy pool. Small pools of this type are often of considerable conservation importance for aquatic invertebrates, so it was decided that a limited amount of survey work in this area should also be undertaken (although this work was not specified by the contract).

2.4.1 Methods

Sampling the main lake

A three-minute macroinvertebrate sample was taken from the main lake, following standard National Pond Survey methods (Pond Action, 1992). To provide information about the relative value for invertebrates of different microhabitats, the standard NPS survey method was modified slightly: for ordinary NPS surveys, all material from different microhabitats is combined into a single sample, but in this survey, microhabitat samples were kept separate. This provided information to enable site management to focus on maintenance of the most valuable invertebrate habitats.

The three-minute sample was divided equally between microhabitats. Since eight microhabitats (see Table 7) were distinguished, 8 sub-samples, each timed at 22.5 seconds, were taken in total. These were kept separate and returned to the laboratory for sorting and identification of aquatic macroinvertebrate species present. The samples were sorted exhaustively; i.e. all macroinvertebrates found were removed and identified to species level.

It should be noted that a single three-minute sample collected from a site will not record all macroinvertebrate species present. Consequently, if further samples were collected from the site (particularly during a different season) it is highly probable that more species would be recorded. For comparative purposes, however, this single-season sample (a) provides consistent data which can be used to assess both the conservation value of the whole community, and the relative value of different microhabitats; and (b) enables the site's conservation value to be compared with other sites which have been sampled using the same method.

Sampling the small grassy pool

For the small grassy pool, a limited additional survey was undertaken. This followed standard NPS methods, but (due to restrictions imposed by time) a single sample, timed at 22.5 seconds (i.e. equivalent to the time spent on one microhabitat in the main lake), was taken. Consequently, the number of species recorded in the grassy pool is not strictly comparable with the number recorded from the main lake; however, Species Rarity Indices were broadly comparable.

Assessment of conservation value

The conservation values of the macroinvertebrate communities in both the main lake and the grassy pool were assessed using the Species Rarity Index (SRI). The method used to calculate SRIs is described in Appendix 10.

2.4.2 Aquatic macroinvertebrates in the main lake

A total of 64 macroinvertebrate species was recorded from the main lake. The number of species recorded from individual microhabitats ranged from nine (microhabitats A and B - see table) to 34 (microhabitat C). A composite species list for the main lake, showing the microhabitats and the species recorded from each, is given in Appendix 4, and discussed briefly below.

Conservation value of the main lake invertebrate community

Of the aquatic macroinvertebrate species recorded in the main lake at Stanford, four were Nationally Notable B (all water beetles: *Helochares lividus*, *Hydroglyphus pusillus*, *Ilybius fenestratus*, and *Rhantus suturalis*) and three were nationally 'local' (two lesser waterboatmen *Corixa panzeri* and *Sigara concinna*, and the caddis fly *Agraylea sexmaculata*).[1]

The Species Rarity Index (SRI) for the macroinvertebrate community from the main lake was 1.23 (see Appendix 10). This indicates that the lake invertebrate community should be regarded as being of high nature conservation value (on a four point national scale: low, moderate, high and very high - see Table 6).

Individual microhabitats in the main lake and their macroinvertebrate communities

Eight different microhabitat types were distinguished in the main lake. These are listed, with a brief description of the habitat, in Table 7, and are further discussed below.

Table 7. Description of invertebrate microhabitats in Stanford Quarry Main Lake

Microhabitat	Description of microhabitat
A	Sandy-bottomed, deeper-water areas with little or no vegetation.
B	Shallow sandy bank at the side nearest to the refuse-tip; again, little or no vegetation.
C	Western bank area, overhung by long trailing herbs and grasses.
D	Steep cliff bank to the northern side, overhung by willows and willowherb.
E	Shallow, muddy bay on the north-western side, with flooded low rushes and grass.
F	Shallow areas dominated by low flooded dock plants.
G	Deeper water, with taller stands of dock and rushes.
H	Stands of *Polygonum amphibium* (Amphibious Bistort).

In general, the microhabitats supporting the greatest numbers of species also supported the greatest numbers of local or Nationally Notable species. Although the numbers recorded from individual habitats varied between nine and 34, each microhabitat supported at least one local or Nationally Notable species, with a maximum of four in microhabitat C.

Overall, it was clear that those microhabitats which supported both the highest overall numbers of aquatic macroinvertebrate species and the most uncommon and notable species were those which provided plant cover. This cover consisted of a variety of different types of vegetation, including dense stands of marginal grasses or rushes, emergent plants (e.g. willowherb, dock or bistort) and willows (which provide bundles of fine, submerged roots). Conversely, the microhabitats which supported least species - regardless of water depth - were those in which little or no plant cover of any sort was available.

[1] See Appendices 8 and 9 for definition of these terms, and notes on all species of nature conservation importance which were recorded.

Description of the macroinvertebrate communities of individual microhabitats

In this section the invertebrate communities of the eight microhabitats are described (beginning with those which were of greatest value for macroinvertebrates).

Microhabitat C (the bank areas on the western side of the lake, overhung by mixed herbs dominated by dense clumps of marginal grasses which trailed into the water).

This area appeared to provide the most valuable invertebrate microhabitat in the main lake, with the greatest number of species overall (34, a little over half of the total number) and the greatest number of uncommon species (4) recorded. Three of the uncommon species found in this area were not seen elsewhere in the lake. These were the water scavenger beetle *Helochares lividus* and the diving beetle *Ilybius fenestratus* (both Nationally Notable B species), and the lesser waterboatman *Corixa panzeri* (a nationally local species). The fourth uncommon species, the nationally local caddis fly *Agraylea sexmaculata*, was abundant throughout the lake (it was found in seven of the eight microhabitats). Microhabitat C appeared to be particularly favoured by snails (seven species), water bugs (seven species) and, especially, water beetles (11 species, including, in addition to the notable species, the great diving beetle *Dytiscus marginalis* and the Screech Beetle *Hygrobia hermanni*).

Microhabitat D (the steep bank to the north, overhung by *Epilobium* (willowherb) and willows).

Microhabitat D appeared to provide a hospitable environment for a wide variety of different macroinvertebrates and was second only in species-richness to C, with 28 species recorded. Although no Nationally Notable, and only one local, species were recorded here on this occasion, the microhabitat should be considered a valuable habitat in the lake. Most of the invertebrate groups recorded in the lake were well-represented in D, so that, whilst no particular group appeared to have an obvious preference for this habitat, there was a fairly even spread (five snail species, all three crustaceans, four mayfly species, two damselflies, five water bugs, three caddis and five beetles). The local species present was the near-ubiquitous caddis fly *Agraylea sexmaculata.*

Microhabitat G (the parts of the lake with tall *Juncus* (rushes) and large stands of tall dock in deep water)

Microhabitat G supported a larger number of water bug species (8) than any other microhabitat, reflecting the preference of many of this group for deeper water where some plant cover is available. (Note that the other deep-water habitat, A, where there was little or no plant-cover, produced only one water bug species.) Six of the ten aquatic snail species recorded at the site occurred in this habitat, but only one beetle, *Dytiscus marginalis* (a great diving beetle), was found here. Overall, the microhabitat was moderately species-rich with 25 macroinvertebrate species recorded, including two local species - the lesser waterboatman *Sigara concinna* (recorded only in G), and, again, the caddis fly *Agraylea sexmaculata.* No Nationally Notable species were recorded from this microhabitat.

Microhabitat H (the stands of *Polygonum amphibium* (Amphibious Bistort))

Microhabitat H was also moderately species-rich with 25 species recorded, although the only local species recorded was the caddis fly *Agraylea sexmaculata.* The most notable feature of H was that four of the five mayfly species, and five of the six caddis fly species, recorded in the lake were present in this microhabitat.

Both microhabitats G and H were moderately species-rich and appeared particularly suited to certain invertebrate groups; however, since no notable species were recorded in either, they cannot be considered more valuable than microhabitats E and F, which, although supporting lower numbers overall, each supported a Nationally Notable B species.

Microhabitat E (the shallow, muddy bay on the north-western side with flooded grass and *Juncus*)

Microhabitat E was dominated by water beetles (10 species of the 17 species recorded), including the Nationally Notable B diving beetle *Rhantus suturalis*, which was only recorded from this microhabitat. This was also the only microhabitat in the main lake where the local caddis species *Agraylea sexmaculata* was not recorded (possibly due to the somewhat variable water level here: it may be completely dry at times).

Microhabitat F (the shallow water with stands of low flooded dock plants)

More than half the species recorded in this microhabitat (6 of the 11 species) were diving beetles, reflecting the fact that this area is usually dry for part of the year. Two uncommon species, the local caddis *Agraylea sexmaculata* and the Nationally Notable B diving beetle *Hydroglyphus pusillus*, were found here; despite this, microhabitat F is probably not a particularly important zone of the lake since *Agraylea sexmaculate* was abundant in all the other microhabitats (except E), and *Hydroglyphus pusillus* is a species which does not appear

to be particularly discriminating in its choice of habitat (see notes in Appendix 8). *H. pusillus* was the only Nationally Notable species which was recorded in both the main lake and in the small grassy pool.

Microhabitat A (the deeper, sandy-bottomed areas) and **Microhabitat B** (also sandy, but shallower).

These two microhabitats comprised, essentially, the rest of the main lake after the other six microhabitats had been distinguished. For survey purposes the deep water was distinguished from the shallow, but there was little or no vegetation in either. Overall, although A and B were each considerably larger than any other microhabitat, neither appeared to be of great significance for macroinvertebrates. In both, only 9 species were recorded, and there was only one uncommon species (the local caddis fly *Agraylea sexmaculata*, which was, however, present in very large numbers in nearly all other parts of the lake). Although the individual species recorded in these two microhabitats did differ (for example, two beetle species were recorded in the shallower water but none in the deeper), few of the species recorded from either A or B appeared to be confined to these parts of the lake (two common snails were recorded only from A, and one common lesser waterboatman only from B).

2.4.3 Aquatic macroinvertebrates in the small grassy pool

This pool was relatively shallow, very irregular in shape, well-vegetated, mainly by grasses, was shaded at one end by a small tree which also provided some leaf litter, and had a small inflow. These features are characteristic of a type of water body which, in past surveys by Pond Action, has often been found to support macroinvertebrate communities with a high, or very high, nature conservation value.

Numbers of species recorded from the pool and occurrence of uncommon species

The total number of macroinvertebrate species recorded from the pool was 31. Of these, 13 species were not recorded from the main lake.

Despite the much lower sampling time compared to the main lake, the same number of Nationally Notable B species - four - were recorded from the pool. The diving beetle *Hydroglyphus pusillus*, recorded from the main lake, was also recorded here, but the other three notable species, the water scavenger beetles *Helophorus strigifrons* and *Laccobius sinuatus* and the diving beetle *Agabus chalconatus* were recorded only in the small grassy pool. Thus over 40% (3 out of 7) of Nationally Notable B species recorded from the whole site at Stanford were restricted to the pool habitat alone. The three notable species which were only recorded from the pool are typical of water bodies of this type, and indeed would be unlikely to be able to colonise or survive in the main lake (for notes on habitats see Appendix 8).

A full species list for the pool is given in Appendix 5, and more detailed notes on these notable species are given in Appendix 8.

Conservation value of the aquatic macroinvertebrate community of the pool

Since the sampling time for the grassy pool was substantially less than for the main lake, comparisons of Species Rarity Indices should be made with caution (since SRIs are affected by the amount of time spent sampling). However, calculating an SRI gives a value of 1.39 for the pool, strongly suggesting that the community in this small pool is of considerable nature conservation value.

Macroinvertebrate community of the pool

The macroinvertebrate community recorded from the pool was, as would be expected, considerably different from that of the main lake. By far the largest proportion of the species recorded here were water beetles: 20 species, nearly two-thirds of the entire list, were recorded. Of these, 11 (including, of course, three of the notable species) were recorded only from the pool. The pool indeed represents a habitat type particularly well-suited to many water beetle species, being dominated by thick, long and straggling grass and receiving leaf-litter and shade from the small tree, so that this result was not unexpected. Other species recorded in the pool included aquatic snails, crustaceans, one dragonfly and one damselfly, and caddis flies. It was noticeable that no water bug species - which usually prefer sites where the water is deeper and less temporary, and the vegetation more open in structure - were recorded in the pool.

The fact that the pool receives an inflow was also reflected in its macroinvertebrate community: for example, the freshwater shrimp *Gammarus pulex*, which would not be associated with small ponds without inflows, and the cased caddis fly *Limnephilus extricatus*, common in marginal vegetation of slowly-flowing ditches and streams were both present.

2.5 Amphibians

2.5.1 Methods

The objective of amphibian survey work was to determine which species were present and to obtain a rough impression of the size of the population of any species present. Three visits, coinciding with the periods when Common Frogs, Common Toads and newts are most easily detected, were made.

Visits were made in spring and early summer, each lasting 2 hours. Frog and Toad spawn clumps, tadpoles and/or breeding pairs were searched for. For newts, searches, both for newt eggs wrapped in water plants (considered to be the most reliable survey method) and for adults and/or newtpoles, were carried out. In addition, amphibians were extensively netted-for during the macroinvertebrate surveys of Stanford Lake and the small adjacent pool in May 1994.

2.5.2 Results

No amphibians were recorded during evening visits in the spring and early summer, or during extensive hand-netting for invertebrates. However, Mark Garrett (Oxfordshire County Council) recorded recently-metamorphosed Common Frogs on 25 June 1994. It is very likely that the site supports both Common Frog and Smooth Newt populations. However, population levels appear to be low.

2.6 Breeding birds

Although birds were not specifically included in the survey programme, it was noted during both spring and summer visits to the site that Little Ringed Plover were present. The site appears to provide a suitable breeding habitat for this species. Little Ringed Plovers are uncommon birds in Britain, with an estimated 1000 pairs in the country as a whole; the Oxfordshire population is at present estimated to be between 10 and 12 pairs (Brucker et al, 1992). Redshank and Common Sandpiper were also seen during the spring and Little Grebe were proved to breed on the site this year (1994). Snipe were 'put-up' from the lake margin during late autumn and winter 1994.

3. The Frogmore Brook

The aim of surveys of the Frogmore Brook was to investigate its biological water quality above and below Stanford-in-the-Vale, using aquatic macroinvertebrate assessment methods.

3.1 Method

Two sections of stream, one upstream of Stanford (Grid. Ref. SU33589469) and one downstream (Grid. Ref SU34769344), were surveyed for aquatic macroinvertebrates. Two three-minute, time-limited hand-net samples (A and B) were taken from each of these sections. The samples were placed in separate plastic buckets before return to the laboratory for sorting and identification.

The method employed followed that used by NRA Thames Region for RIVPACS (River Invertebrates Prediction and Classification System). Each sample was sorted for two hours, the object being to record as full a list of aquatic macroinvertebrate families (rather than species) as possible within the time available.

Based on the lists of aquatic macroinvertebrate families obtained, BMWP (Biological Monitoring Working Party) scores and ASPTs (Average Scores Per Taxon) were calculated for each section surveyed. This system awards 'points' (between 1 and 10) to macroinvertebrate families according to their perceived ability to tolerate organic pollution, with the highest scores being awarded to those families which are most 'pollution-sensitive' and the lowest scores to those which are relatively 'pollution-tolerant'. Thus the system enables the extent of pollution present in a river or stream to be gauged, and also allows for simple comparisons between different sections of the same watercourse.

3.2 Site descriptions

3.2.1 Upstream section

The upstream section of the Frogmore brook was characterised as fairly straight, slow-flowing, and with a substrate composed of 95% deep silt and 5% gravels and pebbles. Stream depths averaged 77cm (i.e. to the top of the silt). The width varied from 140cm to 230cm, with an average of 170cm. The stream banks were almost perpendicular and largely unshaded. Fields used for pasture bordered both right and left banks. Habitats which were sampled included silt/sand, stands of *Carex* sp. (sedge), stands of *Apium nodiflorum* (Fool's Watercress). and trailing herbs and grasses.

3.2.2 Downstream section.

The downstream channel was slightly meandering with a moderate to fast flow, riffling in places. The bottom substrate comprised approximately 50% sand, 30% gravels/pebbles, 10% cobbles and 10% silt. Water depth averaged 23cm and the width varied from 90cm to 230cm (average of 140cm). The left bank of the brook was bordered by pasture, and a hedgerow lined the right bank. The stream sides were steep, and lightly to moderately shaded by the hedge. Habitats for sampling included the different substrate types present, extensive stands of *Apium nodiflorum* (Fool's Watercress) and trailing grasses.

3.3. Aquatic macroinvertebrates

Overall, 30 species were recorded in the upstream stretch. All are common, and differ from those recorded downstream in that many are species typically associated with a more silty flowing-water environment (e.g. the two alderflies *Sialis lutaria* and *S. fuliginosa*).

24 macroinvertebrate species were recorded from the downstream length. All are, again, common, with the possible exception of one Notable caseless caddis species (*Tinodes unicolor*) which, however, requires confirmation. Descriptive notes on this species are given in Appendix 8.

3.4. Comparison of water quality indices for two stretches of the Frogmore Brook

The standard method of assessing biological water quality in the United Kingdom relies on the comparison of actual BMWP indices (i.e. BMWP score, TAXA score and ASPT) with those derived from the computer programme RIVPACS (River Invertebrate Prediction and Classification System). This programme estimates the BMWP indices which would be expected from a river with the same physical parameters as the study river, but with good water quality. From the predicted indices and the actual indices, Ecological Quality Indices (EQIs) are derived, where:

EQI = actual index / predicted index.

EQIs are derived for all three BMWP indices (i.e. BMWP.EQI, TAXA.EQI and ASPT.EQI). The EQIs are then used to place the sample into a water quality band (currently the 5M band). The system has four bands (A to D) with A representing good water quality and D poor water quality.

Water quality indices from upstream and downstream sections are summarised in Table 7, below. RIVPACS results, supplied by the NRA, and based on field measurements taken on the day of sampling, are given in the table, together with the (EQIs) derived from these.

All samples taken fom the stream are placed within the band A of the 5M water quality banding system, suggesting that the water quality in the stream is good. On average, however, all the EQIs (BMWP, TAXA and ASPT) decreased between the upstream and downstream sections. This is particularly noticable with respect to ASPT.EQI, which is generally regarded as the best single indicator of water quality. Though the difference observed is not statistically significant (Students t-test at 5% confidence level), a decrease in water quality between the two sampling points is suggested by these results.

In the light of these results it might be prudent to carry out further analysis of the water quality in the brook. This could take the form of a more extensive biological sampling programme of upstream and downstream lengths of the Frogmore Brook, or chemical analysis.

Table 7. Water quality indices for the stream sections.

Indices	Upstream Sample A	Upstream Sample A	Downstream Sample B	Downstream Sample B
BMWP	111	119	93	112
TAXA	20	22	20	22
ASPT	5.55	5.42	4.65	5.09
Predicted BMWP	102.4	102.4	112.1	112.1
Predicted TAXA	20.9	20.9	21.7	21.7
Predicted ASPT	4.9	4.9	5.2	5.2
BMWP.EQI	1.08	1.16	0.83	1.00
TAXA.EQI	0.96	1.05	0.92	1.01
ASPT.EQI	1.13	1.10	0.89	0.98
5M water quality band	A	A	A	A

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Appendices

Appendix 1. Pond Action Wetland Plant List

Aquatic Plants

Apium inundatum
Aponogeton distachyos
Azolla filiculoides
Callitriche hamulata
Callitriche hermaphroditica
Callitriche obtusangula
Callitriche platycarpa
Callitriche stagnalis
Callitriche truncata
Callitriche sp. (undetermined)
Ceratophyllum demersum
Ceratophyllum submersum
Crassula helmsii
Egeria densa
Elatine hexandra
Eleogiton fluitans
Elodea canadensis
Elodea nuttallii
Glyceria fluitans
Groenlandia densa
Hippuris vulgaris
Hottonia palustris
Hydrocharis morsus-ranae
Isoetes lacustris
Juncus bulbosus
Lagarosiphon major
Lemna gibba
Lemna minor
Lemna minuscula
Lemna polyrhiza
Lemna trisulca
Littorella uniflora
Lobelia dortmann
Luronium natans
Menyanthes trifoliata
Myriophyllum alterniflorum
Myriophyllum aquaticum
Myriophyllum spicatum
Myriophyllum verticillatum
Nuphar lutea
Nymphaea alba
Nymphoides peltata
Oenanthe aquatica
Oenanthe fluviatilis
Potamogeton alpinus
Potamogeton berchtoldii
Potamogeton coloratus
Potamogeton crispus
Potamogeton friesii
Potamogeton gramineus
Potamogeton lucens
Potamogeton natans
Potamogeton obtusifolius
Potamogeton perfoliatus
Potamogeton pectinatus
Potamogeton polygonifolius
Potamogeton praelongus
Potamogeton pusillus
Potamogeton trichoides
Ranunculus aquatilis
Ranunculus baudotii
Ranunculus circinatus
Ranunculus fluitans
Ranunculus hederaceus
Ranunculus omiophyllus
Ranunculus peltatus
Ranunculus penicillatus
Ranunculus trichophyllus
Sagittaria sagittifolia
Sparganium angustifolium
Sparganium emersum
Sparganium minimum
Stratiotes aloides
Subularia aquatica
Utricularia australis
Utricularia intermedia
Utricularia minor
Utricularia vulgaris
Wolffia arriza
Zannichellia palustris

Marginal and Emergent Plants

Achillea ptarmica
Acorus calamus
Agrostis stolonifera
Alisma lanceolatum
Alisma plantago-aquatica
Alopecurus aequalis
Alopecurus geniculatus
Anagallis tenella
Andromeda polifolia
Angelica archangelica
Angelica sylvestris
Apium nodiflorum
Baldellia ranunculoides
Barbarea intermedia
Barbarea vulgaris
Berula erecta
Bidens cernua
Bidens tripartita
Blysmus compressus
Butomus umbellatus
Calamagrostis canescens
Calamagrostis epigejos
Caltha palustris
Cardamine amara
Cardamine pratensis
Carex acuta
Carex acutiformis
Carex curta
Carex demiss
Carex diandra
Carex disticha
Carex flacca
Carex hostinana
Carex laevigata
Carex lasiocarpa
Carex lepidocarpa
Carex nigra
Carex otrubae
Carex panicea
Carex paniculata
Carex pendula
Carex pseudocyperus
Carex pulicaris
Carex riparia
Carex rostrata
Carex spicata
Carex vesicaria
Catabrosa aquatica
Cicuta virosa
Cirsium dissectum
Cirsium palustre
Cladium mariscus
Conium maculatum
Crepis paludosa
Cyperus longulus
Dactylorhiza fuchsii
Damasonium alisma
Deschampsia caespitosa
Drosera rotundifolia
Eleocharis acicularis
Eleocharis multicaulis
Eleocharis palustris
Eleocharis quinqueflora
Equisetum fluviatile
Equisetum palustre
Epilobium hirsutum
Epilobium nerteroides
Epilobium obscurum
Epilobium palustre
Epilobium parviflorum
Epilobium tetragonum
Epipactis palustris
Erica tetralix
Eriophorum angustifolium
Eriophorum latifolium
Eriophorum vaginatum
Eupatorium cannabinum
Filipendula ulmaria
Galium boreale
Galium palustre
Galium uliginosum
Geum rivale
Glyceria declinata
Glyceria fluitans
Glyceria maxima
Glyceria plicata
Hydrocotyle vulgaris
Hypericum elodes
Hypericum tetrapterum
Impatiens capensis
Impatiens glandulifera
Impatiens noli-tangere
Iris pseudacorus
Isolepis cernua
Isolepis setacea
Juncus acutiflorus
Juncus articulatus
Juncus bufonis agg.
Juncus compressus
Juncus conglomeratus
Juncus inflexus
Juncus subnodulosus
Juncus effusus
Lotus uliginosus
Lychnis flos-cuculi
Lycopus europaeus
Lysimachia nemorum
Lysimachia nummularia
Lysimachia vulgaris
Lythrum hyssopifolia
Lythrum portula
Lythrum salicaria
Mentha aquatica
Mimulus guttatus
Mimulus luteus
Molinia caerulea
Montia fontans
Myosotis laxa
Myosotis scorpioides
Myosotis secunda
Myosoton aquaticum
Myrica gale
Narthecium ossifragum
Nasturtium microphyllum
Nasturtium officinale
Oenanthe aquatica
Oenanthe crocata
Oenanthe fistulosa
Oenanthe lachenalii
Osmunda regalis
Parnassia palustris
Pedicularis palustris
Petasites hybridus
Phalaris arundinacea
Phragmites australis
Pilularia globulifera
Pinguicula vulgaris
Polygonum amphibium
Polygonum hydropiper
Polygonum lapathifolium
Polygonum persicaria
Potentilla erecta
Potentilla palustris
Pulcaria dysenterica
Ranunculus flammula
Ranunculus lingua
Ranunculus sceleratus
Rhynchospora alba
Rorippa amphibia
Rorippa palustris
Rorippa sylvestris
Rumex hydrolapathum
Rumex maritimus
Rumex palustris
Sagina procumbens
Saggittaria sagittifolia
Schoenoplectus lacustris
ssp lacustris
ssp tabernaemontani
Schoenus nigricans
Scrophularia auriculatas
Scutellaria galericulata
Senecio aquaticus
Senecio fluviatilis
Sium latifolium
Solanum dulcamara
Sparganium erectum
Stachys palustris
Stellaria alsine
Stellaria palustris
Symphytum officinale
Thalictrum flavum
Thelypteris palustris
Tofieldia pusilla
Tricophorum cespitosum
Triglochin palustris
Typha angustifolia
Typha latifolia
Valeriana dioica
Veronica anagallis-aquatica
Veronica beccabunga
Veronica catenata
Veronica scutellata
Viola palustris

Bryophytes:
Fontinalis antipyretica
Riccia fluitans
Ricciocarpus natans
Sphagnum sp.

Algae:
Chara sp.
Nitella sp.
Tolypella sp.

Appendix 2 Terrestrial plant species recorded from Stanford Quarry

Specific name	English name
Achillea millefolium	Yarrow
Aegopodium podagraria	Goutweed
Agrostis capillaris	Common Bent
Agrostis gigantea	Black Bent
Anagallis arvensis	Scarlet Pimpernel
Anthriscus sylvestris	Cow parsley
Arctium minus	Burdock
Arenaria serpyllifolia	Thyme-leaved Sandwort
Armoracia rusticana	Horse-radish
Arrhenatherum elatius	False Oat-grass
Artemisia vulgaris	Mugwort
Atriplex patula	Common Orache
Atriplex prostrata	Spear-leaved Orache
Avena sativa	Oat
Ballota nigra	Black Horehound
Barbarea vulgaris	Common Wintercress
Bellis perennis	Daisy
Brassica nigra	Black Mustard
Bromus hordeaceus	Lop-grass
Bromus sterilis	Barren Brome
Bryonia dioica	White Bryony
Calystegia sepium sensu stricto	Hedge Bindweed
Carduus crispus (C. acanthoides)	Welted Thistle
Centaurea scabiosa	Greater Knapweed
Cerastium fontanum	Common Mouse-ear
Cerastium glomeratum	Sticky Mouse-ear
Cerastium semidecandrum	Little Mouse-ear
Chaenorhinum minus	Small Toadflax
Chelidonium majus	Greater Celandine
Chenopodium album	Fat Hen
Chenopodium rubrum	Red Goosefoot
Cirsium arvense	Creeping Thistle
Cirsium vulgare	Spear Thistle
Conium maculatum	Hemlock
Convolvulus arvensis	Field Bindweed
Crataegus monogyna	Hawthorn
Crepis bienns	Rough Hawk's-beard
Crepis capillaris	Smooth Hawk's-beard
Dactylis glomerata	Cock's-foot
Daucus carota	Wild Carrot
Desmazeria rigida	Fern-grass
Dipsacus fullonum	Teasel
Elytrigia repens (Elymus repens)	Couch
Erigeron acer	Blue Fleabane
Eupatorium cannabinum	Hemp Agrimony
Euphorbia peplus	Dwarf Spurge
Fallopia convolvulus	Black Bindweed
Festuca arundinacea	Tall Fescue
Festuca ovina	Sheep's Fescue
Festuca rubra	Red Fescue
Fraxinus excelsior	Ash
Fumaria officinalis	Common Fumitory
Galium aparine	Cleavers
Galium verum	Lady's Bedstraw
Geranium dissectum	Cut-leaved Crane's-bill

(continued)

Appendix 2 **Terrestrial plant species recorded from Stanford Quarry (continued)**

Specific name	English name
Geranium robertianum	Herb Robert
Glechoma hederacea	Ground Ivy
Hedera helix	Common Ivy
Heracleum sphondylium	Hogweed
Holcus lanatus	Yorkshire Fog
Hordeum murinum	Wall Barley
Humulus lupulus	Hop
Hypericum perforatum	Perforate St John's-wort
Hypochaeris radicata	Cat's-ear
Knautia arvensi	Field Scabious
Lactuca serriola	Prickly Lettuce
Lamium album	White Dead-nettle
Lapsana communis	Nipplewort
Lathyrus pratensis	Meadow Vetchling
Leontodon autumnale	Smooth Hawkbit
Leucanthemum vulgare	Ox-eye Daisy
Linaria purpurea	Purple Toadflax
Linaria vulgaris	Common Toadflax
Lolium perenne	Rye Grass
Malus domestica	Apple
Malva sylvestris	Common Mallow
Matricaria matricarioides	Pineapple Weed
Medicago arabica	Spotted Medic
Medicago lupulina	Black Medic
Medicago sativa subsp. *sativa*	Luceme
Melilotus officinalis	Ribbed Melilot
Mentha X villosa var. *alopecuroides*	Applemint
Myosotis arvensis	Field Forget-me-not
Odontites verna	Red Bartsia
Ophrys apifera	Bee Orchid
Papaver dubium	Long-headed Poppy
Papaver rhoeas	Common Poppy
Papaver somniferum	Opium Poppy
Pastinaca sativa	Wild Parsnip
Plantago major	Great Plantain
Poa annua	Annual Meadow-grass
Poa pratensis	Smooth Meadow-grass
Poa trivialis	Rough Meadow-grass
Taraxacum officinale	Dandelion
Thlaspi arvense	Pennycress
Torilis japonica	Hedge Parsley
Tragopogon pratensis	Goat's-beard
Polygonum arenastrum	Equal-leaved Knotgrass
Polygonum aviculare	Knotgrass
Potentilla anserina	Silverweed
Potentilla reptans	Creeping Cinquefoil
Prunella vulgaris	Self-heal
Prunus domestica	Plum
Prunus spinosa	Blackthorn
Ranunculus repens	Creeping Buttercup
Reseda luteola	Weld
Rosa canina	Dog Rose
Rubus fruticosus	Bramble

(continued)

Appendix 2 **Terrestrial plant species recorded from Stanford Quarry (continued)**

Specific name	English name
Rubus ulmifolius	Bramble
Rumex acetosella	Sheep's-sorrel
Rumex crispus	Curled Dock
Rumex obtusifolius	Broad-leaved Dock
Rumex sanguineus	Wood Dock
Sagina apetala	Annual Pearlwort
Sambucus nigra	Elder
Senecio erucifolius	Hoary Ragwort
Senecio jacobaea	Ragwort
Senecio vulgaris	Groundsel
Silene alba	White Campion
Silene vulgaris	Bladder Campion
Sinapis arvensis	Charlock
Sisymbrium officinale	Hedge Mustard
Sonchus asper	Prickly Sow-thistle
Sonchus oleraceus	Smooth Sow-thistle
Stachys sylvatica	Woundwort
Stellaria media	Chickweed
Trifolium dubium	Lesser Trefoil
Trifolium repens	White Clover
Tripleurospermum inodorum	Scentless Mayweed
Trisetum flavescens	Yellow Oat-grass
Triticum species	Wheat
Tussilago farfara	Colt's-foot
Ulmus procera	English Elm
Urtica dioica	Common Nettle
Verbascum thapsus	Great Mullein
Verbena officinalis	Vervain
Veronica arvensis	Wall Speedwell
Veronica persica	Common Field-speedwell
Vicia cracca	Bush Vetch
Vicia sativa subsp. *sativa*	Fodder Vetch
Vicia sativa subsp. *segetalis*	Common Vetch
Vulpia bromoides	Squirreltail Fescue
Vulpia myuros	Rat's-tail Fescue

Appendix 3	Wetland plants recorded from Stanford Quarry, including national and regional rarity scores.	
Rarity Score		
National Score	**Regional Score**	**Specific name**	**English Name**
Aquatic plants			
1	1	*Callitriche stagnalis*	Common Water-starwort
1	1	*Elodea canadensis*	Canadian Waterweed
1	1	*Glyceria fluitans*	Floating Sweetgrass
1	1	*Lemna minor*	Common Duckweed
1	1	*Myriophyllum spicatum*	Spiked Water-milfoil
1	1	*Polygonum amphibium*	Amphibious Bistort
2	1	*Potamogeton berchtoldii*	Small Pondweed
2	1	*Potamogeton crispus*	Curled Pondweed
2	1	*Potamogeton pectinatus*	Fennel Pondweed
1	1	*Ranunculus sp*	Water-crowfoot species
2	1	*Zannichellia palustris*	Horned Pondweed
2	2	*Chara vulgaris var. hispidata*	A stonewort species
17	13	National and regional conservation scores	
Marginal Species			
1	1	*Agrostis stolonifera*	Creeping Bent
1	1	*Alisma plantago-aquatica*	Water- plantain
1	1	*Alopecurus geniculatus*	Marsh Foxtail
1	1	*Apium nodiflorum*	Fool's Water-cress
1	1	*Carex otrubae*	False Fox-sedge
1	1	*Carex riparia*	Greater Pond-sedge
1	1	*Deschampsia caespitosa*	Tufted Hair-grass
1	1	*Eleocharis palustris*	Common Spike-rush
1	1	*Equisetum palustre*	Marsh Horsetail
1	1	*Epilobium ciliatum*	
1	1	*Epilobium hirsutum*	Great Willow-herb
1	1	*Epilobium obscurum*	Short-fruited Willow-herb
1	1	*Epilobium palustre*	Marsh Willow-herb
1	1	*Epilobium parviflorum*	Hoary Willow-herb
2	2	*Epilobium tetragonum*	Square-stalked Willow-herb
1	1	*Filipendula ulmaria*	Meadowsweet
1	1	*Juncus articulatus*	Jointed-rush
1	1	*Juncus bufonis agg.*	Toad Rush
1	1	*Juncus inflexus*	Hard Rush
1	1	*Juncus effusus*	Soft-rush
1	1	*Lycopus europaeus*	Gipsywort

(Continued)

Appendix 3		Wetland Plants recorded from Stanford Quarry, including national and regional rarity scores.	
Rarity Score			
National Score	Regional Score	Specific name	English Name
Marginal plants (Cont.)			
1	1	*Lythrum salicaria*	Purple-loosestrife
1	1	*Myosotis scorpioides*	Water Forget-me-not
1	1	*Nasturtium officinale*	Water-cress
1	1	*Polygonum lapathifolium*	Pale Persicaria
1	1	*Polygonum persicaria*	Redshank
1	1	*Ranunculus sceleratus*	Celery-leaved Buttercup
1	1	*Salix cinerea*	Willow
1	1	*Scrophularia auriculata*	Water Figwort
1	1	*Solanum dulcamara*	Bittersweet
1	1	*Symphytum x uplandicum*	Russian Comfrey
1	1	*Typha latifolia*	Bulrush
1	1	*Veronica anagallis-aquatica*	Blue Water-speedwell
51	47	National and regional conservation score	
12		Number of aquatic species	
33		Number of marginal species	
45		Total number of species	
National Score	**Regional Score**		
1.41	1.2	Aquatic plants rarity index	
1.03	1.03	Marginal plants rarity index	
1.15	1.04	Total rarity index	

Appendix 4. Aquatic macroinvertebrate species recorded from Stanford Quarry main lake.

* = Nationally Notable B species; † = local species. (See Appendix 8 for definition of terms.) English species names are given where they exist.

Species	Microhabitats							
	A	B	C	D	E	F	G	H
Tricladida (flatworms)								
Polycelis tenuis	-	-	+	-	-	-	-	-
Hirudinea (leeches)								
Theromyzon tessulatum	-	-	-	-	-	-	+	-
Gastropoda (snails)								
Anisus vortex (Whirlpool Ramshorn)	-	-	+	-	-	-	-	-
Armiger crista (Nautilus Ramshorn)	-	-	+	+	+	-	+	+
Gyraulus albus (White Ramshorn)	-	-	+	+	-	-	+	+
Lymnaea peregra (Wandering Snail)	-	+	+	+	+	+	+	+
Lymnaea truncatula (Dwarf Pond Snail)	-	-	+	-	+	-	+	+
Physa acuta	-	+	-	+	+	-	+	+
Physa fontinalis (Bladder Snail)	-	-	+	-	-	-	-	-
Planorbis carinatus (Keeled Ramshorn)	-	-	+	+	-	-	+	+
Potamopyrgus jenkinsi (Jenkins' Spire Shell)	+	-	-	-	-	-	-	-
Valvata piscinalis (Valve Snail)	+	-	-	-	-	-	-	-
Bivalvia (bivalves)								
Sphaerium corneum	-	-	-	+	-	-	-	-
Crustacea (slaters and shrimps)								
Asellus aquaticus	-	-	+	+	+	-	+	+
Crangonyx pseudogracilis	+	-	+	+	+	-	+	+
Gammarus pulex	-	+	+	+	-	+	-	+

(continued)

Note:
Microhabitats: A = deeper water with sandy bottom; B = shallow sandy bank; C = grassy bank; D = steep bank overhung by willows and *Epilobium* (willowherb); E = shallow, muddy bay with low *Juncus* (rush) and grass; F = shallow water with low dock; G = deeper water, with taller *Juncus* and *Rumex* (dock) spp.; H = stands of *Polygonum amphibium* (Amphibious Bistort)

Appendix 4. **Aquatic macroinvertebrate species recorded from Stanford Quarry main lake (continued).**

Species	Microhabitats							
	A	B	C	D	E	F	G	H
Ephemeroptera (mayflies)								
Caenis horaria (a white midge/angler's curse)	+	+	-	+	-	-	-	+
Caenis luctuosa (a white midge/angler's curse)	-	-	-	-	-	-	-	+
Cloeon dipterum (Pond Olive)	-	-	+	+	-	-	+	+
Cloeon simile (Lake Olive)	-	-	-	+	-	-	+	+
Ephemera vulgata (Drake Mackerel)	-	-	-	+	-	-	-	-
Odonata (dragonflies and damselflies)								
Enallagma cyathigerum (Common Blue Damselfly)	-	-	-	+	-	-	+	+
Ischnura elegans (Blue-tailed Damselfly)	+	-	+	+	-	-	+	+
Sympetrum striolatum (Common Darter)	+	-	+	-	-	-	-	-
Hemiptera (water bugs)								
Callicorixa praeusta	+	-	+	+	-	+	+	+
Corixa panzeri†	-	-	+	-	-	-	-	-
Corixa punctata	-	-	+	-	-	-	+	-
Gerris thoracicus	-	-	-	-	-	-	+	-
Ilyocoris cimicoides (Saucer Bug)	-	-	+	-	-	-	-	-
Plea leachi	-	-	+	+	-	-	+	+
Sigara concinna†	-	-	-	-	-	-	+	-
Sigara dorsalis	-	-	+	+	-	-	+	+
Sigara distincta	-	-	-	+	-	-	+	+
Sigara falleni	-	-	-	-	-	-	+	-
Sigara fossarum	-	-	+	+	+	+	-	-
Sigara lateralis	-	+	-	-	-	-	-	-
Trichoptera (caddis flies)								
Agraylea multipunctata	+	+	-	+	-	-	+	+
Agraylea sexmaculata†	+	+	+	+	-	+	+	+
Athripsodes aterrimus (Black Silverhorn)	-	-	-	-	-	-	-	+
Leptocerus tineiformis	-	-	-	-	-	-	-	+
Limnephilus lunatus (Cinnamon Sedge)	-	-	+	+	-	-	+	-
Mystacides longicornis (Grouse-wing)	-	-	-	-	-	-	-	+
Coleoptera (beetles)								
Agabus bipustulatus	-	-	-	-	+	-	-	-
Anacaena limbata	-	-	-	-	+	-	-	-

(continued)

Note:
Microhabitats: A = deeper water with sandy bottom; B = shallow sandy bank; C = grassy bank; D = steep bank overhung by willows and *Epilobium* (willowherb); E = shallow, muddy bay with low *Juncus* (rush) and grass; F = shallow water with low dock; G = deeper water, with taller *Juncus* and *Rumex* (dock) spp.; H = stands of *Polygonum amphibium* (Amphibious Bistort).

Appendix 4. **Aquatic macroinvertebrate species recorded from Stanford Quarry main lake (continued).**

Species	Microhabitats							
	A	B	C	D	E	F	G	H
Coleoptera (continued)								
Coelambus confluens	-	+	-	-	-	-	-	-
Colymbetes fuscus	-	-	+	-	+	+	-	-
Dytiscus marginalis (a great diving beetle)	-	-	+	-	-	-	+	-
Haliplus flavicollis	-	-	-	+	-	-	-	-
Haliplus ruficollis	-	-	-	+	-	-	-	-
*Helochares lividus**	-	-	+	-	-	-	-	-
Helophorus brevipalpis	-	-	-	-	+	-	-	-
Helophorus grandis	-	-	-	-	+	-	-	-
Hydrobius fuscipes	-	-	-	-	+	-	-	-
*Hydroglyphus pusillus**	-	-	-	-	-	+	-	-
Hydroporus planus	-	+	+	-	+	+	-	-
Hydroporus pubescens	-	-	+	-	-	-	-	-
Hydroporus tesselatus	-	-	+	-	+	+	-	-
Hygrobia hermanni (Screech or Squeak Beetle)	-	-	+	-	-	-	-	-
Hygrotus inaequalis	-	-	+	+	-	+	-	-
Hyphydrus ovatus	-	-	+	+	-	-	-	-
*Ilybius fenestratus**	-	-	+	-	-	-	-	-
Ilybius fuliginosus	-	-	-	-	+	-	-	-
Laccophilus minutus	-	-	+	+	-	+	-	+
*Rhantus suturalis**	-	-	-	-	+	-	-	-
Microhabitat:	A	B	C	D	E	F	G	H
Number of species per microhabitat:	9	9	34	28	17	11	25	25

Overall total number of species recorded: 64

Species Rarity Index: 1.23

Note:
Microhabitats: A = deeper water with sandy bottom; B = shallow sandy bank; C = grassy bank; D = steep bank overhung by willows and *Epilobium* (willowherb); E = shallow, muddy bay with low *Juncus* (rush) and grass; F = shallow water with low dock; G = deeper water, with taller *Juncus* and *Rumex* (dock) spp.; H = stands of *Polygonum amphibium* (Amphibious Bistort).

Appendix 5. Aquatic macroinvertebrate species recorded from Stanford Quarry: the small grassy pool adjacent to the main lake

* = Nationally Notable B

Gastropoda (snails)

Armiger crista (Nautilus Ramshorn)
Lymnaea palustris (Marsh Snail)
Lymnaea peregra (Wandering Snail)
Physa acuta

Crustacea (slaters and shrimps)

Asellus aquaticus
Crangonyx pseudogracilis
Gammarus pulex

Odonata (dragonflies and damselflies)

Ischnura elegans (Blue-tailed Damselfly)
Libellula depressa (Broad-bodied Chaser)

Trichoptera (caddis flies)

Limnephilus extricatus
Limnephilus lunatus (Cinnamon Sedge)

Coleoptera (beetles)

Agabus bipustulatus
*Agabus chalconatus**
Agabus nebulosus
Colymbetes fuscus
Dytiscus marginalis (a great diving beetle)
Helophorus aequalis
Helophorus brevipalpis
Helophorus grandis
Helophorus minutus
*Helophorus strigifrons**
Hydraena riparia
Hydrobius fuscipes
*Hydroglyphus pusillus**
Hydroporus planus
Hydroporus tesselatus
Ilybius ater
Ilybius fuliginosus
Laccobius bipunctatus
*Laccobius sinuatus**
Ochthebius minimus

Overall total number of species recorded: 31

Species Rarity Index: 1.38

Appendix 6a. Aquatic macroinvertebrates, BMWP and ASPT scores recorded from the Frogmore Brook - upstream site.

Species	Sample A	Sample B
Hirudinea (leeches)		
Erpobdella octoculata	+	+
Glossiphonia complanata	+	+
Piscicola geometra	+	+
Gastropoda (snails and limpets)		
Ancylus fluviatilis (River Limpet)	-	+
Bathyomphalus contortus	+	+
Lymnaea peregra (Wandering Snail)	+	-
Potamopyrgus jenkinsi (Jenkins' Spire Shell)	+	-
Valvata piscinalis (Valve Snail)	+	-
Bivalvia (bivalves)		
Sphaerium corneum	+	+
Crustacea (slaters and shrimps)		
Gammarus pulex	+	+
Ephemeroptera (mayflies)		
Baetis rhodani (Large Dark Olive)	+	+
Ephemera vulgata (Drake Mackerel)	+	+
Habrophlebia fusca	+	+
Megaloptera (alderflies)		
Sialis lutaria	-	+
Trichoptera (caddis flies)		
Goera pilosa (Medium Sedge)	-	+
Halesus digitatus	+	+
Halesus radiatus	+	-
Hydropsyche siltalai	+	+
Limnephilus lunatus (Cinnamon Sedge)	+	+
Micropterna lateralis	+	-
*Tinodes ?unicolor** (N.B. to be confirmed)	+	-

(Continued)

* = Notable species. See Appendix 8 for definition. (Note that *Tinodes unicolor** requires confirmation.)

Appendix 6a. **Aquatic macroinvertebrates, BMWP and ASPT scores recorded from the Frogmore Brook - upstream site (continued).**

Species (continued)	**Sample A**	**Sample B**
Coleoptera (beetles)		
Brychius elevatus	-	+
Elmis aenea	+	+
Platambus maculatus	-	+

Total number of species recorded in upstream samples: 24

BMWP Scores: (Sample A) = **93**
(Sample B) = **112**

ASPT Scores: (Sample A) = **4.65**
(Average score per taxon) (Sample B) = **5.09**

Appendix 6b. Aquatic macroinvertebrates, BMWP and ASPT scores recorded from the Frogmore Brook - downstream site.

Species	Sample A	Sample B
Hirudinea (leeches)		
Erpobdella octoculata	-	+
Glossiphonia complanata	-	+
Helobdella stagnalis	-	+
Piscicola geometra	-	+
Gastropoda (snails)		
Anisus vortex (Whirlpool Ramshorn)	-	+
Bathyomphalus contortus	+	+
Potamopyrgus jenkinsi (Jenkins' Spire Shell)	+	+
Crustacea (slaters and shrimps)		
Asellus meridianus	+	+
Gammarus pulex	+	+
Ephemeroptera (mayflies)		
Baetis rhodani (Large Dark Olive)	+	+
Ephemera vulgata (Drake Mackerel)	+	+
Paraleptophlebia submarginata (Turkey Brown)	+	-
Plecoptera (stoneflies)		
Nemurella picteti (a small brown)	+	-
Megaloptera (alderflies)		
Sialis fuliginosa	+	+
Sialis lutaria	+	+
Trichoptera (caddis flies)		
Adicella reducta	+	+
Beraeodes minutus	+	+
Chaetopteryx villosa	+	-
Halesus digitatus	+	-
Lasiocephala basalis	-	+
Limnephilus extricatus	-	+
Limnephilus lunatus (Cinnamon Sedge)	+	+
Limnephilus marmoratus	+	-
Sericostoma personatum (Welshman's Button)	-	+

(continued)

Appendix 6b. Aquatic macroinvertebrates, BMWP and ASPT scores recorded from the Frogmore Brook - downstream site.

Species (continued)	Sample A	Sample B
Coleoptera (beetles)		
Agabus didymus	+	-
Agabus paludosus	+	-
Anacaena globulus	+	+
Anacaena limbata	-	+
Elmis aenea	+	+
Haliplus lineatocollis	+	-

Total number of species recorded in downstream samples: 30

BMWP Scores: (Sample A) = **111**
(Sample B) = **119**

ASPT Scores: (Sample A) = **5.55**
(Average score per taxon) (Sample B) = **5.41**

Appendix 7. Notes on the national distribution of uncommon plant species recorded from Stanford Quarry

Potamogeton berchtoldii **(POTAMOGETONACEAE) Small Pondweed**

Widespread, native. Found in lakes, ponds, canals, streams, ditches, temporary waters etc., in very calcareous and very acid waters, but often absent from oligotrophic waters. (Clapham *et al.*1989; Croft *et al.* 1991.)

Potamogeton crispus **(POTAMOGETONACEAE) Curled Pondweed**

Native; widespread in England, but decreasing in lowland lakes, ponds, streams etc. Very local in Wales and absent from much of NW Scotland: in Orkney and locally frequent in Ireland. Found in a wide range of habitats, including lakes, ponds, rivers, streams, canals and ditches. (Clapham *et al.*1989; Croft *et al.* 1991.)

Potamogeton pectinatus **(POTAMOGETONACEAE) Fennel Pondweed**

Widespread throughout Britain in base-rich water of the lowlands, but absent from mountainous districts of Wales, N.England and Scotland. Found in eutrophic or brackish water in a wide range of lowland habitats: one of the most pollution-tollerant *Potamogeton* species. (Clapham *et al.*1989; Croft *et al.* 1991.)

Zannichellia palustris **(ZANNICHELLIACEAE) Horned Pondweed**

Native. Found in a number of distinct habitats, including clear water in shallow streams over chalk and limestone, eutrophic ditches, lakes and pools of fresh or brackish water. Locally common throughout the British Isles, though most frequent in England and E. Ireland. (Clapham *et al.*1989; Croft *et al.* 1991.)

Epilobium tetragonum **(ONAGRACEAE) Square-stalked Willow-herb**

Native. Found in damp woodland clearings, stream and ditch banks etc, and cultivated ground in lowland Britain where it is locally common. Becoming rare northwards. (Croft *et al.* 1991.)

Appendix 8. Notes on uncommon and Nationally Notable aquatic macroinvertebrate species recorded from Stanford Quarry and the Frogmore Brook

Note: The information given below includes, for species recorded from the main lake, the particular microhabitats in which they were found. All references to 'Britain' are to mainland Britain, and do not include Ireland.

Corixa panzeri (HETEROPTERA: Corixidae). A lesser waterboatman.

Present status: Local[1]. (Main lake: grassy bank [C].)

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

Sigara concinna (HETEROPTERA: Corixidae). A lesser waterboatman.

Present status: Local. (Main lake: deeper water with tall rushes and dock [G].)

Found throughout mainland Britain, particularly in the Midlands, but scarce where it occurs. Restricted to still waters, usually with some vegetation: often associated with new or disturbed sites. (Savage, 1989; Pond Action, unpublished data.)

Agraylea sexmaculata (TRICHOPTERA: Hydroptilidae). A cased caddis fly.

Present status: Local. (Main lake: all microhabitats except the shallow, muddy bay with low rushes and grass [E])

Local and scarce throughout Britain, in ponds, lakes and slow-flowing waters. The larva is dependent upon filamentous algae (blanket weed), from which it makes its case and upon which it feeds. Often (as indeed at Stanford) shares its habitat with the much more common and very similar *Agraylea multipunctata* (Wallace, 1991; Pond Action, unpublished data.), although *A. sexmaculata* appears to be the more abundant and widely distributed of the two within Stanford lake.

Tinodes unicolor (TRICHOPTERA: Psychomyiidae). A caseless caddis fly. (N.B.: to be confirmed.)

Present status: Notable. (Frogmore Brook : downstream sample.)

Found, often in thin water films running over rocks, in highly calcareous small streams, and also in streams enriched by marl bands in the rock. There is evidence that it is associated with a particular blue-green alga upon which it appears to feed, but little information about this species is as yet available. In Britain its habitat is restricted, and moreover, according to Wallace, 'it is not found universally where it occurs'. (Wallace, 1991; Edington and Hildrew, 1981.)

(continued)

[1] 'Nationally Notable B': Uncommon species which have been recorded only from between 31 and 100 10-km squares of the National Grid.

'Notable': Species not falling into any Red Data Book categories (i.e. 'rare', 'vulnerable' or 'endangered'), but nonetheless appearing scarce in Britain and thought to occur in fewer than 100 10-km grid squares. This term is employed where a particular group of invertebrates, for example Trichoptera (caddis flies), is not sufficiently known or recorded to allocate Notable A or B subdivisions.

'Local': Species not falling into any of the RDB or Notable categories, but usually either (a) confined to certain limited geographical areas within which they may, however, be abundant; (b) of widespread 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.

Appendix 8. Notes on uncommon and Nationally Notable aquatic macroinvertebrate species recorded from Stanford Quarry and the Frogmore Brook (continued)

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

Present status: Nationally Notable B. (Small grassy pond.)

Found in ponds, ditches etc. in stagnant or slow-flowing, often acid waters, tending to be associated with temporary habitats and shading/leaf litter. Locally common (though not necessarily abundant where it occurs) throughout southern England, but uncommon in the north and apparently absent altogether from Scotland. (Friday, 1988; Pond Action, unpublished observations.)

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

Present status: Nationally Notable B. (Main lake: grassy bank [C].)

Though more likely to occur in the south-east than in other parts of Britain, this species may well have been under-recorded in the past since it is by no means always easy to distinguish from the very similar (but also Nationally Notable B) H. punctatus (with which it is occasionally found). Typically found in ponds and lakes where there is some plant cover. (Friday, 1988: Pond Action, unpublished observations.)

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

Present status: Nationally Notable B. (Small grassy pond.)

Scattered local distribution throughout most of Britain. Characteristically, the species prefers temporary still waters with emergent vegetation such as rushes and sedges. (Friday, 1988.)

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

Present status: Nationally Notable B. (Small grassy pond; main lake: shallow water with low dock [F].)

Locally distributed in the south of England and the Midlands. The preferred habitat of this species is said to be heath pools, mossy ditches, and new, man-made ponds (where it is often one of the earliest colonisers, as at Pinkhill Meadows in Oxfordshire). At present, however, this species appears to be fairly common - and perhaps even on the increase - in Oxfordshire, where in recent years it has been recorded in a wide variety of different water bodies from rivers to lakes, and indeed is often present in very large numbers. (Foster, 1981; Friday, 1988; Pond Action, various reports and unpublished research.)

Ilybius fenestratus **(COLEOPTERA: Dytiscidae). A diving beetle.**

Present status: Nationally Notable B. (Main lake: grassy bank [C].)

A species of slow or stagnant permanent open water which occurs in older artificial ponds and canals, and also occasionally in marshes and rivers. Despite its apparent flightlessness, it often appears in recently man-made gravel-pits and lakes. The species has a sparsely scattered distribution in the east and south-east of England, and does not occur at all in the south-west of England and most of Wales, being also largely absent from Scotland (with the exception of an isolated area in the south-west where there are relict populations in lakes). It is, however, locally common where it occurs. (Foster, 1983; Foster et al., 1989; Friday, 1988; Foster and Eyre, 1992.)

(continued)

Appendix 8. Notes on uncommon and Nationally Notable aquatic macroinvertebrate species recorded from Stanford Quarry and the Frogmore Brook (continued)

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

Present status: Nationally Notable B. (Small grassy pond.)

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

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

Present status: Nationally Notable B. (Main lake: shallow, muddy bay with low rushes and grass [E].)

A species which, characteristically, prefers silt and detritus pools. Locally distributed over most of England, but more especially in the south. (Foster, 1985; Friday, 1988.)

Appendix 9. Definition of distribution status terms used for plant and invertebrate species in this report and conservation scores for each category

Description	Score	Invertebrates	Plants
Common	1	Sufficiently frequently recorded from a wide area not to signify any particular conservation significance.	Recorded from >700 10x10km grid squares in Britain.
Local	2	Not falling into any RDB or Notable categories, but usually either (a) confined to certain limted geographical areas within which they may, however, be abundant; (b) of widespread 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.	Recorded from between 101 and 700 grid squares in Britain.
Nationally Scarce B/ Nationally Notable B	4	Recorded from 31-100 grid squares in Britain.	Nationally Scarce. Recorded from 31-100 grid squares in Britain.
Nationally Scarce A/ Nationally Notable A	8	Recorded from 16-30 grid squares in Britain.	Nationally Scarce. Recorded from 16-30 grid squares in Britain.
RDB 3	16	Red Data Book: Category 3 (Rare).	Red Data Book: Category 3 (Rare).
RDB 2	32	Red Data Book: Category 2 (Vulnerable).	Red Data Book: Category 2 (Vulnerable).
RDB 1	64	Red Data Book: Category 1 (Endangered).	Red Data Book: Category 1 (Endangered).

Notes: Distribution information is derived from the following sources:

Plants:

Aquatic plants: Croft, Preston and Forrest (1991).
Emergent wetland plants: Palmer and Newbold (1983), Perring and Farrell (1983) Perring and Walters (1990).

Aquatic macroinvertebrates:

Ball (1986), Elliott and Tullett (1982), Bratton (1991), Wallace (1991), Hyman and Parsons (1992), Kirby (1992), Shirt (1987), Kerney (1976), Foster (1981,1985, 1987), Elliott et al. (1988), Friday (1988b), Goddard and Hogger (1986), Hammond (1983), Reynoldson (1978), Savage (1989).

Appendix 10 Species Rarity Indices (SRI's)

A10.1 Use of species rarity indices.

Species rarity indices provide an objective method of comparing the conservation value of the animal and plant communities of different sites and have been used to good effect in other studies (e.g. Foster et al. ,1992).

SRI's have several advantages over other systems of conservation assessment:

1. Objectivity. The SRI method is one of a very small number of systems available for objectively comparing community value.

2. Effort independence Random variation of sampling will affect species-richness results, whereas an SRI, because it represents average rarity, is able to be largely independent of the actual numbers of plants or animals recorded.

3. Site type Comparisons of species-richness between sites can give misleading information on community value, as certain types of community, e.g. those of oligotrophic waters, will tend to be naturally less diverse than other types, e.g. those of eutrophic waters.

4. Analytical simplicity The SRI of a community is a single datum which makes it ideal for use in subsequent statistical analysis.

Species Rarity Indices should be used with caution. When using them it is necessary to be aware of the following qualifications:

1. Tourist species Some specimens present in a sample from a site might be 'tourists', i.e. individuals which have recently arrived at a site but which would not breed there. In some cases the site might provide a valuable 'stopover' for a species, and this habit might be quite normal for that species. If this were the case, then it would be correct to consider the site as, in some way, supporting that species, and the species should be considered when evaluating the site. However, some records will be of 'strays' which have been blown far from their natural habitat. For example, Pond Action, during the course of the National Pond Survey, recorded the endangered Lesser Silver Water Beetle (*Hydrochara caraboides*) from a site in Cheshire. This was almost certainly a specimen which had been blown from the Somerset Levels, which were drying out at the time (Biggs et al. 1991). It would have been wrong to use this record as part of an SRI to estimate the conservation value of the macroinvertebrate community of that pond. Therefore, the inclusion of individual species, which have a large influence on the SRI, should be reviewed critically.

2. Types of sampling Though SRI's are largely independent of sampling effort, they are not independent of the type of sampling used. For example, a survey which was directed at recording water bugs would inevitably yield lower SRI's than would one directed at recording water beetles, the simple reason being that most water bugs are fairly widespread and hence do not score as highly as many of the water beetles.

3. Species poor SRI's compensate for differences in community type. However, the SRI's of species-poor communities will be affected considerably by single species, and due to sampling variability the SRI method is inherently prone to variation in these sites.

4. Viable populations SRI's take no account of abundance data, and so give no indication of the viability of the species which are being used to derive the index.

5. 'Writing off' sites A low SRI should not be used to 'write off' a site, as this would assume that a complete record of species at that site had been obtained, which would be unlikely to be the case.

6. Distribution The SRI relies on having up accurate information on the national distribution of information species. The groups surveyed during the OPS were chosen partly for this reason.

7. Distribution — Species inhabiting small, fragmented habitats, (e.g. ponds) with a relatively wide distribution are apparently less rare than species inhabitating large, unfragmented, habitats which have a less widespread distribution (e.g. Lizard heathland). The threats to the smaller, fragmented habitats, however, may well be greater than those to the larger, unfragmented, habitats. For the rarer plants and animals, this type of information may be taken into account when assessing status, but this is rarely the case for local and notable species.

A.10.2 Calculation of the Species Rarity Index

The SRI is calculated in the following way:

(i) All species present are given a numerical value depending on their national distribution pattern (see section (a) below).

(ii) The values of all the species present are added together to give a total rarity score.

(iii) The total rarity score is divided by the number of species present to give the Species Rarity Index.

(a) All species present are given a numerical value depending on their national distribution patterns

Common species are given the value of 1, local species the value of 2 and so on, culminating with the most endangered species (RDB 1) which are given a value of 64.

Statuses given to individual species are derived mainly from JNCC invertebrate species reviews and Red Data Books. Within this system, a level of discretion is required when interpreting the literature on species distribution. For example, The Atlantic Stream Crayfish (*Austropotamobius pallipes*) is, technically, a local species. However, the species is currently under threat due to a number of factors and is, therefore, upgraded (for the purposes of calculating SRI) to Nationally Notable B.

(b) The values of all the species present are totalled to give a total rarity score

Were the communities being compared of the same type (e.g. communities of large fishponds) and individual sites of the same size (and, therefore, expected to support similar numbers of species), then it would be valid to use the total rarity score to assess the relative conservation value of the sites.

However, different types of site often differ in the number of species they support: temporary ponds, acidic ponds and gravel-pit lakes are all likely to have different types of macroinvertebrate community and, therefore, likely to support different numbers of species. To make comparisons, therefore, an index must be used which corrects for differences in species numbers.

(c) The total rarity score is divided by the number of species present to give the SRI

The SRI gives a good comparison between sites of any type. It should also be relatively independent of sampling effort. The SRI is, in effect, a measure of the '**average rarity**' of the species recorded.

In sites with low numbers of species, the presence of one or two local or notable species can have a large effect on the SRI. For this reason, it is particularly important to be cautious in the interpretation of SRI's of small sites (particularly those with less than 16 species).