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A SURVEY OF THE PLANT AND MACRO-INVERTEBRATE COMMUNITIES OF FOUR  
PONDS IN WYCHWOOD FOREST, OXFORDSHIRE

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## S U M M A R Y

The results of a survey of four ponds in Wychwood Forest are presented.

48 species of wetland plants were recorded from the ponds, including three locally distributed species (*Hippuris vulgaris*, *Myriophyllum spicatum* and *Potamogeton lucens*).

A total of 98 aquatic macro-invertebrate taxa were recorded (excluding species found in earlier surveys). A number of local species were recorded including several not previously reported in Wychwood.

No nationally rare species of plants or animals were recorded.

The macro-invertebrate communities of the ponds contained many species commonly associated with running water or large lakes.

The main physical and biological features of each pond are described. Aims of management at each pond are specified and practical work required to achieve these aims suggested.

Brief recommendations for further work are made.

## 1. INTRODUCTION

*More introduction*

This report describes the results of a detailed survey of the plants and macro-invertebrate animals of four ponds in Wychwood Forest, Evenden Pond, Withy Pond, New Hill Pond and Kennel Pond (Ponds 1 to 4) in Wychwood Forest (see Figure 1 and Appendix 1).

The results of the survey are used to propose guidelines for the management of the ponds.

*Describe management conflicts*

## 2. METHODS

### 2.1 PHYSICAL AND CHEMICAL FEATURES

Ponds 1 to 4 were surveyed by Pond Action on 8 September 1988. The ponds were mapped, depth of water and silt measured at selected points and the distribution of major stands of vegetation recorded. The outlines of Ponds 1 and 2 were obtained by plane table surveying. Ponds 3 and 4 were too large to be plane-tabled and their outlines were taken from the Pathfinder Series of the 1:25,000 scale Ordnance Survey map. The distribution of vegetation was drawn onto these outlines

A water sample was collected from each pond and pH, conductivity and alkalinity measured. *Check alkalinity*

### 2.2 VEGETATION

Plants were recorded by bankside survey and by using a hand-thrown grapnel. Aquatic vascular plants were identified to species level with the exception of *Callitriche* spp. and *Ranunculus* spp. (water crowfoots), which require fruiting material for critical determination. Charophytes were identified to species and variety where possible.

### 2.3 MACRO-INVERTEBRATES

Macro-invertebrates were collected using a 1mm mesh Freshwater Biological Association-pattern pond net. Before sampling began, zones of the pond which appeared to provide distinctive habitats for macro-invertebrates were identified (eg stands of *Potamogeton lucens*, stands of *Hippuris vulgaris*, stands of *Typha latifolia*, shaded margins). The zones sampled in each pond are listed in Table 1 and shown on the inset maps on figures 2-5.

Invertebrate samples were collected during three minutes of vigorous hand netting. Sampling time was divided equally between each zone of the pond (for example, with six zones, there was 30 seconds sampling in each zone). The material collected in each zone was pooled to give a composite three-minute sample. This procedure was repeated to obtain three replicate samples from each pond. Samples were taken

back to the laboratory and macro-invertebrates removed for counting and identification, to species where possible.

One sample was fully sorted (all specimens present in the sample removed) to assess the abundance of the species recorded. The two remaining samples were sorted more rapidly to locate any further taxa not found in Sample 1.

#### 2.4 ADDITIONAL INFORMATION

The report also incorporates the results of a survey of macro-invertebrates of Withy Pond undertaken in 1987 by J Biggs. In this survey macro-invertebrates were collected and sorted in the field until no new taxa could be found. Only the presence/absence data was collected.

*Date of visit*  
A final visit was made to the ponds on 26 February 1989 shortly before the submission of this report to check the recommendations made. Further casual collections of macro-invertebrates were made during this visit, at a season when no previous collecting has been reported.

TABLE 1. MACRO-INVERTEBRATE SAMPLING ZONES IN PONDS 1-4, WYCHWOOD FOREST

Positions of zones sampled are shown as inset on figures 2-5

POND	ZONE	DESCRIPTION
1	1	Myriophyllum spicatum/Potamogeton lucens stand
	2	Shaded north bank (with Callitriche sp.)
	3	South bank (marginal Mentha aquatica/Nasturtium officianale
	4	South bank (scattered Mentha aquatica)
	5	Dam wall
2	1	Hippuris vulgaris/Myriophyllum spicatum stand
	2	North-east bank (with Epilobium hirsutum stand)
	3	North-west bank (shaded by trees)
	4	Marginal Mentha aquatica/Nasturtium officianale
	5	Marginal Juncus effusus/J. inflexus (south bank)
	6	Vegetation at margin of inflow
3	1	Two sides of island (shaded by dogwood)
	2	Dam wall
	3	Marginal Iris pseudacorus and Mentha aquatica
	4	Typha latifolia stand
	5	Hippuris vulgaris stand and bank
	6	North bank, under trees
	7	Central stand of Potamogeton lucens
4	1	Potamogeton lucens/Potamogeton natans stand
	2	Scirpus lacustris/Equisetum fluviatile stand
	3	South bank (shaded margins)
	4	Elodea canadensis/Chara sp. stand
	5	North bank (shaded margins)
	6	North bank (marginal Eleocharis sp., E. fluviatile)

Underwriting

### 3. GENERAL DESCRIPTION OF THE PONDS

The general physical and chemical features of the Wychwood ponds are described briefly in section 3.1. The aquatic vegetation and macro-invertebrate fauna are considered in more detail in sections 3.2 and 3.3 respectively.

#### 3.1 PHYSICAL AND CHEMICAL FEATURES

The Wychwood Ponds, including Ponds 1 to 4, lie on Upper Lias mudstones. It is not known whether the ponds are clay lined or whether water retention relies entirely on the impermeability of the underlying strata.

Ponds 1 to 4 vary in area from about 0.075ha to about 0.5ha. They are fed predominantly by spring water rising near the base of the surrounding Middle Jurassic limestones. All four ponds have accumulations of stream-borne sediments at the upstream ends. All are dammed at their downstream ends and have sluice gates allowing the water level to be drawn down.

On 8 September 1988 the pH of the four ponds varied from 7.8 to 8.4. Conductivities varied between 401 and 454 micro-siemens/cm (a little below the modal value for 150 Oxfordshire ponds). Alkalinities ranged from 1.8 to 2.1 m/eq/l

#### 3.2 VEGETATION

##### 3.2.1 Wetland vegetation

All the ponds supported dense stands of submerged water plants, 48 species of wetland plants being recorded in total in the four ponds. The ponds supported similar numbers of species with the exception of Pond 1 which had fewer marginal/emergent species (see Appendix 2).

Three of the species of submerged plants that were recorded are of local occurrence. All are species characteristic of base-rich water:

*Hippuris vulgaris* (Ponds 2 and 3), local.

*Myriophyllum spicatum* (Ponds 1, 2 and 3), locally common.

*Potamogeton lucens* (Ponds 1, 3 and 4), locally common in S. and E. England (Clapham, Tutin and Moore, 1987).

The pond margins are generally steep, and in many areas shaded, preventing the development of a diverse marginal flora. Deltas formed from deposited stream sediments have allowed the development of some fen/marsh vegetation at the head of Ponds 1, 2

and 4. All the marginal/emergent plants recorded were common and widespread species.

*Blysmus compressus*, although not found around the ponds' margins was observed in damp grassland just below the Cyder Well.

### 3.2.2 Terrestrial vegetation

A further 50 species of terrestrial herbs, shrubs and trees were recorded on the margins of the ponds, in most cases within about 5m of the pond margin (see Appendix 2).

These included several of the local species characteristic of the limestone flora of Wychwood (eg *Inula conyza*, *Atropa bella-donna* and *Colchicum autumnale*).

## 3.3 MACRO-INVERTEBRATES

### 3.3.1 Composition of the macro-invertebrate community

A total of 85 macro-invertebrate taxa were recorded on 8 September 1988. A further 13 taxa were recorded in surveys on 6 June 1987 and 26 February 1989. *Previous surveys have located . . .*

Individual ponds supported between 36 and 59 taxa (see Appendix 3). 14 species were recorded in all four ponds: *Lymnaea peregra*, *Planorbis albus*, *Sialis lutaria* and haliplid water beetles were abundant in all ponds. Also widespread, but less abundant, were the crustaceans *Gammarus pulex* and *Asellus meridianus*, the leech *Glossiphonia complanata*, the mayfly *Cloeon dipterum*, the damselfly *Coenagrion puella*, and the dytiscid beetle *Potamonectes depressus-elegans* (Appendix 3).

A number of local species were recorded (see Table 2) although no nationally rare aquatic macro-invertebrates were found.

Brief notes on the species recorded are given below:<sup>v)</sup>

#### Crustacea

Crayfish (*Austropotamobius pallipes*) were found in Ponds 1, 2 and 3 including individuals of 2-3cm length (see Table 2).

#### Odonata

No larval dragonflies were recorded in the 8 September survey, only larval *Coenagrion puella*, in low abundance being found. Despite the apparent scarcity of larvae a variety of Odonata have been recorded from Wychwood. Adult *Aeshna cyanea* and *A. grandis* were recorded during this survey and J. Campbell (personal communication) has recorded adult *Cordulia aenea* and *Erythromma najas* on Lake Superior.



Lansbury (1976) also recorded several species of dragonflies and damselflies although it is not entirely clear whether all were breeding at the ponds. Species observed were *Enallagma cyathigerum*, *Coenagrion puella*, *Ischnura elegans*, *Libellula depressa*, *Orthetrum cancellatum* and *Cordulegaster boltonii*.

#### Heteroptera

The interest of the Wychwoods ponds for aquatic heteroptera was noted by Lansbury (1976) who recorded three uncommon species (*Micronecta scholtzi*, *Gerris argentatus*, and *Corixa panzeri*). *Ranatra linearis* has also been recorded from Pond 3.

The Pond Action survey of 8 September 1988 recorded 13 species of Heteroptera including four previously unrecorded common species. Although none of the uncommon species found by Lansbury were recorded, overwintering larval *Micronecta* sp. were found by J Biggs in Ponds 2 and 4 on 26 February 1989. Unfortunately it is not possible to identify immature *Micronecta* beyond generic level.

#### Coleoptera

27 species of water beetles were recorded during the 8 September survey. Haliplidae were the most abundant water beetles, the locally common *Halplus obliquus* (which is associated with *Chara* sp.) being found in all the ponds. Dytsiscid and hydrophilid water beetles were generally scarce but included the uncommon riffle beetle *Riolus subviolaceus* (Pond 3).

#### Trichoptera

Ten species of caddis flies were recorded including three species believed to be of local occurrence, *Beraeodes minutus* (Pond 2), *Lype reducta* (Pond 1) and *Holocentropus dubius* (Ponds 1, 3 and 4) (P. Barnard, British Museum, personal communication). All caddis flies were recorded in low abundance although this may have reflected seasonal trends in numbers of individuals.

A complete list of uncommon species found in the Wychwood ponds, including those recorded in this survey, is given in Table 4. A list of taxa recorded prior to the Pond Action survey (8 September 1988) and the observations of J Biggs is given in Appendix 4.

### 3.3.2 Macro-invertebrate community structure

Ponds 1 to 4 supported a number of species which are commonly associated with rivers and lakes (despite the relatively small size of the water bodies). Appendix 5 lists some of the species more commonly associated with running water and lakes that were found in the Wychwood ponds.

The 1987 survey data from Wychwood Pond 2 were included in a preliminary TWINSPAN classification of 30 Oxfordshire ponds based

on macro-invertebrate community structure (Biggs, 1988). Pond 2 was most closely related in the classification to the Main Pond on the Dry Sandford Nature Reserve. Together these two ponds formed a highly distinctive group in which water flow appeared to be the most important factor in influencing community structure. Like the Wychwood ponds the pond at Dry Sandford was fed by alkaline spring water rising from calcareous Jurassic strata.

This work also showed that it was a characteristic feature of stream and spring-fed ponds, like the Wychwood ponds, to support relatively few water beetle species. The Wychwood ponds collectively supported 27 species of water beetles, about one-third of all taxa recorded. In ponds fed by ground water (or connected to intermittently flowing ditches) it is common to find that half of the macro-invertebrate species recorded are water beetles (Biggs, 1988).

Could give more information,

Analyse : Jaccard

proportion of different species

TABLE 2. LOCALLY DISTRIBUTED AQUATIC MACRO-INVERTEBRATES RECORDED IN THE WYCHWOOD PONDS

SPECIES	RECORDER	POND	COMMENTS ON DISTRIBUTION
CRUSTACEA: MALACOSTRACA			
<i>Austropotamobius pallipes</i>	NCC, 1968, JB, PA	1 to 4	'Increasingly rare'
ODONATA			
<i>Cordulia aenea</i>	JC	5	Scarce outside the SE England.
<i>Erythromma najas</i>	JC	5	Locally common.
EPHEMEROPTERA			
<i>Leptophlebia marginata</i>	JB	2,3,4	In smaller numbers than (common) <i>L. vespertina</i>
<i>Cloeon simile</i>	NCC, 1968		'Often with <i>Cloeon dipterum</i> .'
HETEROPTERA			
<i>Corixa panzeri</i>	IL	3	Rare (but several other sites in Oxon)
<i>Gerris argentatus</i>	IL	3,4	Locally common.
<i>Micronecta scholtzi</i>	IL	5	Southern Britain
	<i>Micronecta</i> sp. larvae recorded by JB	2,4	
COLOEPTERA			
<i>Halipus obliquus</i>	PA	1-4	Locally common.
<i>Riolus subviolaceus</i>	PA	3	Locally common.
TRICHOPTERA			
<i>Beraeodes minutus</i>	PA	2	Locally common.
<i>Lype reducta</i>	PA	1	Locally common.
<i>Holocentropus dubius</i>	PA	1,3,4	Locally common.

Recorders: JB = Jeremy Biggs, July 1987 and 26 February 1989.  
 JC = John Campbell/Oxfordshire Biological Records Centre  
 IL = Ivor Lansbury, 1976.  
 NCC, 1968 = NCC 'Edinburgh Survey' of 16 September 1968.  
 PA = Pond Action, 8 September 1988.

Distribution information: Crustacea: NCC (Wychwood SSSI Notification)  
 Odonata: Hammond, 1983.  
 Ephemeroptera: Macan, 1979.  
 Hemiptera: Lansbury, 1976.  
 Coleoptera: Friday, 1988.  
 Trichoptera: P. Barnard, pers. comm.

#### 4. M A N A G E M E N T O F T H E W Y C H W O O D P O N D S

##### 4.1 INTRODUCTION

The survey results reported here and the observations made by previous workers indicate that the Wychwood ponds support distinctive plant and macro-invertebrate communities, including a number of uncommon species. Features of particular conservation value are:

- i) the occurrence of large stands of locally distributed submerged water plants;
- ii) the occurrence of at least 12 species of uncommon aquatic macro-invertebrates (see Table 2).
- iii) the occurrence of a highly distinctive community with many species commonly associated with running water or lakes.

However, it should be noted that the ponds are not known to support any nationally rare species of aquatic plants or animals.

##### 4.2 AIMS OF MANAGEMENT

The three main aims of the management proposed here are:

- 1) to maintain the distinctive character of the ponds.
- 2) to maintain populations of uncommon species.
- 3) to increase the diversity of plants and animals present where this does not conflict with Aims 1 and 2.

## 5. DESCRIPTION AND MANAGEMENT OF PONDS

In this section the main physical and biological features of each pond are described. This information is used to define the aims of management and to propose an outline programme of practical work on each pond.

### 5.1 POND 1 (EVENDEN POND)

#### 5.1.1 Physical features

Evenden Pond is the smallest of the Wychwood ponds with a total area of about 750m<sup>2</sup> (0.075ha). It is roughly triangular in shape, having a stone dam at its eastern end. About two-thirds of the pond margin are dominated by shrubs and trees. The pond was drained for dredging and rebuilding of sluices in 1971/72 (Mears, 1979).

The pond has a maximum total depth (silt + water) of 1.3m although at the dam it is only 1.1m deep. The banks are steeply shelving. At the time of the survey the mean depth of silt in the pond was 16cm. Silt depth was at a maximum near the centre of the pond (34cms). Thick silts had also accumulated at the western end of the pond where the inflowing stream had deposited a silt delta extending over approximately 100m<sup>2</sup> (about 15% of the total area of the pond).

#### 5.1.2 Vegetation

The vegetation of the pond was dominated by a mixed stand of *Myriophyllum spicatum*, *Potamogeton lucens*, *Elodea canadensis* and charophytes (including *Nitella flexilis* var *flexilis*). Small quantities of *Callitriche* sp. were also present.

The pond supported little marginal emergent vegetation because of shading of the margins by shrubs and trees. The area of accumulated silts at the western end of the pond had a sparse cover of filamentous algae but did not provide a suitable rooting medium for vascular plants or charophytes. Accumulated sediments at the edge of the inflow stream, however, supported a stand of *Carex riparia*.

*Blysmus compressus* was found in damp grassland about 200m upstream of this pond.

#### 5.1.3 Macro-invertebrates

A total of 47 macro-invertebrata taxa were recorded in the pond on 8 September 1988. The macro-invertebrate fauna was dominated numerically by molluscs (particularly *Lymnaea peregra*, *Planorbis albus*, *P. carinatus* and *Valvata piscinalis*), *Sialis lutaria*, the corixid *Sigara dorsalis* and haliplid water

beetles. Crayfish (*Austropotamobius pallipes*) are present in the pond. Six species of caddis fly were recorded including the two caseless species *Lype reducta* and *Holocentropus dubius*. Both species are thought to be a locally common species (P. Barnard, British Museum, personal communication). This was the only pond in which the predatory corixid *Cymatia bonndorfi* was found, a species not previously recorded in Wychwood.

Rainbow trout and 3-spined sticklebacks (*Gasterosteus aculeatus*) were seen in the pond on 9 September 1988.

#### 5.1.4 Summary of pond characteristics

Pond 1 was the smallest pond in the group, supporting little marginal or emergent vegetation. However a stand of four species of submerged water plants supported a macro-invertebrate fauna second only in species richness to the considerably larger Pond 3.

#### 5.1.5 Management of Pond 1

##### Aims of management

Management of Pond 1 should aim to:

- a) monitor and control silt accumulation.
- b) maintain the extent and diversity of the mixed stand of submerged water plants.
- c) create more open pond margins to increase area available for colonisation by marginal aquatic plants
- d) maintain suitable conditions for *Austropotamobius pallipes*, *Holocentropus dubius* and *Lype reducta*.

##### Practical work required

- a) resurvey silt depths every 3-5 years;
- b) clear woody vegetation from the margins of the stream delta to encourage the spread of *Carex riparia* and other species into delta area.
- c) overhanging snowberry should be cleared from the north bank; native shrubs and trees should be retained on about 30% of the pond margin on the south-west side.
- d) retain areas of submerged stone/wood for larval galleries of *L. reducta* and to give shelter for *A. pallipes*. Maintenance of stands of submerged water plants should protect habitat of *H. dubius*.

## 5.2 POND 2 (WITHY POND)

### 5.2.1 Physical features

The Withy Pond has an area of about 0.15ha. It is roughly rectangular in shape, with a stone dam at its eastern end. About 20% of the pond margin is overhung by shrubs and trees. The pond was drained for dredging and rebuilding of sluices in 1971/72 (Mears, 1979). The pond is fed by three springs and a stream at its western end (see Figure 3). The pond has a maximum depth of 2.1m and has steeply sloping banks.

At the time of the survey silt had accumulated at the western (inflow) end of the pond, creating a delta which extended 7-8m into the pond. This area had no vascular plants. The mean depth of silt in the pond was 30cm with a maximum depth of 78cm in the centre of the pond.

### 5.2.2 Vegetation

The pond was dominated by a large stand of *Hippuris vulgaris* with smaller quantities of *Chara vulgaris* and *Myriophyllum spicatum*. *Potamogeton berchtoldii* and *Callitriche* sp. (probably *platycarpa*) also occurred but *Potamogeton lucens* was absent.

At the head of the pond is an area of marshy vegetation growing on accumulated sediments. This area supported a number of common species such as *Iris pseudacorus*, *Epilobium hirsutum* and *Nasturtium officinale*. Most of the vegetation was low growing and probably grazed by deer.

### 5.2.3 Macro-invertebrates

39 macro-invertebrate taxa were found in the Withy Pond on 8 September 1988. The fauna was dominated numerically by the molluscs *L. peregra*, *P. albus* and *P. crista* with *A. meridianus*, *G. pulex* and *S. lutaria* also abundant (ie in abundance categories 3 & 4). Haliplid water beetles were common.

The pond also supported the local cased caddis fly *Beraeodes minutus*, larvae of *Micronecta* sp. and *A. pallipes*.

### 5.2.4 Summary of pond characteristics

Marginal vegetation was poorly developed in Pond 2. The submerged vegetation was dominated by a large stand of *Hippuris vulgaris* which covered about 80% of the pond. Withy Pond supported fewer macro-invertebrate taxa than Ponds 1 and 3 but uncommon species were still present.

### 5.2.5 Management of Pond 2

#### Aims of management

Management should aim to:

- a) prevent extensive accumulation of sediments deposited by main inflow stream.
- b) control the development of shading vegetation on margins.
- c) Maintain conditions suitable for *B. minutus*, *Micronecta* sp. and *A. pallipes*
- d) Maintain marsh area at head of pond.

#### Practical work required

- a) Monitor sediment accumulation (growth of sediment delta and increased depth of silt in body of pond) preferably dredging relatively small quantities of silt once every 10-20 years.
- b) Prevent development of shrubs along south margin. Ensure that at least 50% of south shore remains unshaded. Remove stand of young ash growing just back from the south shore. Although they cast little shade at present their effect will become increasingly detrimental as they mature.
- c) Remove shrub willow growing at the edge of the delta and two ashes (dbh 15cm) shading this margin.
- d) Ensure that large stones are retained at the margin of pond to provide shelter for *A. pallipes*. If possible, maintain areas free of sediment and vegetation for *Micronecta* sp.
- e) Check the dam for necessary repair work.



### 5.3 POND 3 (NEW HILL POND)

#### 5.3.1 Physical features

New Hill Pond has an area of approximately 0.5ha with a maximum depth of 2.3m. It has a small wooded island at its western end. At the time of survey the most deeply silted area was north of the island where 1.3m of sediment had accumulated. The mean depth of silt in the pond was 50cm. Kennel Pond receives water from Ponds 1 and 2. There is also a small piped water supply on the western bank of the pond, the source of which is not known.

#### 5.3.2 Vegetation

The northern bank of Newhill Pond is shaded or overhung by trees and shrubs throughout most of its length. The pond has generally steep margins preventing extensive growth of marginal emergent plants except in the area of accumulated sediments at the western end of the pond. However the southern margins are partly fringed by a stand of *Iris pseudacorus*.

At the time of the survey the pond supported a wide variety of submerged and floating-leaved water plants (see Figure 4 and Appendix 2). To the east of the island, the pond is dominated by a large stand of *Potamogeton lucens* with smaller stands of *Polygonum amphibium*, *Potamogeton natans* and *P. berchtoldii*. The western end of the pond supported *Hippuris vulgaris* and *Typha latifolia*. *Chara vulgaris pappilata* was found on the northern margin of the main stand of *P. lucens*.

In several areas beside the northern shore, filamentous algae had colonised the otherwise unvegetated silt.

#### 5.3.3 Macro-invertebrates

Pond 3 supported the most diverse macro-invertebrate fauna of the four ponds sampled with 59 taxa being recorded. *L. peregra*, *Planorbis albus*, *P. jenkinsi*, *Gammarus pulex*, *Erpobdella octoculata*, *Sialis lutaria*, two species of haliplid beetle and *Potamonectes depressus-elegans* were all abundant (abundance categories 3 or 4).

The pond supported crayfish. It was also notable for the occurrence of three species of riffle beetle (including the local *Riolus subviolaceus*) and the local caseless caddis fly *Holocentropus dubius*.

A bullhead (*Cottus gobio*) was netted in Pond 3 in the 8 September survey.

#### 5.3.4 Summary of pond characteristics

Pond 3 is a large pond (0.5ha) supporting a variety of submerged and marginal water plants. The pond was dominated by a large stand

of *Potamogeton lucens*. Pond 3 supported the greatest number of macro-invertebrate taxa of the four ponds including three species of riffle beetles, *A. pallipes* and the caddis fly *H. dubius*.

#### 5.3.5 Management of Pond 3

Aims of management

Management should aim to:

- a) maintain diversity of aquatic plants (particularly submerged species).
- b) control accumulation of silt, particularly at western end of pond in vicinity of *Typha* stand.
- c) control further development of shading shrubs and trees growing on southern margin of pond.
- d) reduce area of shading vegetation on northern shore.
- e) maintain the open/unshaded areas of shoreline, particularly those on south side of pond.
- f) Maintain for *H. dubius* and *A. pallipes*.

Practical work required

- a) monitor silt depths especially to the west of the island where there are considerable accumulations of silt.
- b) prevent further encroachment of *Typha*, removing small areas if necessary. NB Do not remove altogether, *Typha* may be acting as a partial silt trap for the water entering from the North Pond.
- c) clear areas of overhanging vegetation from north shore of pond to leave about 50% of shoreline open. Coppice or clear back hazel, ash, hawthorns and elder. Concentrate clearance work in the bay on the north shore. Cut back/control shrubs on south shore of pond.
- d) clear back overhanging vegetation from island. Leave at least 50% of shore available for colonisation by aquatic marginal plants.

## 5.4 POND 4 (KENNEL POND)

### 5.4.1 Physical features

The Kennel Pond is about 330m long with a maximum width of about 30m and an area of just over 0.5ha. The western (upstream) boundary of the pond is marked by a decaying line of fencing. Kennel Pond was the most heavily silted and shaded of the four ponds surveyed. Open water was present from the dam westwards to 240m. Above the south bank spring at 180m, the pond was filled by bare uncolonised silt covered by shallow water. From 240m the pond basin was entirely filled with sediments, colonised by woody shrubs and fen/marsh species (see Figure 5).

### 5.4.2 Vegetation

Only the eastern half of the pond supported a diverse flora, with the best developed communities in the bay nearest the dam. A large stand of *Equisetum fluviatile* with a smaller stand of marginal *Scirpus lacustris*. *Sparganium emersum* dominated the margins of this area with *Potamogeton natans* and *P. lucens* in deeper water. Three *Chara* spp. were recorded in the pond.

### 5.4.3 Macro-invertebrates

The Kennel Pond had the least diverse macro-invertebrate fauna of the four ponds sampled with only 36 taxa recorded on 8 September 1988. Only two species, *P. albus* and *Sialis lutaria*, were found in abundance category 3. Water beetles other than Haliplidae were particularly scarce.

A single *Micronecta* sp. larva was found on 26 February 1989. The pond also supported the caseless caddis fly *Holocentropus dubius*.

### 5.4.4 Summary of pond characteristics

Pond 4 was the most silted and shaded of the four ponds surveyed and the most in need of management. A large proportion of the pond was dominated by unvegetated silt and about 75% of the pond margin was shaded and lacked marginal vegetation. Despite its size only 36 macro-invertebrate taxa were recorded. *Micronecta* sp. larvae were found outside the main survey period.

### 5.4.5 Management of Pond 4

Aim of management

Management should aim to:

- a) prevent silting-up of pond.
- b) extend the area suitable for colonisation by submerged and marginal plants.
- c) prevent encroachment of shading vegetation into open/unshaded

areas of shoreline.

- d) prevent domination of eastern end of pond by *Equisetum fluviatile*
- e) maintain habitat of *Micronecta* sp. and larval *H. dubius*.

Practical work required

- a) dredge silt from western end of pond (upstream of large south bank oak (adjacent to spring) (see Figure 5). As so much of Kennel Pond is already silted-up, dredging is likely to be a costly and time consuming job.
- b) cut back/remove shading marginal shrubs on southern shore from about 60m west of the dam and above. Cutting back on both sides of the path may be necessary. If possible remove up to 50% of overhanging shrubs and small trees on north shore.
- c) Clear some *E. fluviatile* if area of stand begins to increase significantly.
- d) create/maintain silt and plant-free areas for *Micronecta* sp.

## 6. RECOMMENDATIONS FOR FUTURE WORK

- 6.1 Surveys of the Wychwood ponds have clearly indicated that the ponds are of importance for nature conservation. However, in order to maintain the conservation value of the ponds a more detailed understanding of some aspects of their ecology is required.

In particular the development of more refined management techniques for the Wychwood ponds requires further research in two main areas.

- a) Investigations of the specific habitat requirements of uncommon macro-invertebrate species (particularly *Gerris argentatus*, *Micronecta scholtzi*, *Corixa panzeri*, *Beraeodes minutus*, *Holocentropus dubius* and *Lype reducta* and the larvae of *Cordulia aenea*).
  - b) Experimentation on the impact of fish on macro-invertebrate populations to assess the effect of stocking of the ponds.
- 6.2 Since the Wychwood ponds probably function as a group it would be valuable to carry out surveys of the remaining ponds (particularly Lake Superior).

## 7. REFERENCES

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APPENDIX 1. NAMES AND LOCATIONS OF PONDS IN WYCHWOOD FOREST AND PREVIOUS WORK

Interpretation of the results of previous work on the ponds in Wychwood Forest is hampered by the confusion over the names of the ponds. A list of previous site names is given below. In this report ponds are numbered 1 to 8 from west to east (ie downstream) (see also Figure 1).

POND	NAME USED IN THIS REPORT	PREVIOUS NAMES	PREVIOUS VISITS
1	Evenlode Pond	- -	Lansbury, 1976 Biggs, 1987
2	Withy Pond	Withy Pond - -	NCC, 1968. Lansbury, 1976 Biggs, 1987
3	New Hill Pond	Island Pond ( 'pond nearby with small island')	Lansbury, 1976
4	Kennel Pond	Kennel Pond ( 'largest of the four ponds')	NCC, 1968 Lansbury, 1976
5	Lake Superior	'Blue Marl'	Lansbury, 1976
6	-	'2nd Lake '	NCC, 1985
7	-	'3rd Lake'	NCC, 1985
8	-	'final lake', '4th Lake'	Lansbury, 1976 NCC, 1985

NOTES

NCC, 1968.	Surveys of macro-invertebrates with water chemistry measurements. Referred to by I. Lansbury as NCC Edinburgh Report.
Lansbury, 1976.	Ivor Lansbury visited the ponds listed on 1 July and 20 August 1976. His typescript report is held in NCC files.
NCC, 1985.	Graham Bathe and Janet Porter visited the ponds on 21 June 1985 in preparation for the renotification of Wychwood Forest as SSSI.
Biggs, 1987.	New Hill South Pond was surveyed as part of a pilot study for the Oxfordshire Pond Survey.
Pond Action, 1988	Ponds 1-4 surveyed on contract to NCC.

John Campbell has provided additional records of Heteroptera and Odonata (1988 pers. comm.)

Work on the Wychwood streams and ponds has also been undertaken by students from Oxford Polytechnic but has not been reviewed in this report.

APPENDIX 2. PLANT SPECIES ASSOCIATED WITH WYCHWOOD PONDS 1 TO 4

A) Submerged, Floating, Emergent and Other Wetland Plants

Species categories as defined by NCC recording sheet for standing and flowing water habitats.

SPECIES	P O N D			
	1	2	3	4
<i>Alisma plantago-aquatica</i> (Water-plantain)	-	-	+	+
<i>Alnus glutinosa</i> (Alder)	-	-	+	-
<i>Apium nodiflorum</i> (Fool's watercress)	-	+	-	+
<i>Callitriche stagnalis</i> (Water starwort)	+	-	-	-
<i>Callitriche ?platycarpa</i> (Water starwort)	-	+	+	-
<i>Caltha palustris</i> (Marsh marigold)	-	-	-	+
<i>Carex riparia</i> (Great pond sedge)	+	-	+	-
<i>Chara globularis ?globularis</i> (Stonewort)	-	-	-	+
<i>Chara hispida major</i> (Stonewort)	-	-	-	+
<i>Chara vulgaris pappilata</i> (Stonewort)	-	-	+	-
<i>Chara vulgaris vulgaris</i> (Stonewort)	-	+	-	+
<i>Chara</i> (undet sp.) (Stonewort)	+	+	-	-
<i>Cirsium palustre</i> (Marsh thistle)	-	-	-	+
<i>Eleocharis</i> sp. (Spike-rush)	-	-	-	+
<i>Elodea canadensis</i> (Canadian pondweed)	+	-	+	+
<i>Epilobium hirsutum</i> (Great hairy willow-herb)	+	+	-	-
<i>Equisetum ?palustre</i> (Marsh horsetail)	-	-	-	+
<i>Equisetum fluviatile</i> (Water horsetail)	-	-	-	+
<i>Glyceria fluitans</i> gp. (Sweet-grasses)	-	+	-	-
<i>Hippuris vulgaris</i> (Marestail)	-	+	+	-
<i>Hypericum tetrapterum</i> (Square-stemmed St John's-wort)	+	+	+	+
<i>Iris pseudacorus</i> (Yellow iris)	-	+	+	+
<i>Juncus articulatus</i> (Jointed rush)	-	+	-	+
<i>Juncus effusus</i> (Soft rush)	-	+	+	+
<i>Juncus inflexus</i> (Hard rush)	-	+	+	+
<i>Lemna minor</i> (Common duckweed)	-	-	+	-
<i>Lycopus europaeus</i> (Gipsywort)	-	+	+	+
<i>Lysimachia nummularia</i> (Creeping jenny)	-	+	-	-
<i>Mentha aquatica</i> (Water mint)	+	+	+	+
<i>Myosotis scorpioides</i> (Water forget-me-not)	-	+	+	-
<i>Myriophyllum spicatum</i> (Spiked water-milfoil)	+	+	+	-
<i>Nasturtium officianale</i> (Green water-cress)	+	+	-	-
<i>Nitella flexilis</i> var. <i>flexilis</i> (Stonewort)	+	-	-	-
<i>Polygonum amphibium</i> (Amphibious bistort)	-	-	+	-
<i>Potamogeton berchtoldii</i> (Small pondweed)	+	?	+	+
<i>Potamogeton lucens</i> (Shining pondweed)	+	-	+	+
<i>Potamogeton natans</i> (Broad-leaved pondweed)	-	-	+	+
<i>Ranunculus ?aquatilis</i> (Water crowfoot)	-	+	-	-
<i>Ranunculus</i> sp. (Water crowfoot)	-	+	+	-
<i>Salix cinerea</i> (Common willow)	-	+	-	+
<i>Salix</i> sp.	-	-	+	-
<i>Scirpus lacustris</i> (Bulrush)	-	-	-	+
<i>Scrophularia auriculata</i> (Water figwort)	+	+	+	+
<i>Scutellaria galericulata</i> (Skullcap)	-	+	-	+
<i>Solanum dulcamara</i> (Bittersweet)	-	+	+	-



Sparganium emersum	(Unbranched bur-reed)	-	-	-	+
Sparganium erectum	(Branched bur-reed)	-	+	-	-
Typha latifolia	(Reedmace)	-	-	+	+
Urtica dioica	(Stinging nettle)	+	+	+	-
Veronica anagalis-aquatica	(Blue water-speedwell)	+	-	-	-
Veronica beccabunga	(Brooklime)	-	+	+	+

## B) Non Wetland Species Growing on Pond Margins

Species categories as defined by NCC recording sheet

SPECIES		PONDS			
		1	2	3	4
Acer campestre	(Field Maple)	-	-	+	+
Achillea millefolium	(Yarrow)	-	-	+	-
Agrimonia eupatoria	(Agrimony)	-	+	+	-
Aster sp.	(Michaelmas daisy)	-	-	+	-
Atropa bella-donna	(Deadly nightshade)	-	-	-	+
Betula pendula	(Silver birch)	-	-	+	-
Calamintha sylvatica	(Wood calamint)	-	-	+	-
Calystegia sepium	(Hedge bindweed)	+	-	-	-
Chamaenerion angustifolium	(Rosebay willow-herb)	-	-	-	+
Cirsium arvense	(Creeping thistle)	+	-	+	-
Cirsium vulgare	(Spear thistle)	+	-	-	-
Clematis vitalba	(Traveller's joy)	+	-	+	+
Colchicum autumnale	(Meadow saffron)	-	-	-	+
Cornus ?sanguinea	(Dogwood)	-	-	+	-
Corylus avellana	(Hazel)	-	-	+	+
Crataegus monogyna	(Hawthorn)	-	-	+	+
Cruciata laevipes	(Crosswort)	-	+	+	+
Dryopteris sp.		-	-	-	+
Epilobium ?montanum	(Broad-leaved willow-herb)	-	-	-	+
Euonymus europaeus	(Spindle tree)	-	-	+	-
Euphrasia sp.	(Eyebright)	-	-	-	+
Fraxinus excelsior	(Ash)	+	-	+	+
Galium aparine	(Cleavers)	-	+	-	-
Glechoma hederacea	(Ground-ivy)	-	+	+	-
Heracleum sphondylium	(Hogweed)	-	-	-	+
Hypericum perforatum	(Perforate St John's-wort)	+	-	-	-
Inula conyza	(Ploughman's spikenard)	+	-	-	+
Lapsana communis	(Nipplewort)	-	-	+	-
Lathyrus pratensis	(Meadow vetchling)	-	-	-	+
Mercurialis perennis	(Dog's mercury)	+	-	-	-
Odontites verna	(Red bartsia)	-	-	+	-
Pastinaca sativa	(Wild parsnip)	-	-	+	-
Plantago lanceolata	(Ribwort plantain)	-	-	+	-
Populus sp.	(Poplar)	-	-	+	-
Potentilla anserina	(Silverweed)	+	-	+	+
Prunella vulgaris	(Selfheal)	+	-	-	+
Prunus spinosa	(Blackthorn)	-	-	+	-
Pteridium aquilinum	(Bracken)	+	-	+	-
Quercus robur	(Pedunculate oak)	-	-	-	+
Ranunculus repens	(Creeping buttercup)	-	+	+	+

Reseda luteola	(Weld)	+	-	-	-
Rosa sp.		-	+	+	-
Rubus fruticosus agg.	(Blackberry)	-	-	+	+
Rumex conglomeratus	(Sharp dock)	-	+	-	+
Rumex sp.		-	+	-	-
Sambucus nigra	(Elder)	+	-	+	+
Senecio jacobaea	(Common ragwort)	+	-	+	-
Silene latifolia	(White campion)	+	-	-	-
Stellaria graminea	(Lesser stitchwort)	-	-	-	+
Symphoricarpos albus	(Snowberry)	+	-	-	-
Tussilago farfara	(Coltsfoot)	-	-	+	+
Valeriana officianalis	(Common valerian)	-	-	-	+
Verbascum thapsus	(Great mullein)	+	-	-	-

APPENDIX 3 MACRO-INVERTEBRATES RECORDED IN WYCHWOOD PONDS 1 TO 4

Values indicate abundances in Sample 1 on 8 September 1988.

Values in parenthesis are species/taxa recorded in Samples 2/3 on 8 Sept 1988. All taxa have been assumed to be present in Abundance Category 1.

+ indicates species/taxa present in Pond 2 on 12 June 1987.

X indicates species/taxa recorded for the first time on 26 February 1989.

Abundance categories	Number of individuals recorded
1	1-9
2	10-25
3	26-99
4	100-599
5	600+

	P O N D			
	1	2	3	4
<b>TRICLADIDA</b>				
Polycelis tenuis	-	-	1	-
<b>OLIGOCHAETA</b>				
	1	-	1	1
<b>MOLLUSCA:Gastropoda</b>				
Acroloxus lacustris	-	-	(1)	-
Ancylus fluviatilis	-	+	1	-
Lymnaea peregra	3	4+	4	(1)
Lymnaea stagnalis	1	-	-	(1)
Physa fontinalis	-	-	-	(1)
Planorbis albus	4	4+	3	3
Planorbis carinatus	3	-	(1)	(1)
Planorbis contortus	2	-	(1)	-
Planorbis crista	1	3+	-	1
Potamopyrgus jenkinsi	1	+	3	-
Valvata piscinalis	3	1+	(1)	1
<b>CRUSTACEA:Malacostraca</b>				
Gammarus pulex	1	3	3	1
Asellus meridianus	3	3+	1	1
Austropotamobius pallipes	(1)	+	(1)	-
<b>HIRUDINEA</b>				
Erpobdella testacea	1	1	1	-
Erpobdella octoculata	1	1+	3	-
Erpobdella sp.	-	-	1	-
Glossiphonia complanata	1	1+	2	1
Glossiphonia heteroclita	-	-	1	-
Helobdella stagnalis	-	-	(1)	1
Piscicola geometra	(1)	-	-	-
Theromyzon tessulatum	-	1	2	(1)
<b>EPHEMEROPTERA</b>				
Cloeon dipterum	1	1+	1	1
Caenis horaria	1	1+	1	-
Ephemera vulgata	-	x	-	-
Leptophlebia marginata	-	x	x	x
<b>ODONATA</b>				
Coenagrion puella	2	1+	(1)	1
Coenagriidae (undet. larvae)	-	-	1	1

19

Mention why no Sphaeriidae

Molluscs 8 4 8 7  
 Beetles 11 12 18 8  
 Non-beetles 27 24 20 27 16  
 Bugs 5 3 6 5  
 48 39 55 59 36

PLECOPTERA

Nemurella picteti	-	+	-	-
HETEROPTERA				
Corixa punctata	-	1+	-	1
Cymatia bonndorffi	1	-	-	-
Gerris lacustris	1	-	(1)	-
Hesperocorixa linnei	-	-	1	-
Hydrometra stagnorum	-	(1)	-	(1)
Mesovelgia furcata	-	-	-	1
Notonecta glauca	-	x	-	-
Sigara distincta	1	+	(1)	1
Sigara dorsalis	3	-	1	1
Sigara falleni	-	+	-	-
Sigara fossarum	1	+	(1)	-
Sigara nigrolineata	-	1	1	-
Sigara scotti	-	-	-	1
Corixidae (undet. nymphs)	-	-	-	1

MEGALOPTERA

Sialis lutaria	4	4+	4	3
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COLEOPTERA: Gyrinidae

Gyrinus substriatus	-	x	-	-
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COLEOPTERA: Haliplidae

Halipus confinis	-	1	1	-
Halipus flavicollis	1	1	3	1
Halipus fluviatilis	1	-	1	1
Halipus immaculatus	-	-	1	-
Halipus lineatocollis	1	2+	2	1
Halipus obliquus	2	1+	3	1
Halipus wehnkei	2	1+	2	2
Halipus ruficollis gp. females	2	1	3	1
Undet. haliplid larvae	1	1	2	1

COLEOPTERA: Dytiscidae

Agabus sturmi	-	+	-	x
Colymbetes fuscus	-	-	(1)	-
Graptodytes pictus	1	-	-	-
Hydroporus palustris	1	1	-	-
Hydroporus planus	-	+	-	-
Hygrotus inaequalis	-	-	(1)	-
Hygrotus versicolor	(1)	-	-	-
Ilybius fuliginosus	-	1+	-	-
Laccophilus minutus	-	-	1	-
Platambus maculatus	-	-	1	-
Potamonectes depressus-elegans	1	1+	3	(1)
Stictotarsus duodecimpustulatus	-	1	-	-
Undet. dytiscid larvae	1	2	1	1

COLEOPTERA: Hydrophilidae

Anacaena globulus	-	+	1	-
Elmis aenea	-	-	2	-
Enochrus quadripunctatus	-	-	-	1
Enochrus testaceus	1	-	(1)	-

Helophorus brevipalpis	-	1+	-	-
Helophorus grandis	-	1	-	-
Helophorus minutus gp females	-	1	(1)	-
Laccobius biggutatus	1	-	-	?
Oulimnius tuberculatus	-	-	2	-
Riolus subviolaceus	-	-	1	-
Elmidae (undet. larvae)	-	-	2	-
Helodidae (undet. larvae)	-	-	1	-
Hydrophilidae (undet. larvae)	1	-	-	-
TRICHOPTERA				
Agraylea sp.	-	1	-	-
Anabolia nervosa	-	+	-	-
Athripsodes aterrimus	1	1+	1	-
Athripsodes cinereus	2	2	-	-
Beraeodes minutus	-	1	-	-
Cyrnus trimaculatus	-	+	-	-
Holocentropus dubius	1	-	(1)	1
Holocentropus picicornis	1	-	-	-
Limnephilus lunatus	-	+	-	-
Lype reducta	1	-	-	-
Mystacides longicornis	-	?	1	?
Phryganea striata	2	-	1	(?)
Tinodes waeneri	-	+	-	-
Triaenodes bicolor	-	1	-	-
Leptoceridae (undet larvae/pupae)	-	-	1	1
LEPIDOPTERA				
Paraponyx stratiotata	1	-	(1)	1
DIPTERA (larvae)				
Ceratopogonidae	1	-	(1)	1
Chironomidae	-	4	3	2
Culicinae (pupae)	-	1	1	-
Curculionidae	-	1	-	-
Ephydriidae	1	-	-	-
Eristalinae	-	-	(1)	-
Ptychopteridae	-	-	(1)	-
Stratiomyidae	1	-	1	1
Tabanidae	(1)	-	-	-
Tipulidae	1	1	(1)	-

B

APPENDIX 4. MACRO-INVERTEBRATE TAXA RECORDED IN WYCHWOOD PONDS PRIOR TO  
RECENT SURVEYS BY POND ACTION AND J BIGGS

TRICLADIDA

*Polycelis nigra/tenuis*

OLIGOCHAETA

Undet. species.

MOLLUSCA:Gastropoda

*Lymnaea peregra*

*Lymnaea stagnalis*

*Physa fontinalis*

*Planorbis carinatus*

*Potamopyrgus jenkinsi*

*Valvata piscinalis*

MOLLUSCA:Bivalvia

*Anodonta* sp.

*Sphaerium corneum*

*Pisidium* sp.

CRUSTACEA:Malacostraca

*Gammarus pulex*

*Asellus meridianus*

*Austropotamobius pallipes*

HIRUDINEA

*Erpobdella octoculata*

*Helobdella stagnalis*

EPHEMEROPTERA

*Centroptilum luteolum*

*Cloeon dipterum*

*Cloeon simile*

ODONATA

*Aeshna mixta*

*Aeshna cyanea*

*Aeshna grandis*

*Agrion splendens*

*Coenagrion puella*

*Cordulegaster boltonii*

*Enallagma cyathigerum*

*Ischnura elegans*

*Libellula depressa*

*Orthetrum cancellatum*

*Pyrrhosoma nymphula*

HETEROPTERA

*Callicorixa praeusta*

*Corixa panzeri*

*Gerris argentatus*

*Gerris lacustris*

*Gerris odontogaster*

*Hesperocorixa sahlbergi*

*Hydrometra stagnorum*

*Mesovelia furcata*

*Micronecta scholtzi*

*Nepa cinerea*

*Notonecta glauca*

*Ranatra linearis*

Sigara distincta  
Sigara dorsalis  
Sigara falleni  
Sigara fossarum  
Sigara scotti  
Velia caprai

MEGALOPTERA

Sialis lutaria

COLEOPTERA:Haliplidae

Halipus sp.

TRICHOPTERA

Athripsodes aterrimus

Cyrnus trimaculatus

LEPIDOPTERA

Undet. larvae

DIPTERA (larvae)

Chironomidae

RECORDERS: John Campbell/Oxfordshire Biological Records Centre  
I. Lansbury (1976)  
NCC, 1968.



APPENDIX 5. MACRO-INVERTEBRATES ASSOCIATED WITH FLOWING WATER OR LAKES  
FOUND IN THE WYCHWOOD PONDS

SPECIES	BRIEF NOTES ON HABITATS
<i>Ancylus fluviatilis</i>	Very common; in lakes, ponds, rivers and streams wherever there is a hard surface and sufficient wave action or current to keep surfaces clear.
<i>Potamopyrgus jenkinsi</i>	Common in running waters of all types from fast rivers to trickles, rarely in closed ponds
<i>Valvata piscinalis</i>	Common in running water of all kinds, provided the current is not too fast. Rarely in closed ponds.
<i>Anacaena globulus</i>	Running water and damp, shaded
<i>Halipus flavicollis</i>	Running water and lakes.
<i>Halipus fluviatilis</i>	Rivers, sometimes lakes and pools.
<i>Halipus lineatocollis</i>	Mainly slow running water.
<i>Platambus maculatus</i>	Running water and wave-washed lakes.
<i>Potamonectes depressus-elegans</i>	Rivers and lochs.
<i>Stictotarsus duodecimpustulatus</i>	Running water and lakes.
<i>Elmis aenea</i>	Running water in riffles
<i>Oulimnius tuberculatus</i>	Running water and lakes
<i>Riolus subviolaceus</i>	Base-rich running waters
<i>Tinodes waeneri</i>	Widely distributed on stony lake shores and in large streams and rivers

Notes on Mollusca: Macan (1977).

Notes on Coleoptera: Friday (1988)

Notes on Trichoptera: (Edington and Hildrew, 1981).

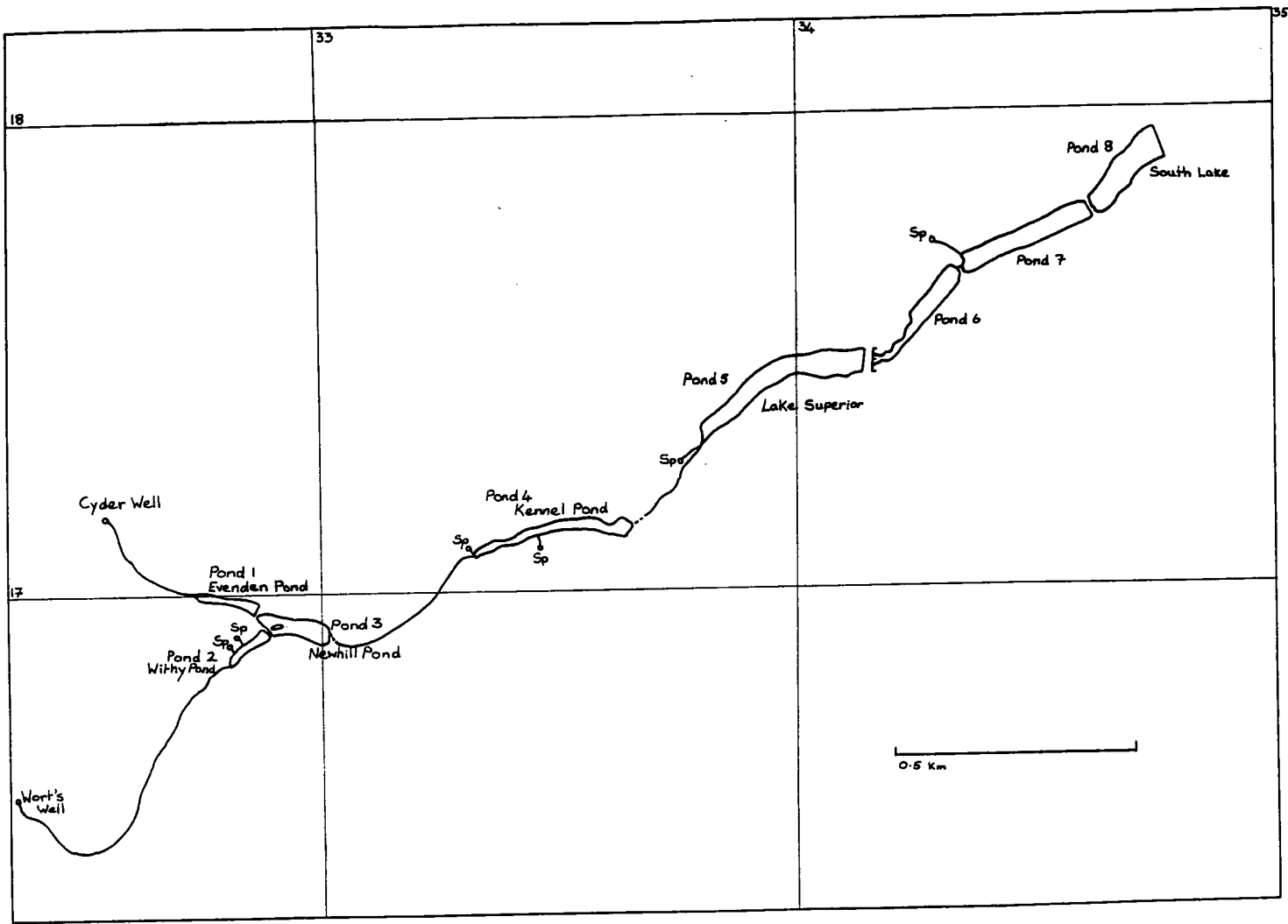
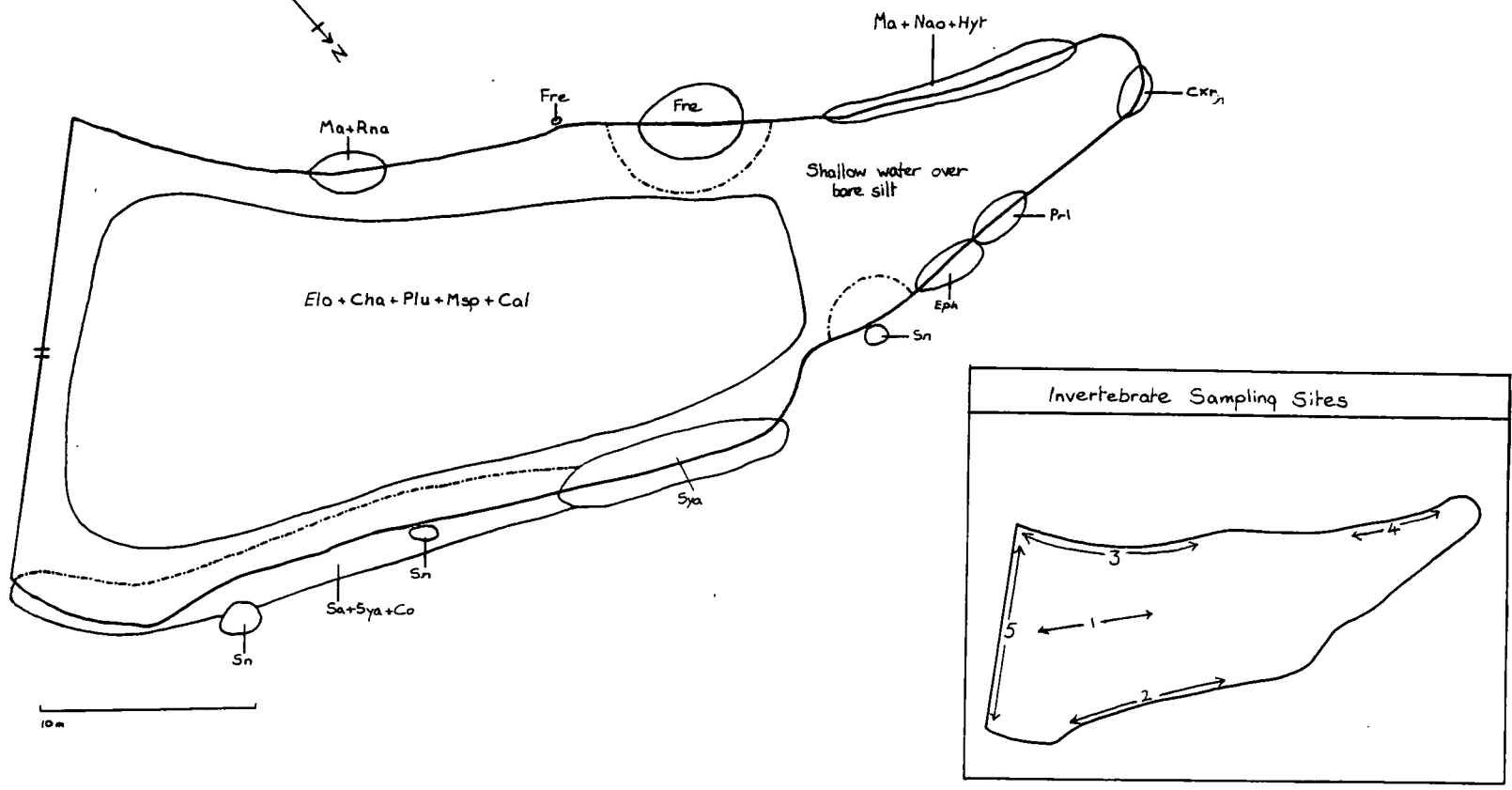


Figure 1: The Wychwood Ponds

Figure 2: Evenden Pond (Pond 1)

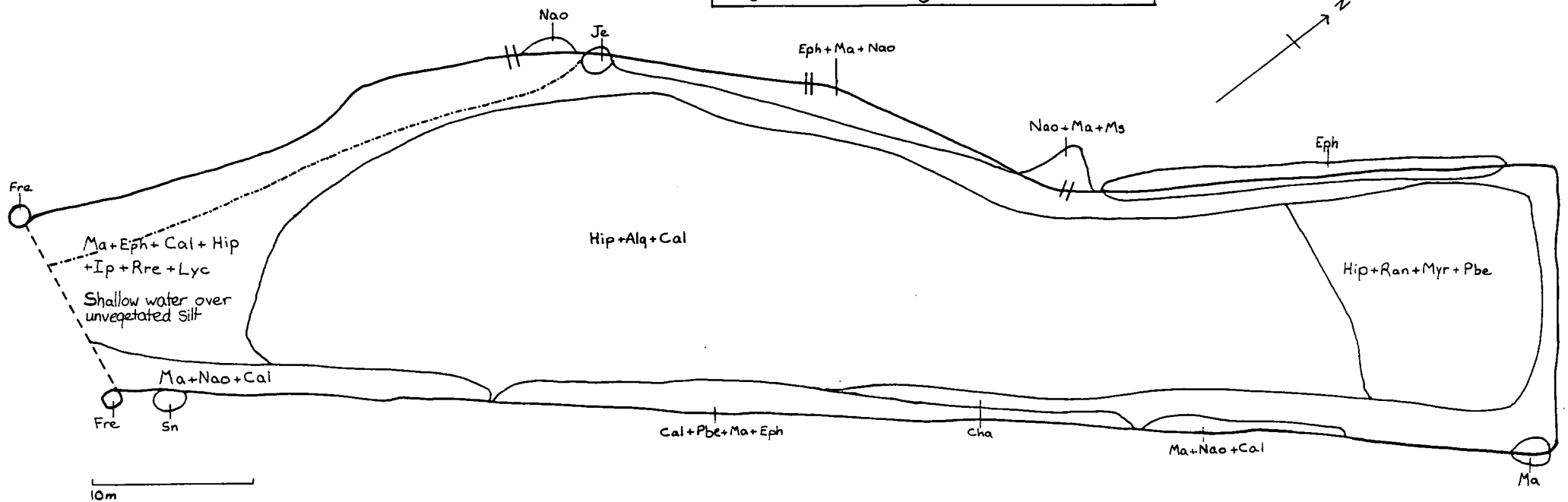


— Main areas of vegetation  
 - - - Areas of shading

KEY TO VEGETATION STANDS

- |                              |                                     |
|------------------------------|-------------------------------------|
| Cal... Callitriche sp.       | Msp... Myriophyllum spicatum        |
| Cha... Chara sp.             | Nao... Nasturtium officinale        |
| Cxr... Carex riparia         | Plu... Potamogeton lucens           |
| Co... Cornus sp.             | Pr... Prunus laurocerasus           |
| Elo... Elodea canadensis     | Rna... Rorippa nasturtium-aquaticum |
| Eph... Epilobium hirsutum    | Sa... Salix sp.                     |
| Fre... Fraxinus excelsior    | Scr... Scrophularia aquatica        |
| Hyt... Hypericum tetrapterum | Sn... Sambucus nigra                |
| Ma... Mentha aquatica        | Sya... Symphoricarpos albus         |

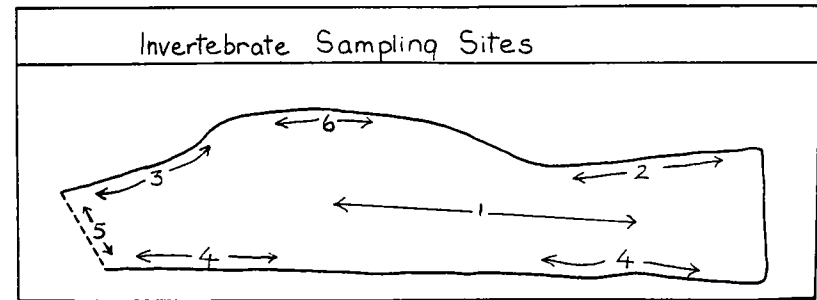
Figure 3: Wither Pond (Pond 2)

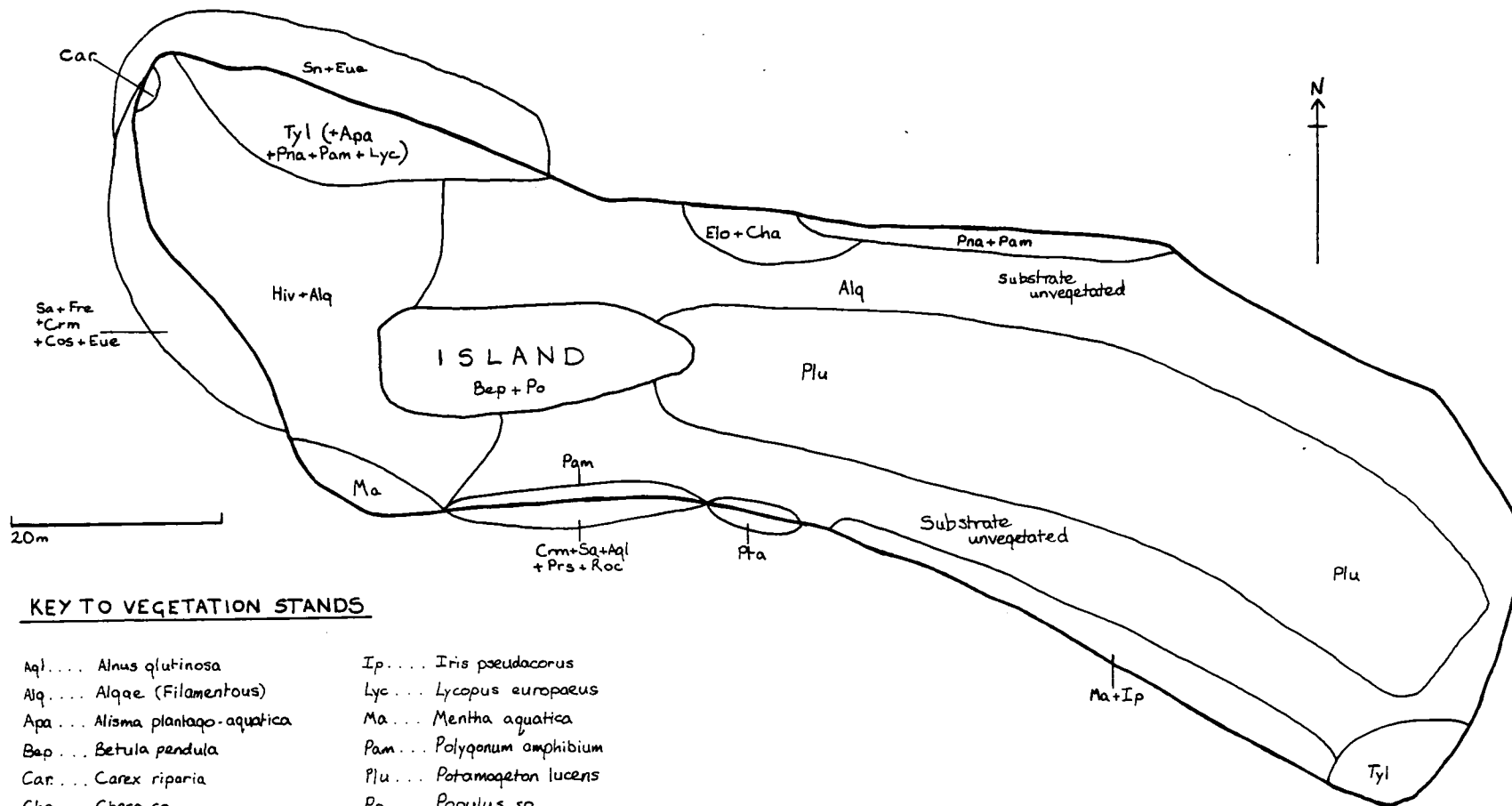


- Main areas of vegetation
- - - Areas of shading
- = Inlets

KEY TO VEGETATION STANDS

- |                                       |                                       |
|---------------------------------------|---------------------------------------|
| Alq..... Algae ( <i>Filamentous</i> ) | Ma.... <i>Mentha aquatica</i>         |
| Cal.... <i>Callitriche</i> sp.        | Ms.... <i>Myosotis scorpioides</i>    |
| Cha... <i>Chara</i> sp.               | Myr... <i>Myriophyllum spicatum</i>   |
| Eph... <i>Epilobium hirsutum</i>      | Nao... <i>Nasturtium officinale</i>   |
| Fre.... <i>Fraxinus excelsior</i>     | Pot.... <i>Potamogeton</i> sp.        |
| Hip.... <i>Hippuris vulgaris</i>      | Pbe... <i>Potamogeton berchtoldii</i> |
| Ip.... <i>Iris pseudacorus</i>        | Ran... <i>Ranunculus</i> sp.          |
| Je.... <i>Juncus effusus</i>          | Sn.... <i>Sambucus nigra</i>          |
| Lyc... <i>Lycopus europaeus</i>       |                                       |





**KEY TO VEGETATION STANDS**

- |                                 |                             |
|---------------------------------|-----------------------------|
| Aql... Alnus glutinosa          | Ip... Iris pseudacorus      |
| Alq... Algae (Filamentous)      | Lyc... Lycopodium europaeus |
| Apa... Alisma plantago-aquatica | Ma... Mentha aquatica       |
| Bep... Betula pendula           | Pam... Polygonum amphibium  |
| Car... Carex riparia            | Plu... Potamogeton lucens   |
| Cha... Chara sp.                | Po... Populus sp.           |
| Cos... Cornus sanguinea         | Prs... Prunus spinosa       |
| Crm... Crataegus monogyna       | Pta... Pteridium aquilinum  |
| Elo... Elodea canadensis        | Roc... Rosa canina          |
| Eue... Euonymus europaeus       | Sa... Salix sp.             |
| Fre... Fraxinus excelsior       | Sn... Sambucus nigra        |
| Hiv... Hippuris vulgaris        | Tyl... Typha latifolia      |

**Figure 4: New Hill Pond (Pond 3)**

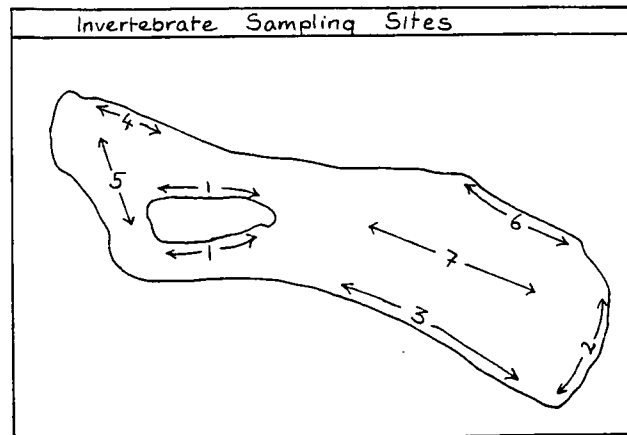
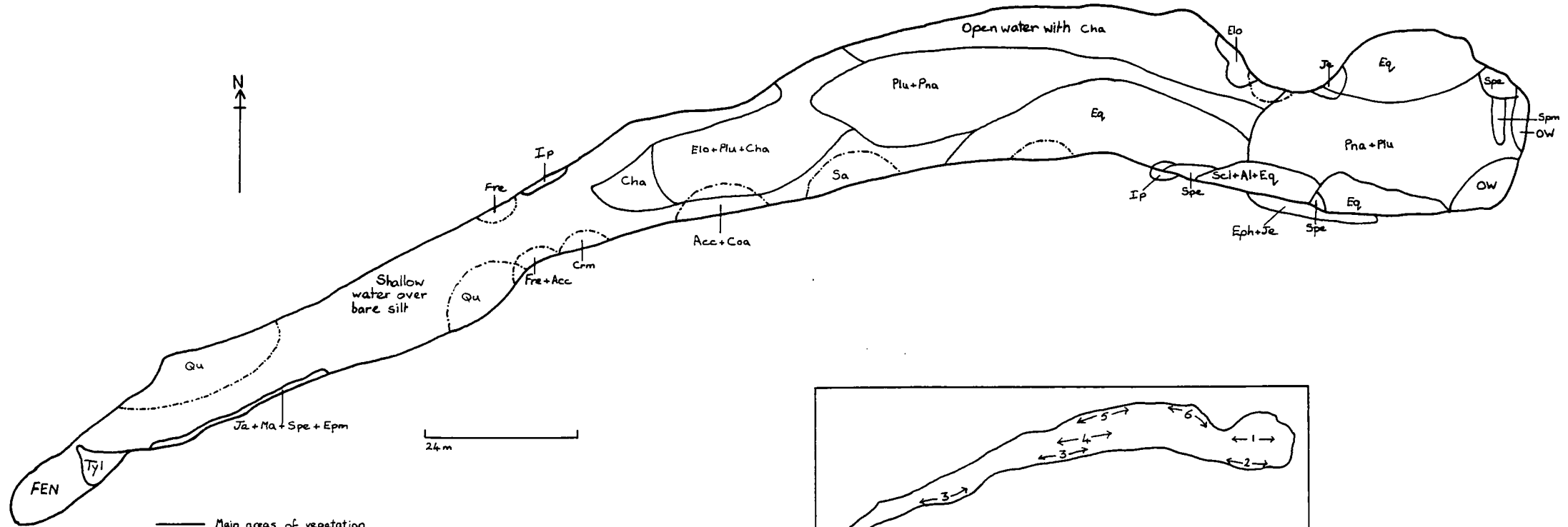


Figure 5: Kennel Pond (Pond 4)



— Main areas of vegetation  
 - - - Areas of shading  
 OW Open water

**KEY TO VEGETATION STANDS**

- |                                  |                             |                           |
|----------------------------------|-----------------------------|---------------------------|
| Acc.... Acer campestre           | Epm.... Epilobium montanum  | Pna... Potamogeton natans |
| Al..... Alisma plantago-aquatica | Eq.... Equisetum fluviatile | Qu.... Quercus robur      |
| Cha.... Chara spp.               | Fre.... Fraxinus excelsior  | Sa.... Salix sp.          |
| Coa... Corylus avellana          | Ip.... Iris pseudacorus     | Sci... Scirpus lacustris  |
| Crm... Crataegus monoqyna        | Je.... Juncus effusus       | Spe... Sparqanium erectum |
| Elo... Elodea canadensis         | Ma.... Mentha aquatica      | Spm... Sparqanium emersum |
| Eph.... Epilobium hirsutum       | Plu... Potamogeton lucens   | Tyl.... Typha latifolia   |

