2056

AN ECOLOGICAL SURVEY OF THE UPPER LAKE AT CRYSTAL PALACE

REPORT TO THE HAMLET PARTNERSHIP (AQUATIC ENVIRONMENTAL CONSULTANTS)

Pond Action
c/o BMS Oxford Polytechnic
Headington Oxford OX30BP

September 1989

SUMMARY

A preliminary ecological survey of the Upper Lake at Crystal Palace was undertaken on 6 July 1989. The survey described the physical and chemical environment of the lake and its plant and invertebrate animal communities.

The lake was found to have a deep layer of silt on the bottom and an impoverished aquatic flora. The invertebrate community resembled that of many other small lakes but showed evidence of intense predation pressure from the large, mixed, coarse fish population. Although a decline in the quality of angling was reported in 1988, angling was said to be good during 1989.

Silt accumulation and predation by fish appear to be most important factors influencing the plant and invertebrate communities.

C O N T E N T S P A G E

1. BACKGROUND

The Upper Lake at Crystal Palace has been fished by the Crystal Palace Angling Association (CPAA) since the 1920's. During 1988 a decline in the quality of the angling on the lake was reported prompting CPAA to initiate an investigation of the fish population in 1989.

As part of this investigation a preliminary ecological survey of the lake was required to provide background information prior to the examination of fish.

The aims of this survey were:

(i) to make a preliminary description of the physical and chemical features of the lake and of its plant and invertebrate animal communities.

(ii) to identify the main factors influencing the composition of the plant and invertebrate animal communities in the lake.

2. METHODS

2.1 DATE OF THE SURVEY

The lake was surveyed on 6 July 1989 by J Biggs and D Walker.

2.2 SEDIMENT DEPTHS, WATER DEPTHS AND WATER CHEMISTRY

Water and sediment depths and dissolved oxygen concentrations were measured along two transects, taken at right angles to each other, across the lake. Transect A ran west-east along the centre of the lake and Transect B north-south through the western half of the lake. Measurements were made at roughly one-quarter, one-half and three quarters of the way along both transects. Two water samples were analysed by standard methods for pH, conductivity and alkalinity.

2.3 MACROINVERTEBRATES

2.3.1 Sampling

A standard system for sampling macroinvertebrates, devised by Pond Action, was used. Eighteen areas of the lake were selected to represent the diversity of macroinvertebrate habitats in the lake (see Appendix 1). Each area was vigorously sampled with a standard pondnet (Freshwater Biological Association pattern; 1mm square mesh) for 10 seconds. The material from all the sampling areas was merged to give one composite sample for the lake. In the laboratory all macroinvertebrates were removed from the sample for identification.

2.3.2 Identification

The following groups were identified to species level.

Tricladida	(Flatworms)
Hirudinea	(Leeches)
Gastropoda	(Snails and Limpets)
Malacostraca (Crustacea)	(Shrimps and Slaters)
Ephemeroptera	(Mayflies)
Odonata	(Dragonflies and Damselflies)
Hemiptera	(Water bugs)
Megaloptera	(Alderflies)
Coleoptera	(Water Beetles)
Trichoptera	(Caddis-flies)

Larvae of the Diptera (true flies) were identified to family.

2.4 ZOOPLANKTON

2.4.1 Sampling

The zooplankton was sampled by trawling a standard plankton net (100 micron square mesh) behind a moving boat. The net was trawled at various levels in the water column to provide a qualitative indication of the zooplankton composition of the lake.

2.4.2 Identification

Zooplankton were identified to generic level.

2.5 WATER PLANTS

Emergent and floating-leaved macrophytes were identified in the field. No submersed water plants were found in the lake.

3. RESULTS AND DISCUSSION

3.1 SITE DESCRIPTION

3.1.1 Physical features

The lake is about 0.47ha (4700 square metres) in area and of fairly uniform depth (about 2.6 metres). It is underlain by London Clay but local outcrops of the sandy and pebbly Claygate Beds may also be present. The Lake is surrounded by parkland with mown grass, scrub and deciduous woodland. The lake is probably maintained by the natural water table, although it also receives run-off from the surrounding land and overflow from a nearby stock pond.

Sediment had accumulated to a depth of about 1m throughout the lake. The sediment was largely composed of organic ooze, with whole and decomposing leaves and twigs. The larger debris was most noticeable around the edges of the lake. Water and sediment depths are listed in Table 1.

3.1.2 Previous management

(This section is based on notes taken during conversation with the Water Bailiff on 6 July 1989.) The lake has been under the control of CPAA since 1924 during which time it has not been dredged. CPAA currently has about 200 members although only about 100 regularly fish the lake. Physical management of the lake consists mainly of maintaining swims by cutting of water-lilies. A variety of trees, shrubs and herbs have been planted around the margins of the lake. The lake has 42 swims.

The lake supports a varied coarse fish population (see Appendix 2). During the last nine years the lake has been stocked with fish on a number of occasions. 125 crucian carp, 125 small tench, 55 1-1.5lb roach and 900 lbs (240 fish) of common, mirror and leather carp of up to 7lbs weight have been stocked. There has been no official stocking for at least five years. The Bailiff described the fishing during the 1989 season as very good. The fishing of the previous year was described as poor.

3.2 WATER CHEMISTRY

The pH, alkalinity and conductivity of the lake suggest that it is chemically well-buffered and eutrophic (nutrient-rich). At the time of the survey the water was fully saturated with dissolved oxygen at the water surface. There was a noticeable decline in dissolved oxygen saturation lower in the water column and the sediment surface was probably anoxic. Measurements over 24 hours would be needed to determine whether significant diurnal deoxygenation of the whole water column was occurring. The results of the chemical analyses are shown in Table 1.

3.3 VEGETATION

The lake was almost entirely surrounded by trees and shrubs although relatively few areas were deeply shaded. Beyond the immediate margins, most of the lake was well-illuminated.

The wetland and aquatic flora was very impoverished, with only 11 species recorded (see Appendix 3). Marginal emergent vegetation was poorly developed and the only abundant plant in the lake was yellow water-lily (Nuphar lutea). This grew in a band approximately 6 metres wide around most of the lake. It is not clear why their growth is restricted to a narrow band. Isolated stands of yellow flag (Iris pseudacorus) and white water-lily (Nymphaea alba) were also found. Other marginal wetland plants were sparsely scattered around the lake. No submersed water plants were recorded.

3.4 THE INVERTEBRATE FAUNA

3.4.1 Composition of the macroinvertebrate fauna

Twenty-four species of macroinvertebrates (excluding Diptera larvae) were recorded in the sample (see Appendix 4). This was a rather low total for the size of water body. For example, in a similar sized pond in a woodland nature reserve in Oxfordshire, with large mixed stands of submerged, floating-leaved and marginal water plants, 39 macroinvertebrate species were found with a similar amount of sampling effort.

The numbers of species contributed by each of the major groups of macroinvertebrates (see Appendix 4) was broadly consistent with observations of other large ponds and small lakes (Pond Action, unpublished data). Flatworms, leeches and water snails contributed over half of the number of species recorded whereas water beetles represented less than 15% of the species. All the species recorded in the Upper Lake were common with the exception of the caseless caddis fly Cyrnus flavidus (a widespread but uncommon species).

As well as having features which are typical of large ponds and small lakes generally, the macroinvertebrate fauna of the Upper Lake also showed evidence of intense fish predation. In particular, macroinvertebrates which often move in open water were either rare or apparently absent. Backswimmers (Notonecta species), lesser water boatmen (Corixidae), water beetles (especially the active Haliplidae and Dytiscidae) and mayflies (such as Cloeon dipterum) were all rare in the sample or absent altogether. The effects of fish predation are probably enhanced by the absence of submerged vegetation, which provides shelter (as well as food) for a variety of macroinvertebrates.

Although there was evidence of the impact of fish on the composition of the macroinvertebrate community it was not possible to determine in this study whether there was an adequate supply of natural food available for the fish. Such an investigation would require a further study.

3.4.2 Zooplankton

The zooplankton of the the lake was dominated by small cladocerans (*Daphnia* sp. and *Bosmina* sp.) and cyclopoid copepods. It has been found in many studies of lakes that fish predation has the effect of removing larger members of the zooplankton, leaving only individuals of smaller species. The size of the zooplankton collected from the Upper Lake was indicative of high grazing pressure by fish (Moss, 1980).

TABLE 1. SITE DESCRIPTION UPPER LAKE, CRYSTAL PALACE

(i) Water depths and silt depths; dissolved oxygen concentrations

(ii) Basic water chemistry.

(i) WATER AND SILT DEPTHS

	Water depth (cm)	Silt depth (cm)	Total depth (silt & water) (cm)	Dissolved oxygen concentration at 20cm (% saturation)
Transect A				
1/4 (depth marker)	185	75	260	104
1/2	170	100	270	105
3/4	175	85	260	108
Transect B				
1/4	170	55	225	102
1/2	Same point as Transect A, 1/4.			
3/4	170	95	265	103

(ii) BASIC WATER CHEMISTRY

Determinand	Value		Units
pH	7.45	+/- 0.02	pH units
Conductivity	759		microSiemens per centimetre
Alkalinity	3.87	+/- 0.02	milliequivalents per litre

4. CONCLUSIONS

4.1 PHYSICAL AND CHEMICAL FEATURES OF THE LAKE

The lake is relatively uniform in depth, probably rich in nutrients and has a deep layer of silt evenly distributed throughout its area.

4.2 AQUATIC VEGETATION

The steeply shelving margins of the lake ensure that only a small area, very close to the margins, is suitable for the growth of emergent (reed-like) plants. In practice, even within this area, there is very little growth of marginal plants because of the shade cast by surrounding trees and shrubs.

The lake apparently lacks submersed plants. This is probably caused by a combination of silt accumulation, interception of light by planktonic algae or suspended solids and grazing by fish. Of these three factors, silt accumulation may well be the most significant because it is known that few submersed plants grow well on deep organic sediments (Barko and Smart, 1986). However, yellow water-lily, a floating-leaved plant which is tolerant of these conditions, can be expected to continue to flourish in the lake.

The lack of marginal and submersed plants reduces invertebrate habitat diversity in the pond.

4.3 INVERTEBRATES

The lake supported relatively few macroinvertebrate species. This probably reflected the effects of fish predation and the lack of habitat diversity. Predation probably eliminates both conspicuous macroinvertebrates which move in the open water and the larger members of the zooplankton.

Despite the relatively low number of species recorded the community showed features generally associated with large ponds and small lakes.

5. REFERENCE

Barko, J.M. and Smart, M. (1986). Sediment-related mechanisms of growth limitation in submersed macrophytes. Ecology, 67, 1328-1340.

Moss, B. (1980). Ecology of freshwaters. Blackwell Scientific Publications.

APPENDIX 1. MICROHABITATS SAMPLED FOR MACROINVERTEBRATES IN THE UPPER LAKE, CRYSTAL PALACE

18 microhabitats were sampled for 10 seconds. Where a fishing peg was adjacent to the microhabitat the peg number is given.

MICROHABITAT	FISHING PEG
Below overhanging Japanese knotweed	(Peg 1)
Yellow water-lily	-
Edge of yellow water-lily	-
Pendulous sedge	(Peg 3)
Yellow flag	(Peg 5)
Beneath overhanging brambles	(Peg 6)
Square stemmed St. John's-wort	(Peg 8)
Beneath overhanging ivy	(Peg 13)
Bittersweet	(Peg 16)
Lake outlet	-
Heavy shade north of outlet	-
Submersed tree roots	(Peg 22)
Japanese knotweed roots	(Peg 24)
Under platform	(Peg 31)
Concrete bank	(Peg 35)
Submersed tree roots	(Peg 37)
Marginal sedges	(Peg 38)
White water-lily	-

APPENDIX 2. COARSE FISH IN THE UPPER LAKE, CRYSTAL PALACE

SPECIES OR VARIETY		NOTES
Common carp	(Cyprinus carpio)	Up to 14.5lbs
Mirror carp	(Cyprinus carpio)	Up to 15lbs
Leather carp	(Cyprinus carpio)	Up to 7lbs
Crucian carp	(Carassius carassius)	Up to 1lb
Goldfish	(Carassius auratus)	-
Golden orfe	(Leuciscus idus)	Up to 4lbs
Tench	(Tinca tinca)	'Plentiful' under 1lb and up to 4lbs
Golden tench	(Tinca tinca)	Up to 3lbs
Pike	(Esox lucius)	Up to 25lbs+
Perch	(Perca fluviatilis)	'Breeds very well' 0.5-4lbs
Roach	(Rutilus rutilus)	Abundant; up to 1.5lbs
Rudd	(Scardinius erythrocephalus)	Similar sizes to roach
Gudgeon	(Gobio gobio)	'A few'
Bream	(Abramis brama)	'Breeds well'. Up to 5lbs
Chub	(Leuciscus cephalus)	Introduced but failed

APPENDIX 3. WETLAND PLANTS RECORDED IN AND AROUND THE UPPER LAKE, CRYSTAL PALACE

ENGLISH NAME	SCIENTIFIC NAME
Pendulous sedge	(Carex pendula)
Great hairy willowherb	(Epilobium hirsutum)
Square-stemmed St. Johns-wort	(Hypericum tetrapterum)
Yellow flag	(Iris pseudacorus)
Soft rush	(Juncus effusus)
Gypsywort	(Lycopus europaeus)
Water mint	(Mentha aquatica)
Yellow water-lily	(Nuphar lutea)
White water-lily	(Nymphaea alba)
Crack willow	(Salix fragilis)
Bittersweet	(Solanum dulcamara)

APPENDIX 4. INVERTEBRATE TAXA RECORDED IN THE UPPER LAKE, CRYSTAL PALACE WITH ESTIMATES OF PERCENTAGE ABUNDANCE

TAXA		% ABUNDANCE
TRICLADIDA (FLATWORMS)		
Dugesia lugubris		0.5
Dugesia tigrina		<0.5
Dendrocoelum lacteum		<0.5
HIRUDINEA (LEECHES)		
Helobdella stagnalis		2.9
Hemiclepsis marginata		<0.5
GASTROPODA (SNAILS AND LIMPETS)		
Acroloxus lacustris	(Lake limpet)	10.3
Armiger crista	(Nautilus ramshorn)	2.0
Bithynia tentaculata		24.6
Gyraulus albus	(White ramshorn)	3.9
Hippeutis complanata	(Flat ramshorn)	2.5
Lymnaea auricularia	(Ear pond snail)	0.5
Lymnaea stagnalis	(Great pond snail)	1.0
Viviparus viviparus	(The river snail)	0.5
MALACOSTRACA (SHRIMPS AND SLATERS)		
Asellus aquaticus	(Water slater)	6.4
Crangonyx pseudogracilis	(Freshwater shrimp)	1.5
ODONATA		
Aeshna (probably cyanea)	(Southern hawker)	<0.5
EPHEMEROPTERA (MAYFLIES)		
Cloeon dipterum	(Pond olive)	0.5
HETEROPTERA (BUGS)		
Gerris lacustris	(Pond skater)	0.5
Gerris sp (nymphs)		0.5
Sigara dorsalis	(Lesser water boatman)	0.5
TRICHOPTERA (CADDIS-FLIES)		
Cyrnus flavidus		10.8
Cyrnus trimaculatus		<0.5

APPENDIX 4. INVERTEBRATE TAXA RECORDED IN THE UPPER LAKE, CRYSTAL PALACE WITH ESTIMATES OF PERCENTAGE ABUNDANCE

T A X A		% A B U N D A N C E
COLEOPTERA (BEETLES)		
Helophorus brevipalpis		<0.5
Hygrotus inaequalis		<0.5
Laccobius bipunctatus		<0.5
LARVAE OF THE DIPTERA (FLIES)		
Ceratopogonidae	(Biting midges)	<0.5
Chironomidae	(Non-biting midges)	11.8
Tipulidae	(Crane-flies)	<0.5

(Aeshna grandis, the brown hawker, Erythromma najas, the red-eyed damsel-fly and Ishcnura elegans, the blue-tailed damsel-fly, were seen on the wing on site.)

ZOOPLANKTON

ZOOPLANKTON GENERA	% TOTAL ZOOPLANKTON
Bosmynia sp.	5.0
Daphnia sp.	95.0