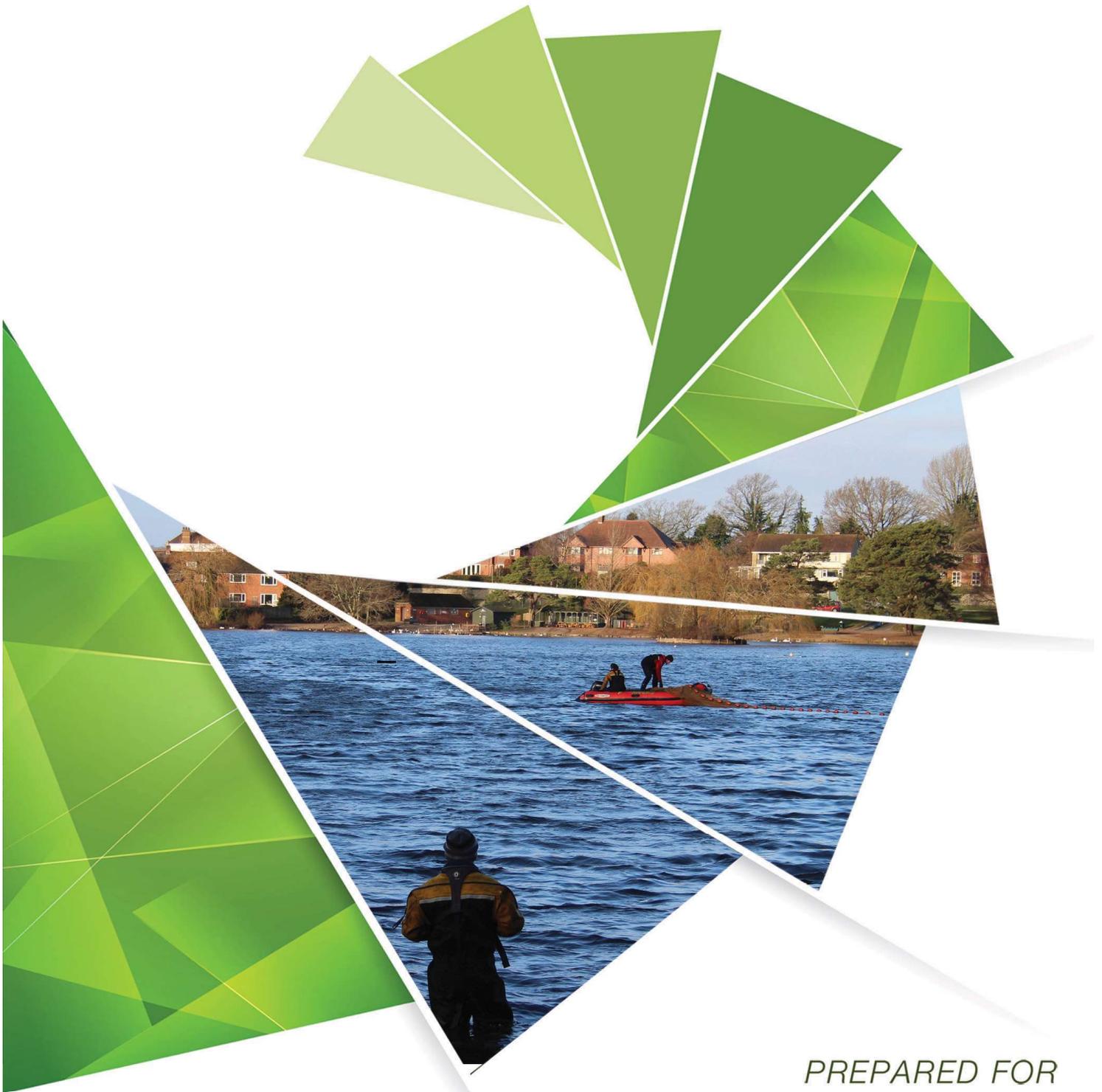


Five Rivers

ENVIRONMENTAL CONTRACTING



PREPARED FOR



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1 Executive Summary

- Five Rivers Environmental Contracting Ltd were commissioned by Petersfield Town Council to undertake a fish population survey at Heath Pond, Petersfield.
- The aim of the survey was to investigate species composition and stocking density of the lake in order to provide recommendations in terms of fishery management.
- Heath Pond suffered a series of fish mortalities leading to a significant incident in 2009 reported to be the result of a suspected blue-green algal bloom. Although there have been no further records of blue-green algal blooms or fish mortalities since 2009, the Council is concerned that Heath Pond may return to a cycle of damaging blue-green algal blooms.
- The fish survey was commissioned prior to a lake enhancement project undertaken by Five Rivers, due to begin in January 2020.
- Fish capture was undertaken using a 100 x 4m seine net, deployed at multiple locations at Heath Pond (SU 75298 22861) on the 12th and 13th December 2019.
- Five fish species were recorded during the survey: carp (common and mirror), common bream, European eel, roach and rudd.
- The catch results show carp dominate in terms of numbers and biomass with 100 caught in total ranging from 1lb 14oz to mid-20lb.
- Recommendations have been made in terms of the long-term management of fish stocks and water quality with the aim of ensuring a self-sustaining, natural fishery with low risk of re-occurrence of large-scale fish mortality events.

2 Introduction

Five Rivers Environmental Contracting Ltd were commissioned by Petersfield Town Council to undertake a fish population survey at Heath Pond, Petersfield. The aim of the survey was to investigate species composition and stocking density of the lake in order to provide recommendations in terms of fishery management.

2.1 Background

Heath Pond is a shallow, mostly tree-lined 9ha lake with a maximum depth of 1.5m. There are Norfolk reed (*Phragmites sp.*) beds on the East bank and South-East corner but otherwise very little emergent or submerged macrophytes (aquatic plants). The lake margins are shallow and slope gently to a central area of deeper water. There is an island towards the North-East bank. The substrate consists of sand and gravel overlaid with silt which is deep in areas such as the South - East and North-West corners.

Anecdotal reports from the council and local anglers suggest that the lake historically supported a significant mixed fishery. However, Heath Pond suffered a series of fish mortalities leading to a significant incident in 2009 reported to be the result of a suspected blue-green algal bloom leading to a dissolved oxygen crash. No formal record is available of the fish lost. The evidence provided suggest that prior to those mortalities, the fishery was dominated by common bream *Abramis brama* and carp *Cyprinus carpio* along with a smaller number of roach *Rutilus rutilus*, rudd *Scardinius erythrophthalmus*, perch *Perca fluviatilis*, pike *Esox lucius*, tench *Tinca tinca* and European eel *Anguilla anguilla*. Anecdotal evidence suggests that a significant biomass of fish was lost (reports suggest fish were taken away in skips).

No formal management of the fishery has occurred since 2009 and little is known regarding the fish species that persist and the density of those populations. Anecdotal reports from anglers suggest that the majority of the fish lost in 2009 were common bream. No legal fish introductions have occurred since the 2009 mortality.

Although there have been no further records of blue-green algal blooms or fish mortalities since 2009, the Council is concerned that Heath Pond may return to a cycle of damaging blue-green algal blooms. Algal blooms tend to be the result of nutrient enrichment (eutrophication) and warm water temperatures resulting in rapid algal growth. Whilst this has a significant impact on diurnal levels of dissolved oxygen, it tends to be the dissolved oxygen crash associated with a sudden algal die back (often as a result of a change in the weather) which results in fish mortalities.

The fish survey was commissioned prior to a lake enhancement project undertaken by Five Rivers, due to begin in January 2020 (see map in Appendix 1). The enhancement scheme aims to:

- re-stabilise areas of failing bank;
- create fish nursery areas;
- plant marginal and emergent macrophytes;
- remove silt from the lake bed to create two new islands; and
- install a new boardwalk, three fishing swims and a bridge to Duck Island

3 Methodology

3.1 Fish Capture

Fish capture was undertaken using a 100 x 4m seine net, deployed at multiple locations at Heath Pond (SU 75298 22861) on the 12th and 13th December 2019. The net consists of a wider 30mm mesh in the wings (each end) and a smaller 15mm mesh in the central bag with a weighted line at the bottom (the lead line) and a floating line (the float line) at the surface. Ropes are fixed to the float lines to add sampling range and aid retrieval. The net was held at one end and set in a semicircle using a boat fitted with an outboard engine and then manually retrieved by a team of six operatives (see Figure 2.1).



Figure 2.1: Retrieving a seine net at Heath Pond

The net was retrieved to the shore until only a small section at the centre of the net (the bag) remained at which point any fish were carefully transferred via hand nets to floating micromesh catch cages for temporary storage. All captured fish were held temporarily in catch cages during sampling to ensure no repeat captures of individual fish.

On completion of sampling the fish were identified to species, measured to fork length (mm) and returned to the lake.

In order to obtain a representative sample of the species present, netting locations covered the majority of the lake habitat with the exception of the very shallow and silted South-East corner and the centre of the lake marked by boat buoys. Netting retrieval locations are provided in Table 2.1.

Table 2.1: Seine net retrieval locations

Seine net	NGR
1	SU 75391 22987
2	SU 75418 22945
3	SU 75439 22855
4	SU 75435 22811
5	SU 75437 22767
6	SU 75309 22707
7	SU 75187 22961
8	SU 75428 22924
9	SU 75200 22745
10	SU 75432 22904
11	SU 75143 22925
12	SU 75092 22853

3.1.1 Data Processing

Fish length measurements were plotted on length-frequency histograms (a graph which shows the number of fish by species within certain size bands) and individual lengths were used to calculate estimated weights using standard Environment Agency length-weight relationships. Fish frequencies and estimated weights were used to produce composition pie charts.

3.2 Water Quality

In situ water quality parameters were measured at the time of survey using a calibrated hand-held YSI Pro-Plus meter. The parameters measured were:

- Dissolved oxygen (% and mg l^{-1})
- Conductivity (μscm^{-1})
- pH
- Temperature ($^{\circ}\text{C}$)

3.3 Limitations

The results and recommendations are based on the survey which had limitations in terms of netting locations within the lake. However, the majority of the lake was sampled, and the results are therefore considered to provide an approximate estimate of the species composition and stocking densities.

Electric fishing was considered as a survey method but discounted due to the very shallow lake margins (the method is not effective in deeper, open water).

4 Results

4.1 Fish Survey

Five fish species were recorded during the survey: carp (common and mirror), common bream, European eel, roach and rudd. The catch data are provided in Table 4.1. Length frequency histograms for the most commonly caught species are provided in Figure 4.1. Species and weight composition charts for the catch are presented in Figures 4.2 and 4.3. Photos of notable fish are presented in Figure 4.4.

Table 4.1: Catch data

Species	Frequency	Estimated weight (kg)
Common bream	13	3.911
Common carp	95	425.854
Mirror carp	5	22.994
European eel	1	1.441
Roach	5	0.030
Rudd	1	0.377
Total	120	454.607

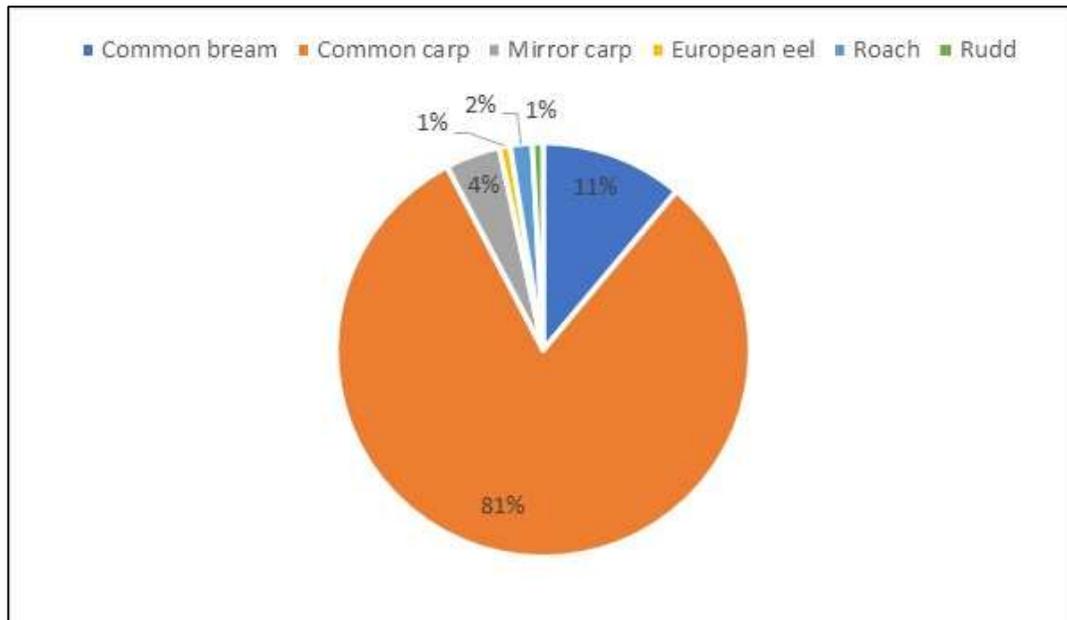


Figure 3.1: Species composition

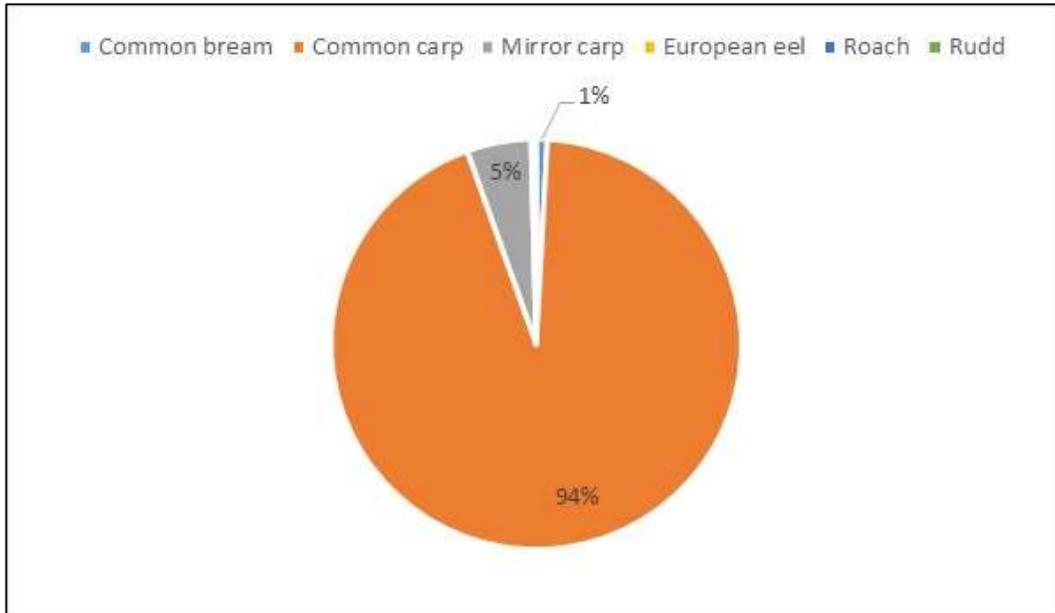


Figure 3.2: Weight composition

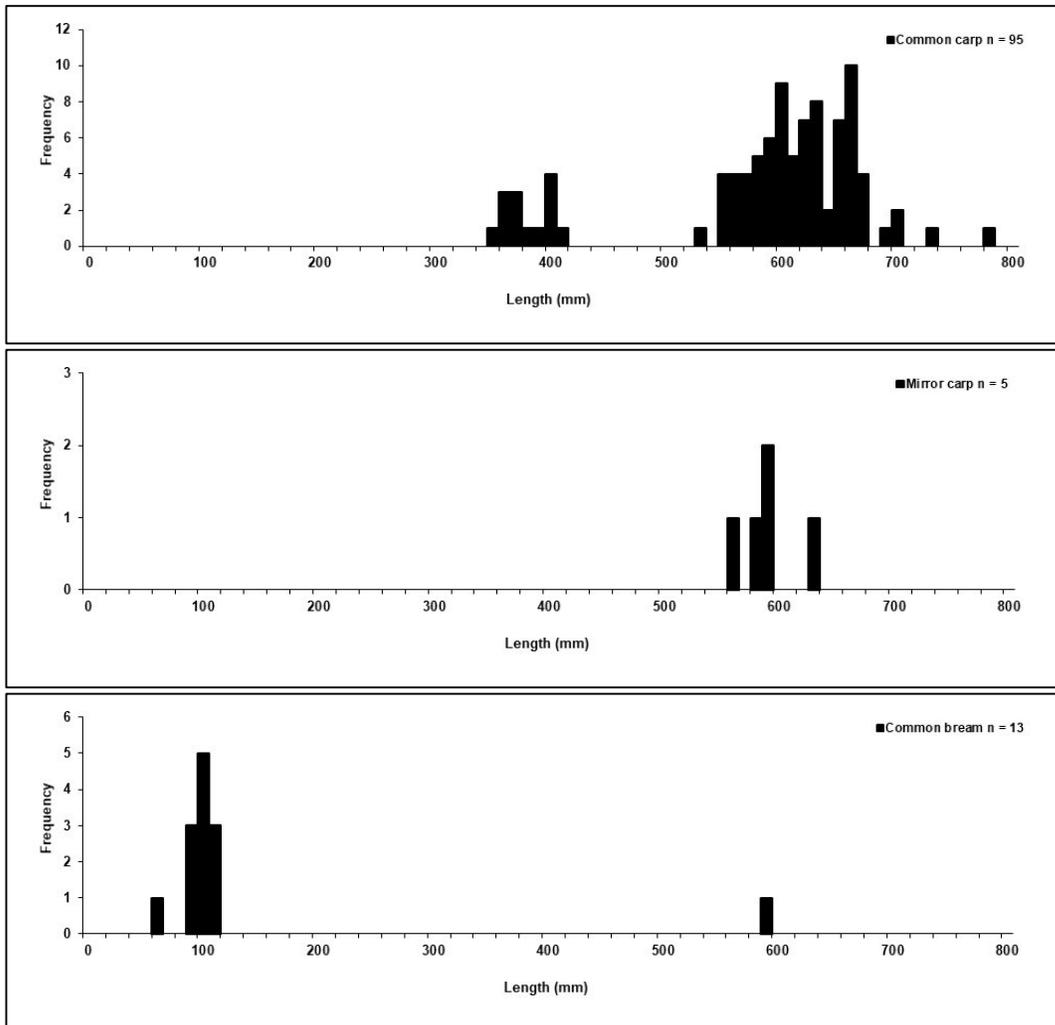


Figure 3.3: Length frequency histograms for carp (common & mirror) and common bream



Figure 3.4 Left to right. Top row: mirror carp and large common carp. Middle row: large common bream and large rudd. Bottom row: large roach and juvenile common carp (with interesting scale pattern resulting from a significant historic injury).

4.2 Water Quality

Water quality spot sample data is presented in Table 3.2.

Table 3.2: Water quality results

Parameter	Recorded Value
Dissolved oxygen (DO) (mg ^l ⁻¹)	10.12
Dissolved oxygen (DO) (%)	91.3
pH	8.02
Water temperature (°C)	10.4
Conductivity (µcm ⁻¹)	185.7

5 Discussion

The catch results show carp dominate in terms of numbers and biomass with 100 caught in total ranging from 1lb 14oz to mid-20lb. The length frequency histograms for common carp show a substantial contingent of medium sized carp of 8 - 15lb plus a few individual specimens up to approximately 25lb. In addition, there is a cohort of smaller carp (350 - 420mm in length) of 2 - 5lb which indicates successful in situ spawning from the summer of 2014 or 2015, however, illegal fish introductions cannot be eliminated due to the public nature of the site. The data for carp should be viewed as a minimum estimate; a number of fish were seen to escape the seine nets during retrieval and the results represent a sample of the fish stock rather than the absolute population of the whole lake. It is assumed that a considerably larger carp population is likely to exist in Heath Pond but exact numbers are unknown.

Generally, in a 'natural' mixed fishery we would expect the density to be heavily weighted towards juvenile bream, roach and rudd (silver fish) or perch. It was expected to catch greater numbers of silver fish during the survey but the numbers of these species in the catch was very low. Cool winter water temperatures aggregate shoals of silver fish to deeper water and the deepest area in the centre of the lake was not sampled because of the presence of mooring buoys. However, water temperatures were relatively mild (10 °C) and fish would be expected to be present in the sampled areas. Common bream and roach show recent successful spawning and adult fish were caught, but the significant population of large bream reported pre-2009 is believed to have declined.

Other common species reported to be present pre-2009 were tench, perch and pike but none were recorded during the survey. Tench are a cryptic species which tend to be under-represented in seine netting samples and the absence of perch and pike may be explained by the fact that these species tend to aggregate with their prey (silver fish) which were not encountered in any numbers. However, if perch or pike are currently present it is likely at low densities. One specimen eel was caught weighing just over 3lb which is likely to have entered the lake as a juvenile via the lake outfall.

The Environment Agency (EA) provide fish stocking density recommendations (see Appendix 2) based on three levels of management of a recreational fishery; natural, improved and intensive. The minimum biomass estimate for Heath Pond is 50.5kg per ha (45.5lb per acre). This compares favourably with the 'natural' stocking density recommended by the EA of 200lb/acre. However, this stock density figure has the potential to be misleading as it only represents the minimum estimate and actual stocking density will therefore be greater. In addition, the carp will continue to grow increasing biomass further. High biomass fisheries face increased risk of disease/virus, poor water quality and poor growth rates; all leading to increased risk of fish mortality. In addition, diversity of other aquatic organisms (invertebrates and macrophytes) is reduced with an impact on the overall ecological value of the waterbody. We have made recommendations below in terms of long-term fish stock management which should be considered with the aim of ensuring a diverse aquatic environment that supports a balanced natural fishery.

Water quality spot sampling data show a combination of low conductivity (expected based on the surrounding acidic sand and peat heathland soils) and relatively alkaline pH; unexpected given the geology. This is of note for future management of the lake as it may suggest nutrient enrichment (eutrophication) is a potential issue and this is a primary factor in the development of algal blooms. It is important to highlight that fish are not the only source of nutrients at Heath Pond; surface water inputs, anglers bait, water fowl and associated feeding are also potential sources of nutrients and eutrophication. Spot sampling provides a snap-shot of water quality only. To completely understand potential changes in water quality, especially in relation to nutrients which cause algal blooms, regular water quality testing is recommended; without this information assessments of water quality and the potential for future algal blooms are merely assumptions.

6 Recommendations

Heath Pond is dominated by carp with a potential for long-term increases in numbers and biomass from natural growth and recruitment. High biomass of carp has the potential to effect diversity of wider aquatic ecology and water quality, specifically nutrients. High level of nutrients has the potential to result in algal blooms during summer and die back of those blooms can lead to dissolved oxygen decreasing to lethal levels for fish leading to mortality events. The following recommendations are provided for consideration with the aim of creating a long-term self-sustaining natural fishery with low risk of re-occurrence of large-scale fish mortality events.

6.1 Fish Stock Management

To maintain Heath Pond as a natural, balanced and self-sustaining fishery that provides opportunities for a range of recreational angling, we suggest the following recommendations:

- No fish should be introduced / stocked with an aim to create a self-sustaining fishery focussed on natural fish recruitment allowing fish species at low densities to continue to recover.
- Thinning of the carp within the next 2-3 years should be considered, focussed on removing medium sized fish. This will reduce potential pressure on water quality, improve growth rates of the remaining fish and their general health. Importantly this leaves juvenile carp to grow on thus ensuring the future of the carp population/fishery and retaining the large individuals that are desirable to recreational anglers.

6.2 Water Quality Management

To understand any changes in water quality, levels of nutrients, the risk of future algal bloom events and subsequent fish mortalities the following measures are recommended:

- Regular monitoring of water quality, specifically nutrients.
- Investigating potential water quality inputs associated with misconnections that may also be a source of nutrients.
- Review angling club rules in relation to bait introduction with a focus on ensuring excessive volumes of bait are not introduced.
- Reduce the amount of wildfowl feed being introduced by the public.

7 Appendix 1

Heath Pond habitat improvement General Arrangement Drawing.

