



Appendix 7.6

FRESHWATER ECOLOGY SURVEYS

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ECOLOGY**
EST. 2007
Specialising in aquatic ecological survey

Broadwater Lake Assessment 2024 Macrophyte Report

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SUMMARY

Macroinvertebrate and macrophyte surveys of Broadwater Lake were conducted in 2024 to determine the quality of the aquatic communities in the lake. This report concerns the aquatic macroinvertebrates.

Five macroinvertebrate samples were taken using the Standard three-minute kick-sweep technique, with sample sorting and identification to TL5, mixed taxon and the macroinvertebrates were identified to species level where possible/practical. Analysis of data was undertaken using water quality indices and community conservation indices.

The BMWP quality bands were between 'fair' and 'good'. A difference in quality bands at one site suggests an influence other than organic pollution may be affecting the fauna. In the absence of any known water quality issues, and given the apparent poor, uniform quality of the marginal areas of the lake, it would seem that poor habitat quality is restricting the macroinvertebrate fauna in the lake.

Broadwater Lake was found to have 'Moderate' to 'Fairly High' conservation value, but no rare macroinvertebrates were found. The lake is considered to have the potential to support a much more diverse and conservation rich community through management. Improving the bank profile and reducing the tree cover would allow for a greater diversity of macroinvertebrates.

The presence of Invasive Non-Native Species (INNS) signal crayfish and demon shrimp in the lake will have a negative impact on the macroinvertebrate fauna.

INTRODUCTION

Bywater Ecology has been appointed by Harper Environmental Ltd. to undertake surveys of Broadwater Lake in 2024 to monitor the aquatic macroinvertebrate and macrophyte communities in the lake.

The aim of the project is to determine the biological quality of Broadwater Lake to assess whether improvements to the lake habitat to increase the biodiversity of the lake are recommended as part of a proposed new water sports and outdoor activity facility near the southeast bank of Broadwater.

The site is located off Moorhall Rd, Harefield, Middlesex, UB9 5HJ, OS Map Reference TQ 045 884. The lake is approximately 19 hectares in size with the River Colne along the north and west banks and the Grand Union Canal along the east bank. Access is along a lane to the sailing club off Moorhall Road.

The majority of the lake is surrounded by dense tree cover, with willow (*Salix* spp.) being dominant along much of the perimeter.

Broadwater Sailing Club (BSC) is situated on the northern bank of the lake, and there are several pontoons and slipways.

A walkover survey was undertaken on 9th May 2024 with Steph Harper of Harper Environmental Ltd. and Richard Weston of Hillingdon Borough Council to understand the layout of the site. A stand-up paddleboard (SUP) survey was undertaken on Broadwater Lake on 4th June 2024 to select sites for monitoring aquatic macrophytes and macroinvertebrates, and previous reports of surveys conducted at Broadwater Lake from Greengage and Fiver Rivers were assessed.

The results of the macroinvertebrate survey undertaken in June 2024 are presented in this report. Macrophytes were surveyed at the same locations on the same occasion. The results of these are presented in a separate report.

METHODS

Surveys were conducted at evenly spaced locations around Broadwater Lake to give a good coverage of the entire lake. Sites that had been previously sampled by Five Rivers in a study of the macroinvertebrates and fish in 2023 were used where possible, and if suitable, for continuity of data. It was not possible to survey one of the sites suggested by Steph Harper at the location of the proposed water activity centre, as the banks were very high and deep at this site with a crumbling fishing platform. The site numbering of all sites was adjusted from that used for the preliminary survey to remove this site.

Standard three-minute kick-sweep samples were taken at each site using a 1mm mesh net, followed by a 1-minute timed manual search following the Environment Agency (2017) procedure which conforms to BS EN ISO 10870:2012 Water Quality – Guidelines for the selection of sampling methods

and devices for benthic macro-invertebrates in fresh waters (BSI, 2012). In this method, sample effort is proportionate to the amount of a given habitat present up to three minutes, with further time, up to a maximum of one minute spent searching for animals which may otherwise have been missed in the 3-minute sample. The samples were placed in labelled buckets and preserved in 70% industrial denatured alcohol (IDA) for sorting in the laboratory.

Invertebrate sorting and identification methods followed standard laboratory techniques. Invertebrate samples were identified to Taxonomic Level 5 (TL5) in adherence with the Environment Agency (2014) procedure, which involves species level identification for most groups where possible. In the laboratory, the samples were washed, placed in a white tray a small handful at a time with clean water, and the different macroinvertebrates removed and identified with the aid of a low power stereo zoom microscope, and a high-power microscope where necessary for fine detail (eg. to examine gills). The number of individuals of each taxon present were counted where possible and estimated by subsampling where numbers were too large.

The use of the standard sampling method enables the data to be used to determine water quality using the Biological Monitoring Working Party (BMWP) score and its derivative, the Average Score Per Taxon (ASPT) (Chesters, 1980). In the BMWP scoring system different types of invertebrates are assigned scores (from 1 to 10) depending on their tolerance to organic pollution, and these indices have been used nationally in the biological surveillance of water quality.

The BMWP scores and ASPTs are split into bands as follows;

BAND	BMWP Score	ASPT	Biological quality
A	Over 150	Over 5.4	Very good biological quality
B	101 – 150	4.81 – 5.4	Good biological quality
C	51 – 100	4.21 – 4.8	Fair biological quality
D	16 – 50	3.61 – 4.2	Poor biological quality
E	0 – 15	3.6 or less	Very poor biological quality

Fiver Rivers (2023) used the BMWP scoring index, so that scoring system has been included in this report for comparison, but the Environment Agency (2019) have replaced BMWP by Walley Hawkes Paisley Trigg (WHPT) river invertebrate index to improve the accuracy of invertebrate assessments by taking abundance into account, thus making better use of the data. WHPT index values are on the same scale as BMWP.

The conservation value of the macroinvertebrate fauna was also evaluated for each sample using the Community Conservation Index (CCI) developed by Extence et al (1996) for the future management of the ditches. In the CCI scoring system, the species are each allocated a score according to their rarity (the rarer the species, the higher the score), and the average conservation score is multiplied by the community score. The latter is either the score of the rarest species or a score allocated to BMWP bands depending on which is highest. This allows diverse macroinvertebrate assemblages to be recognised as well as rare species.

CCIs can range from 0 to >40, but a general guide to interpretation of scores is as follows:

Score	Description	Conservation Status
0.0 to 5.0	Sites supporting only common species and/or a community of low taxon richness	Low conservation value
5.0 to 10.0	Sites supporting at least one species of restricted distribution and/or a community of moderate taxon richness	Moderate conservation value
10.0 to 15.0	Sites supporting at least one uncommon species, or several species of restricted distribution and/or a community of high taxon richness	Fairly high conservation value
15.0 to 20.0	Sites supporting several uncommon species, at least one of which may be nationally rare and/or a community of high taxon richness	High conservation value
>20.0	Sites supporting several rarities, including species of national importance, or at least one extreme rarity (e.g. taxa included in the British RDBs) and/or a community of very high taxon richness	Very high conservation value

RESULTS AND DISCUSSION

Five sites were sampled for macroinvertebrates, numbered 1 to 5, in the mid shore survey point of the macrophyte survey (figure 1).

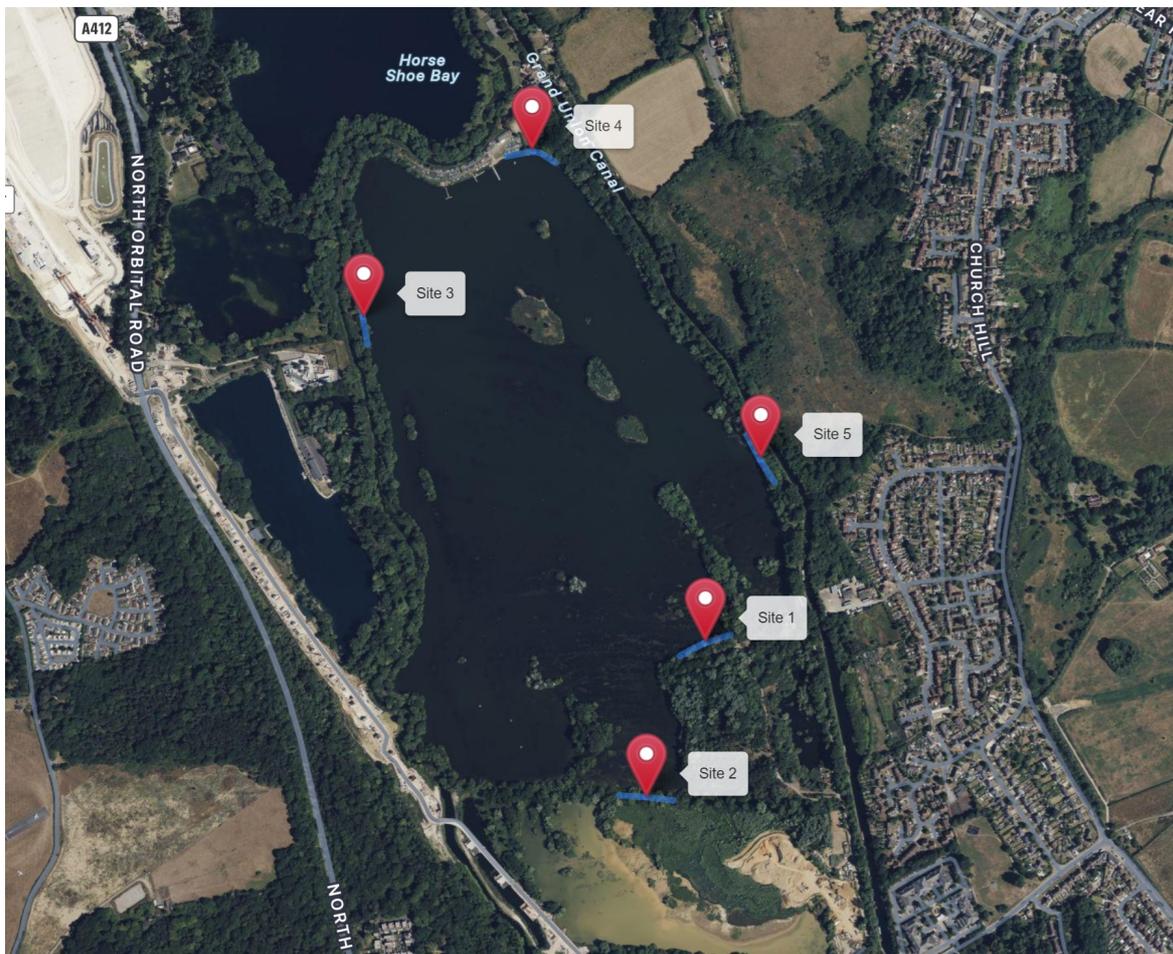


Figure 1. Location of Macroinvertebrate and Macrophyte Sampling Sites

The grid references of each macroinvertebrate sampling location are presented in table 1 below along with the substrate present at each site. Photographs taken at each site are presented in appendix 1.

Table 1. Macroinvertebrate Sample Site Grid references and Substrate

Site	Grid Reference	Silt	Sand/Gravel	Cobbles	Boulders
1	TQ 04630 89314	30	63	5	2
2	TQ 04530 89026	75	24	1	0
3	TQ 03997 89894	50	40	10	0
4	TQ 04298 90205	50	50	0	0
5	TQ 04725 89650	60	40	0	0

Site 1 was located on the northern bank of the peninsula located on the southern shore of Broadwater Lake. It is near the location of the proposed activity center. There was a small stand of emergent marginal vegetation and a few rocks on a gravel bed with some silt. Trees covered the bank to the east.

Site 2 was on the southern shore. The site sampled by Five Rivers further to the west was inaccessible due to the growth of brambles and other scrub and shrubs, so this site was selected as a better alternative for long term monitoring. The open section where the macroinvertebrate sample was taken was the only section along this shore that had a stand of aquatic marginal vegetation. Elsewhere, the shore was heavily shaded by trees, and trees were growing into the lake to the east of the site. There were lots of fine tree roots present in the water with no aquatic macrophytes growing.

Site 3 was on the western shore in the northern section of the lake. Emergent and floating leaved plants were present at this sampling location. This site was accessed from the water so in future, a path will need to be established along the shore for safe access. The bank was heavily shaded to either side of the sampling site with a lot of leaf and twig litter on the lake bed.

Site 4 was on the north eastern shore to the east of the sailing club. There were no trees along the bank in front of the sailing club, and there were a marginal plants all along, but to the east of the sampling site, the bank was heavily shaded by trees with no marginal plants and leaf and twig litter on the lake bed which had a mix of sand and gravel, and silt. There was brick debris near the bank.

Site 5 was located on the eastern shore, A track to the sailing club ran alongside, with the Grand Union Canal on the other side of it. The substrate was composed of an even mix of silt and gravel/sand. The sample was taken next to a submerged fishing platform in an open area. The shore was gently sloping at this location and emergent marginal sedge and broad leaved plants were present. There was a large amount of twig debris and leaf litter with heavy shade from trees to either side along the shore.

Weather Conditions

In June 2024, the weather was dry, warm and sunny with 90 percent cloud cover. The air temperature was 17 degrees Celcius, with 61 percent humidity and there was a gently breeze at times of 4 miles per hour in a north north easterly direction.

Macroinvertebrate Fauna

The species data for each site is presented in appendix 2 and the macro-invertebrate metric scores are presented in Table 2.

Table 2. Broadwater Lake Macro-invertebrate metric scores

Site	1	2	3	4	5
BMWP	108	82	83	88	108
BMWP N-Taxa	22	18	17	20	21
BMWP ASPT	4.91	4.56	4.88	4.40	5.14
WHPT Total	96.50	70.7	81.2	85.3	97
WHPT N-Taxa	25	19	19	22	23
WHPT ASPT	3.86	3.72	4.27	3.88	4.22
CCI Score	8.70	10.00	8.44	11.05	8.54
Number of Species	31	25	23	27	33

Biotic Scores

The BMWP scores, ranging from 82 at site 2 on the southern shore to 108 at sites 1 on the southern shore peninsula and 5 on the western shore. The scores at latter two sites indicated that they were of “good” quality, while the other sites are in the middle band having “fair” biological quality. Top-scoring pollution sensitive caddisflies were recorded at all sites. Previously, Fiver Rivers found that their equivalent sample to our Site 1 had the greatest BMWP.

The WHPT scores ranged from 71 at site 2 to 97 at sites 1 and site 5 on the eastern shore (figure 2), so when the abundance of the various taxa is considered, the same pattern of biological quality is seen amongst the sites.

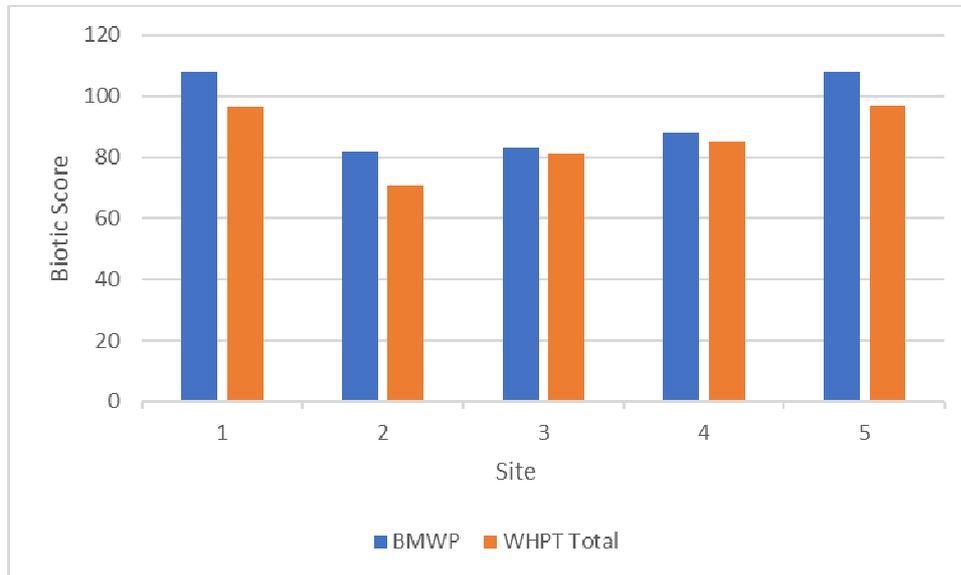


Figure 2 . Macro-invertebrate BMWP and WHPT Scores at Broadwater Lake

Number of Taxa

All sites had a similar number of scoring taxa (figure 3). The number of BMWP scoring taxa (N-taxa) was between 17 and 22 and the WHPT N-taxa was between 19 and 25, indicating that more species were

included in the analysis for the latter. The peninsula on the south bank had the highest N-taxa while the south and west shores had the lowest BMWP N-taxa.



Figure 3 . Macro-invertebrate BMWP and WHPT N-Taxa at Broadwater Lake

Average Score Per Taxon

The BMWP ASPT scores indicated good water quality at sites 1, 3 and 5, and fair quality at sites 2 and 4. Top-scoring (pollution-sensitive) caddisflies belonging to three different families were found at site 3 on the western shore, but only one or two families were found at the other sites. The WHPT ASPT ranged from the western shore, but only one or two families were found at the other sites. The WHPT ASPT followed a similar pattern so including the abundance did not affect the biological quality rating.



Figure 4 . Macro-invertebrate BMWP and WHPT ASPT at Broadwater Lake

Number of Species

The number of species recorded in each sample is presented in figure 5. Where taxa were not identified beyond family or genus, these were counted as one species for inclusion. This chart also includes non-scoring taxa. There were between 25 (Site 2) and 31 (site 5) species at each site. Most families, twenty-

one, had only one species represented in the samples. The exceptions to this were the lesser water boatmen, corixidae, of which there were 4 species, plus two genus that could not be identified further due to their life stages, hydrophilide beetles and limnephilidae caddisflies where 2 species were recorded, and several snail families had between 2 and 5 species represented. The crustacean families astacidae, and gammaridae each had 2 species present in the lake, but one of each was an alien invasive species. Similarly, the physidae snails had one native and one invading species.

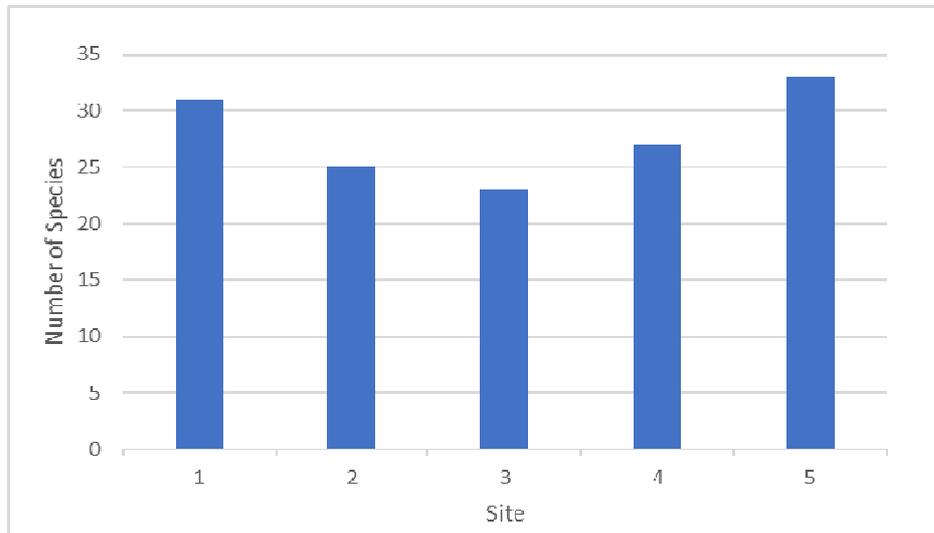


Figure 5 . Macro-invertebrate Number of Species at Broadwater Lake

CCI Scores

All sites were of moderate conservation value, sites supporting at least one species of restricted distribution and/or a community of moderate taxon richness, except for site 4 near the sailing club which was a site of fairly high conservation value, scoring 11.05 (Chadd et al 2004) (figure 6). The CCI scores at site 2 was at the top end of the moderate band. Sites 2 and 4 had two taxa scoring 5.

Overall, there were three species with a conservation score of 5 recorded from this survey (table 3). No species were found scoring greater than 5.

Family	Species	CS Score	CS Definition	IUCN Conservation Status	Abundance				
					Site 1	Site 2	Site 3	Site 4	Site 5
Bithyniidae	Bithynia leachii	5	Local	Least Concern	25	36	2	18	18
Erpobdellidae	Erpobdella testacea	5	Local	Least Concern				4	
Corixidae	Sigara concinna	5	Local	Least Concern		1			

Table 3 . Conservation Status of High Scoring Species at Broadwater Lake

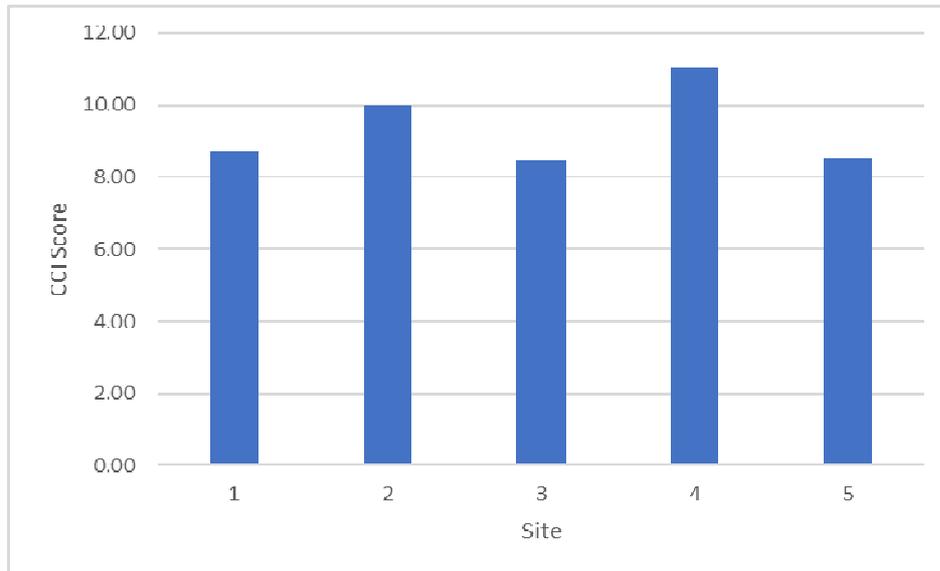


Figure 6 . Macro-invertebrate CCI Scores at Broadwater Lake

The CCI scores in Fiver Rivers study ranged between 9.81 and 22.50. They recorded two different species of corixidae scoring 5, *Cymatia coleoptrata* and *Corixa panzer*, a dragonfly larva scoring 6, and 2 caddisfly species, *Ecnomus tenellus* scoring 6 and *Leptocerus lusitanicus* scoring 8. The site where the latter species, a Red Data Book 3 (Rare) species was found was not surveyed on this occasion as the site had become overgrown with brambles and other vegetation and was not accessible. It is possible that the two corixidae species were present, as nymphs that were not identified further were present in this family.

INNS

Twenty-nine North American signal crayfish, *Pacifasticus leniusculus*, were caught in total whilst hand netting for three minutes at each site. North American signal crayfish are a highly invasive species which have a detrimental effect on habitats, macrophytes, macro-invertebrate populations and fish. They outcompete native species for food and shelter, and prey upon them too. Once they become established in a waterbody, eradication is almost impossible.

Dikerogammarus haemobaphes is a species of freshwater gammarid crustacean. These gammarids are commonly known as demon shrimp, likely because they are an extremely successful invasive species. They expanded their range in from the Ponto Caspian in 1955 and then spread into certain rivers and lakes in Austria, Belgium, Germany, Poland, Russia, Ukraine, and the United Kingdom. The Water Framework Directive UKTAG aquatic alien species impact risk is High. (<https://species.nbnatlas.org/species/NHMSYS0021050246>).

These species impact native flora and fauna leading to decreased diversity in the invaded range by competing with or preying upon a broad range of invertebrates.

The acute bladder snail, *Physella acuta*, is considered to be an invasive species within the United Kingdom. It is a prolific species that has undergone naturalisation and has been observed in several great rivers, streams and tributaries within England, Wales, Scotland and Northern Ireland. The ecological impact of this invasive species to the native floral and faunal species of the United

Kingdom was assessed by the United Kingdom Technical Advisory Group (UKTAG) as "Unknown" under the Water Framework Directive guidelines for Alien species. (<https://species.nbnatlas.org/species/NHMSYS0001702159>).

Engaging with stakeholders and promoting the Check, Clean, Dry process will help slow the spread of these alien invaders.

CONCLUSIONS

The BMWP quality bands indicated the lake was between 'fair' and 'good' biological quality with only slight variation in scores between the sites. Sites 1 and 2 had a slightly more diverse community and site 3 on the south shore had the lowest score. The ASPT scores were in the 'good' biological quality bands for sites 1, 3 and 5, indicating that pollution sensitive species were present. The other two sites were ranked as 'fair' using the ASPT. This difference in bands seen at site 3 suggests that something other than organic pollution is affecting the macroinvertebrate fauna. This could be either toxic pollution or habitat quality. In the absence of any known water quality issues, and given the apparent poor, uniform quality of the marginal areas of the lake, it would seem that poor habitat quality is restricting the macroinvertebrate fauna in the lake. When the abundance of species was also considered using the WHPT scores, the scores followed a similar pattern consistent with the BMWP scores.

Most of the sites in Broadwater Lake were classified as having 'Moderate' conservation value, except for one site that was 'Fairly High', but no rare macroinvertebrates found at any of the sites. The lake has the potential to support a much more diverse and conservation rich community through management because pollution sensitive taxa were present, so water quality would not seem to be the limiting factor.

Improving the bank profile and reducing the tree cover on the shore to allow more areas where various aquatic macrophytes can colonise and establish in the margins would create habitat for a diverse range of macroinvertebrates.

The macroinvertebrate sampling were taken at the optimum habitat around the lake. Much of the habitat around the lake was poor for macroinvertebrate colonisation with steep banks, no marginal vegetation and dense shading from trees. The presence of a large amount of leaf and twig litter lends itself to colonization by grazers such as hog-lice and omnivores like the signal crayfish in large numbers.

The presence of alien signal crayfish and demon shrimp in the lake will have a negative impact on the macroinvertebrate fauna, and this, along with the limited habitat availability around the lake.

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Appendix 1. Photographs



Site 1



Site 2



Site 3



Site 4



Site 5



Sailing club at Site 4

Appendix 2. Macroinvertebrate Taxa found at each site

BMWP Family	Taxa ID	Site 1	Site 2	Site 3	Site 4	Site 5
Planariidae	Polycelis tenuis					1
Dendrocoelidae	Dendrocoelum lacteum	1				1
Hydrobiidae	Potamopyrgus antipodarum	4		36	2	44
Bithyniidae	Bithynia leachii	25	36	2	18	18
Bithyniidae	Bithynia tentaculata	5			9	4
Physidae	Physa fontinalis	3	8	6		1
Physidae	Physella acuta		4			1
Lymnaeidae	Radix balthica	12	16	3	7	8
Planorbidae	Planorbis carinatus	42	44		16	17
Planorbidae	Gyraulus albus	55	20	8	15	6
Planorbidae	Hippeutis complanatus	5			1	
Ancylidae	Ferrissia wautieri			14		
Sphaeriidae	Sphaerium corneum	3	2	5		3
Sphaeriidae	Musculium lacustre				4	
Sphaeriidae	Pisidium henslowanum					4
Sphaeriidae	Pisidium nitidum			9		30
Sphaeriidae	Pisidium subtruncatum			1		5
Oligochaeta	Oligochaeta	1	2		3	
Glossiphoniidae	Helobdella stagnalis	13	2		3	2
Erpobdellidae	Erpobdella testacea				4	
Hydracarina	Hydracarina	2	1	1	1	1
Ostracoda	Ostracoda					1
Astacidae	Pacifastacus leniusculus	6	8	9	3	3
Asellidae	Asellus aquaticus	209	528	30	93	162
Gammaridae	Crangonyx pseudogracilis	30	480	32	40	52
Gammaridae	Dikerogammarus haemobaphes	4	4	11	3	1
Caenidae	Caenis horaria	1				
Coenagriidae	Ishnura elegans	1				
Nepidae	Nepia cinerea	1				
Naucoridae	Ilyocoris cimicoides	5	8		3	
Notonectidae	Notonecta sp	8	15	27	15	12
Corixidae	Micronecta sp					1
Corixidae	Corixa sp nymph	8	12	5	5	12
Corixidae	Callicorixa praeusta		1			
Corixidae	Sigara concinna		1			
Corixidae	Sigara dorsalis	2	5	4	5	3
Corixidae	Sigara falleni	4				
Haliplidae	Haliplus flavicollis				1	
Noteridae	Noterus clavicornis				1	
Dytiscidae	Laccophilus hyalinus	6	8	6	4	1
Hydrophilidae	Enochrus testaceus					1
Hydrophilidae	Helophorus sp				1	
Sialidae	Sialis lutaria		2	8	5	5
Polycentropodidae	Holocentropus picicornis			1		
Phryganeidae	Phryganea bipunctata	4	2		1	2
Limnephilidae	Anabola nervosa	1				
Limnephilidae	Limnephilus lunatus			1		1
Molannidae	Molanna angustata					1
Leptoceridae	Mystacides longicornis	8	1	1		3
Chironomidae	Chironomidae	184	160	142	102	96
	Sciomyzidae	1				
BMWP		108	82	83	88	108
BMWP N-Taxa		22	18	17	20	21
BMWP ASPT		4.91	4.56	4.88	4.40	5.14
WHPT Total		96.50	70.7	81.2	85.3	97
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