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Specialising in aquatic ecological survey

Broadwater Lake Assessment 2024 Macrophyte Report

By Julie Bywater, Bywater Ecology

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 macrophytes.

Five macrophyte surveys were conducted using the Common Standards Monitoring (CSM) guidance for freshwater lakes (JNCC, 2015), whereby the combined species recorded from transects along a 100m sector and a boat survey are recorded along with a shoreline survey.

*The number of aquatic species found at each sector ranged from 11 to 20. This is considered to be poor in terms of number of species. Fennel pond-weed (*Stuckenia pectinatus*) was the dominant species of the submerged macrophytes*

*Only one species of stonewort, *Chara vulgaris* var *papillate* was recorded and only at five survey points, although one of these was a large patch 40m².*

The filamentous algae cover was not dominant in Broadwater Lake, indicating that the aquatic vegetation is not particularly represented by nutrient tolerant taxa.

The marginal stands of emergent macrophytes were limited to a few short lengths of open shore between the trees that dominated the shoreline shading it and thus restricting aquatic plant growth. The macrophyte cover is therefore considered to be poor in terms of its surface area coverage as well as species diversity.

The non-native invasive elodeid species Nuttall's pondweed was recorded in this survey, along with Himalayan Balsam and Japanese knotweed japonica on the banks. Promoting the Check, Clean, Dry process will help slow the spread of these alien invaders.

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.

Macrophytes provide habitats for fish and smaller animals; they bind sediments, protect banks, absorb nutrients and provide oxygenation.

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 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 macrophyte survey undertaken in June 2024 are presented in this report. Macroinvertebrates were undertaken at the same locations at the mid shore survey point. The results of these are presented in a separate report.

METHODS

Survey Location

Surveys were conducted in detail at five locations around Broadwater Lake to give a good coverage of the entire lake (figure 1). 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. This made sampling dangerous, and of little value since there was no marginal area for plants to establish. The site numbering of all sites was adjusted from that used for the preliminary survey to remove this site.

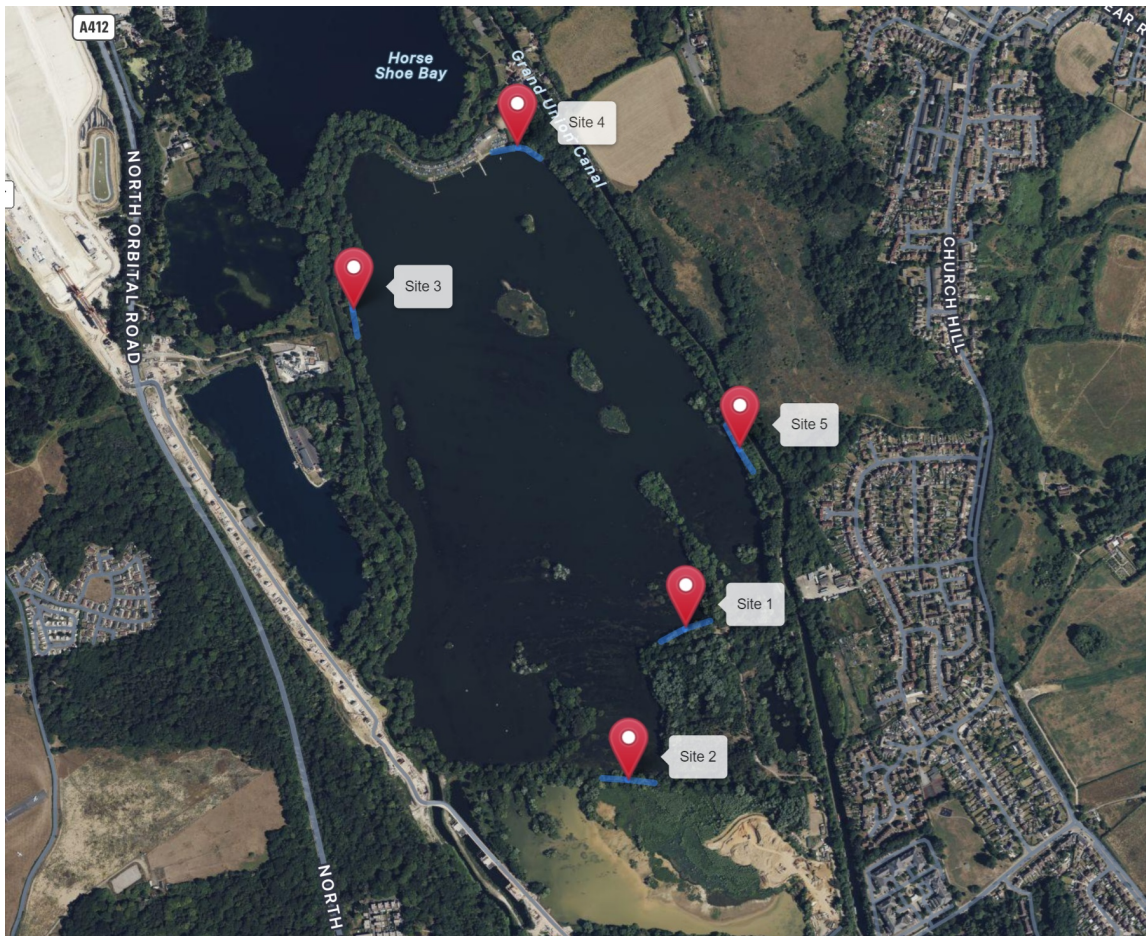


Figure 1. Location of Macroinvertebrate and Macrophyte Sampling Sites

Grid references for the survey sections are presented in table 1.

Table 1. Survey Sections and Transact Grid references

Site	Wader Start	Wader Mid	Wader End	Boat Start	Boat End
1	TQ 04587 89288	TQ 04630 89314	TQ 04678 89331	TQ 04417 89575	TQ 04630 89314
2	TQ 04481 89033	TQ 04530 89026	TQ 04678 89331	TQ 04354 89582	TQ 04530 89026
3	TQ 03991 89947	TQ 03997 89894	TQ 04007 89845	TQ 04054 89915	TQ 03997 89894
4	TQ 04343 90184	TQ 04298 90205	TQ 04295 90121	TQ 04295 90121	TQ 04298 90205
5	TQ 04755 89608	TQ 04725 89650	TQ 04700 89695	TQ 04535 89633	TQ 04725 89650

Survey Method

The method undertaken followed the Common Standards Monitoring (CSM) guidance for freshwater lakes (JNCC, 2015). In this method, a 100m sectors are surveyed. In most lakes four 100 m sectors are expected to give a representative sample. In large, complex water bodies (typically >100 ha in area), where many aquatic plant species are present, consideration should be given to increasing the number of sectors to (e.g.) six or eight, whereas in smaller water bodies <5 ha, two or three 100 m sectors may be sufficient to characterise the water body. Work at each sector involves a strandline and perimeter survey search, and a number of short transects, from shallow to deep water (a wader survey), and a single boat transect, from deeper water to shallow water (a boat survey). Both boat and wader surveys are necessary components of the CSM survey, and the results are pooled when looking at targets.

Five sites were selected for monitoring the macrophytes from both the shore and using SUPs for the 'boat' survey following the Common Standards Monitoring Guidance for Freshwater Lakes (2015).

Along the strandline of each 100m sector, presence / absence data was recorded as 'S' for stranded if washed up, and 'G' if growing at the water's edge. The results of the strandline survey are not normally part of assessments of frequency of occurrence of species, or groups of species. However, they should be used when examining targets for presence of characteristic species. They may also be used if practical problems are encountered in undertaking wader or boat surveys.

Wader survey transects for each 100 m sector, include 20 quadrats (or sampling points), each covering an area of 1 m². Five transects from the shore to deeper water were spaced at 20 m intervals along the 100 m sector, with 1m² quadrats taken at 25cm ('a'), 50cm ('b'), 75cm ('c') and greater than 75cm ('d') depths for each transect. In addition, a grapnel haul of 4 m length was undertaken parallel to the shore, at 0.25 m, 0.5 m and 0.75 m depth. At >0.75 m depth, a 4m grapnel haul was also taken perpendicular to the shore.

All species present were noted and the vegetation assigned an abundance score of 0-3 where 0 is bare substrate, 1 is <25% cover, 2 is 25-75% cover and 3 is >75% cover.

The boat transects were located at the 50m midpoint on the 100m sector. The transects began at the maximum depth of macrophyte colonisation. At each of 10 regularly spaced sampling points an area of lake bed of 1m² was examined, or if visibility was poor, a grapnel haul was carried out. Where the colonisation depth exceeded the maximum depth, transects stopped half way to the opposite shore.

The grid reference of each survey location was recorded using GPS. A secchi disc was used to measure water transparency or turbidity in the lake. Photographs were taken at each transect.

RESULTS & DISCUSSION

Weather Conditions

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

Site Locations

The location of the shore survey start, mid and finish points and boat survey transects for sites 1 to 5 are presented in Figures 2 to 6 respectively below. The blue line indicates the extent of the shoreline survey, with wader transects located at the start (0m), and 20m, 40m 60m and 80m along from the start. The boat surveys start at the location of maximum depth of colonization from the shore labelled 'Boat' and end at the mid-point of the shore survey. Where maximum depth of colonization exceeds the maximum depth of the lake, transects start halfway across to the opposite shore. The maximum depth of colonization for each site is presented in table 2.

Table 2. Maximum depth and average depth of colonization

Site	Maximum depth of colonisation (m)
1	3.7
2	4.25
3	5.5
4	4.25
5	4.25
Mean	4.39
Maximum	5.5

Section 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.

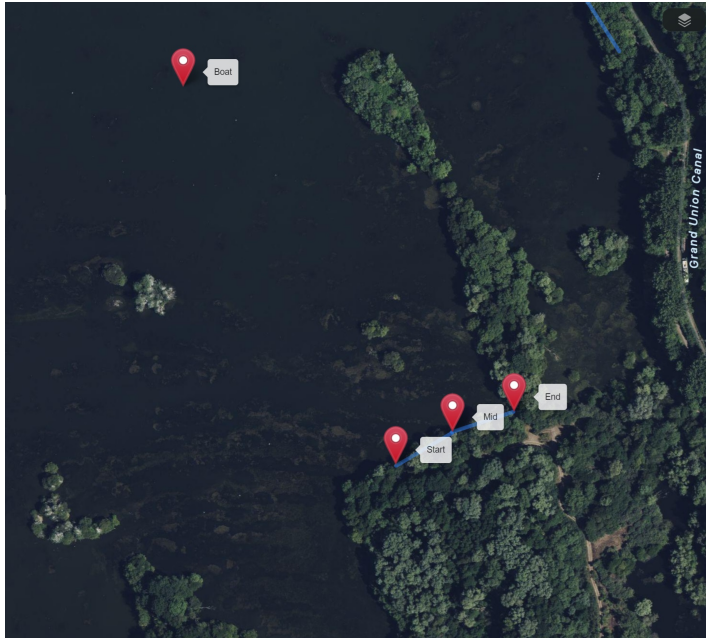


Figure 2. Section 1 Shore and Boat Survey Locations



Figure 3. Section 2 Shore and Boat Survey Locations

Section 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.



Figure 4. Section 3 Shore and Boat Survey Locations

Section 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 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.



Figure 5. Section 4 Shore and Boat Survey Locations

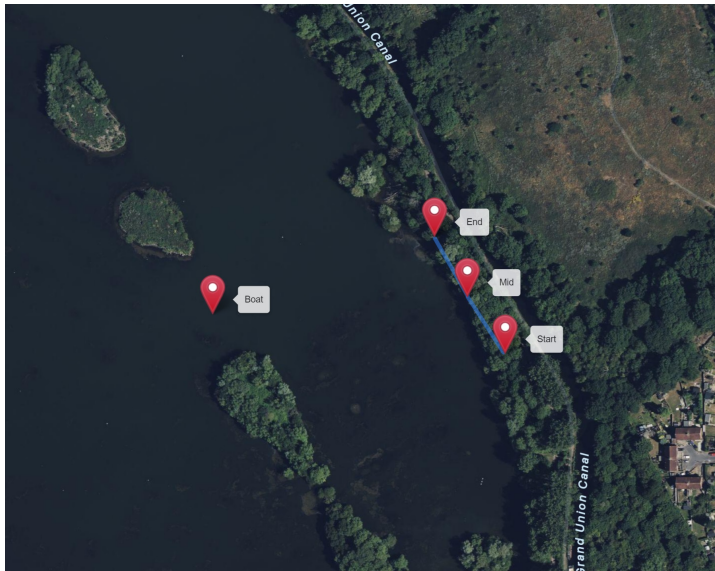


Figure 6. Section 5 Shore and Boat Survey Locations

Section 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 as 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.

Macrophyte Species

The species data for each site is presented in appendix 1. A total of forty-nine species were recorded in the lake, thirteen of which were terrestrial species recorded mainly in the strandline survey including a few saplings. This leaves thirty-six aquatic species as follows:

There were three species of algae, one species of bryophyte (a moss), one stonewort or charophyte, twenty-one emergent macrophytes, three floating leaved species and seven submerged or elodeid species.

The number and type of aquatic macrophytes at each site are presented in a chart (figure 7), excluding the species found only in the shoreline survey, and bindweed and brambles which were growing into the lake at two of the quadrats and not included in the analysis. The aquatic species were separated into groups of aquatic algae, bryophytes, charophytes, emergent marginal,

submerged, and floating plants. The emergent marginals included some species that like a ‘toe’ in the water if they were growing within the lake.

The total number of species ranged from 11 at site 3 to 20 at site 4. This is considered to be a poor species list in terms of number of species. Many of the species were mainly present in the mid sector locations at each site, which were open without trees covering the shore allowing marginal vegetation to grow. Elsewhere, trees covered the banks and marginal areas, shading them and restricting macrophyte growth. The macrophyte cover is therefore considered to be poor in terms of its surface area coverage as well as species diversity.

Site 4 was the most open, with half of the sector in front of the sailing club where there were no trees present for much of the shore. It is quite apparent that the start (0m) and 20m transects within the tree cover to the east of the sailing club had a restricted flora dominated by filamentous algae compared with the more open part from 40 to 100m where macrophyte cover was >75% at most quadrats.

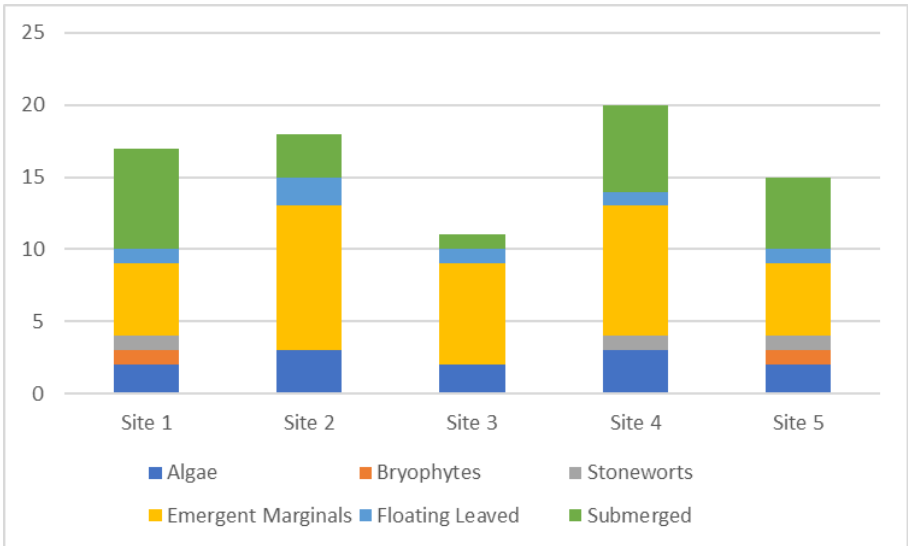


Figure 7. Number of species of each type of macrophyte at each site

The shoreline species are considered if any target species are missing from the surveys, so for completion, the total number of species of each type including the shoreline surveys are presented in figure 8.

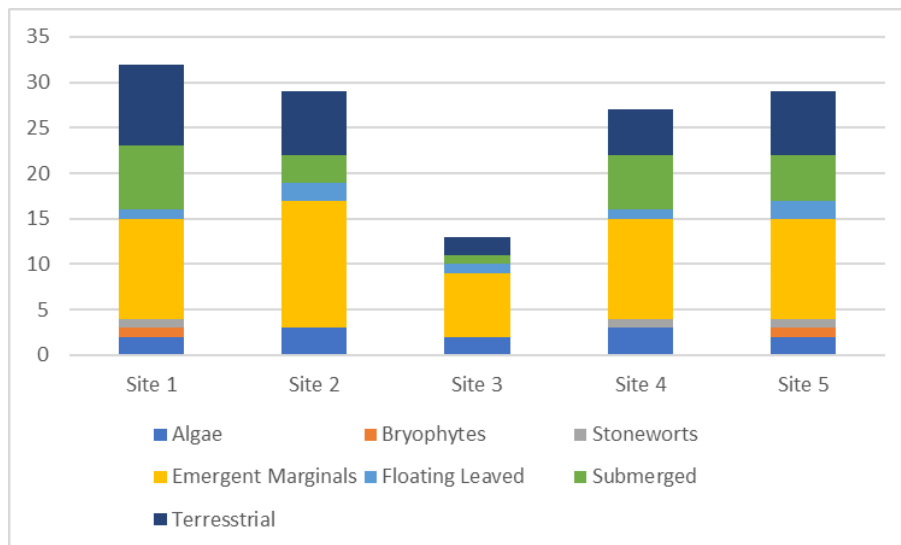


Figure 8. Number of species of each type of macrophyte including species found only in the shoreline survey at each site

In the UKTAG – Biological Status Methods Lakes – Macrophytes, the percentage relative frequency of charophytes and elodeids are two of the six measures used to determine the status, along with the relative frequency of tolerant taxa e.g. filamentous algae. This latter Indicates how much of the aquatic vegetation is represented by nutrient tolerant taxa.

i) Algae

There were two filamentous groups/species, and one thalloid species of algae, *Ulva intestinalis*. This bright-green algae grows into tubular fronds, 10-30cm in length and 6-18mm in diameter. Though principally a marine species it is found in brackish water and occasionally in freshwater, typically where eutrophic conditions exist due high nitrate pollution. (<https://www.naturespot.org.uk/search/content?keys=Ulva>). The latter was mainly floating in mats and not rooted.

The filamentous algae, *Cladophora* and *Spirogyra* sp., were present in some of the quadrats. At sites 1 and 2, eleven sites had no *Cladophora* algae cover recorded, five out of twenty quadrats had <25% cover, four had 25-75 percent cover, and none had >75% cover. Sites 3 and 5 had fifteen and seventeen sites with no *Cladophora* algae cover recorded, and five and three quadrats with <25% cover respectively. *Spirogyra* sp. was absent at these four sites. Site 4 had a higher cover of filamentous algae with seven out of twenty quadrats sites having no *Cladophora* algae cover recorded, six had <25% cover, five had 25-75 percent cover, and two had >75% cover. *Spirogyra* sp. was present in one quadrat at this site.

ii) Bryophytes

Only one moss, Kneiff's feathermoss (*Leptodictyum riparium*), was recorded in four quadrats at site 1, and one quadrat at site 5 only. This moss is a common plant and occurs in wet places in the lowlands, usually on tree bases and roots, old branches and other debris in marshes, by ponds and sluggish streams and in wet woodland. It has been reported that this species tolerates a wide range of nutrient conditions.

(<https://www.britishbryologicalsociety.org.uk/learning/species-finder/leptodictyum-riparium/>).

iii) Stoneworts

One species of stonewort, *Chara vulgaris var papillate*, was recorded at three boat quadrats at site 1 and one boat quadrat each at sites 4 and 5. A large patch of this stonewort 5m wide by 8m long was detected at the latter.

This is considered to be low in terms of species diversity and the cover within the lake. In a lake of this size more species and greater cover might be expected.

iv) Emergent Macrophytes

The twenty-one emergent macrophytes, including a few species that are more damp loving with a 'toe' in the water. Seventeen of these species were found in the combined wader transects and boat survey. Four species were only found in the shoreline survey outside of the 1m² quadrat area. None of these were considered to be rare.

v) Floating Leaved

Two of the three floating-leaved species recorded were free floating and one, *Persicaria amphibia*, was rooted in the lake bed. The free-floating species belonged to the duckweed group and included *Lemna trisulca*, Ivy-leaved duckweed, which was growing submerged on the pondweeds on the bed of the lake.

vi) Submerged

Seven submerged species were recorded of which six were fine leaved in form and one had strap-like leaves. The latter was only present in 3 quadrats at site 4 and 1 quadrat at site 5.

Fennel pond-weed (*Stuckenia pectinatus*) was found in 9 out of 20 wader quadrats and 4 out of 10 boat quadrats at site 1. A few other species were found in a few quadrats, including the alien Nuttall's pondweed (*Elodea nuttalli*). At sites 2 and 5, Fennel pond-weed and Nuttall's pondweed dominated the submerged fauna in the boat survey being present in 6 and 5 quadrats respectively at both sites. Hornwort (*Ceratophyllum demersum*) was found at low cover value in 7 quadrats at site 2 and a few quadrats at other sites. No submerged species were recorded in the wader survey at site 3, and only one species, small pondweed, (*Potamogeton berchtoldii*) was recorded at <25% cover in one boat quadrat only. At site 4, there were various submerged plants, but all were only found in between 2 and 4 quadrats of the wader survey and in one or two boat surveys except for fennel pond-weed which was found in 6 out of 10 boat quadrats.

vii) Terrestrial

Thirteen terrestrial species were recorded which were growing in the edge of the water at the strandline, and sometimes in the first couple of quadrats from the shore. These included several tree saplings, brambles, nettles, cleavers and bindweed.

Invasive Non-Native Species

The submerged species Nuttall's pondweed (*Elodea nuttalli*) was present at all sites in some quadrats of both the wader and boat surveys, except at site 3 where none was recorded.

Nuttall's pondweed grows in still or slow flowing eutrophic waters. It has replaced *E. canadensis* at many sites due to increased eutrophication and is being replaced by *Lagarosiphon major* in turn. It was first found in Europe in 1939 and in Britain in 1966. It has spread to over 4000 sites since then. It is often found in species poor macrophyte communities subject to boat traffic, management and in eutrophic drainage ditches.

(https://nora.nerc.ac.uk/id/eprint/10425/2/N010425_leaflet.pdf).

Himalayan Balsam (*Impatiens glandulifer*) was recorded in the shore survey of site 1, 2 and 5, and in some of the shallow quadrats of site 2. This plant was introduced into the United Kingdom and has become naturalized and widespread across riverbanks (Beerling et al, 1993).

Japanese knotweed (*Reynoutria japonica*/ *Fallopia japonica*) was recorded on the bank at the 20m transect location of section 1 on the peninsula. This was not recorded in the species list as it was outside of the lake margin.

Giant hogweed has been recorded on an island at Broadwater Lake (Steph Harper, pers. comms.), but none was recorded on the banks in this survey.

CONCLUSIONS

Thirty-six aquatic species were recorded in total, three species of algae, one species of bryophyte (a moss), one stonewort or charophyte, twenty-one emergent macrophytes, three floating leaved species and seven submerged or elodeid species. There were also thirteen terrestrial species within the survey area.

The species diversity was lowest at site 3 where only one elodeid species was recorded at low frequency, and highest at site 4, where the bank was more open due to the presence of the sailing club where there were no trees on the shore.

The macrophyte flora is considered to be poor in terms of number of species. Many of the species were mainly present in the mid sector locations at each site, where there were gaps in tree cover allowing marginal vegetation to grow. Elsewhere, trees covered the banks and marginal areas, shading them and restricting macrophyte growth. The macrophyte cover is therefore considered to be poor in terms of its surface area coverage as well as species diversity.

Fennel pond-weed (*Stuckenia pectinatus*) was the dominant species of the submerged or elodeid macrophytes at all sites except site 3 where only small pondweed, (*Potamogeton berchtoldii*) was recorded in only one quadrat. Nuttall's pondweed (*E. nuttallii*) was also quite abundant, growing up to a maximum depth of 4.25 m.

Only one species of stonewort, *Chara vulgaris* var *papillate* was recorded and only at five survey points, although one of these was a large patch 40m².

The filamentous algae cover was not dominant in Broadwater Lake, indicating that the aquatic vegetation is not particularly represented by nutrient tolerant taxa. Site 4 had a higher cover of filamentous algae than the other sites.

Bywater Ecology would be pleased to quote for further work as required.

REFERENCES

Integrated Freshwater Group (2015) Common Standards Monitoring Guidance for Freshwater Lakes. JNCC, Peterborough.

Beerling, David J.; Perrins, James M. (June 1993). "Impatiens Glandulifera Royle (Impatiens Roylei Walp.)". *The Journal of Ecology*. 81 (2): 367–382

Appendix 1. Macrophyte Species Lists June 2024

Section 1	Shore	Start 0m Transect				20m Transect				40m Transect				60m Transect				80m Transect				Boat Survey
Date: 24/6/24	Quadrat:	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	Sample No. (1-10)
Bare Substrate		3	3	3	3	3	3	3	3	2	1	1	1	2	2	2	3	3	3	2	0	3,4,8,9
ALGAE																						
<i>Cladophora (fil algae)</i>		1				1				2	1	1	1	2	2	2						6,7,10
<i>Spirogyra (fil algae)</i>																						
<i>Ulva intestinalis</i>	S	1								1				1	1	1	1	1	1		1	1,9,10
BRYOPHYTES																						
<i>Leptodictyum riparium</i>	G	1	1																			
STONEWORTS																						
<i>Chara vulgaris var papillata</i>																						2,6,7
MARGINAL EMERGENTS																						
<i>Alisma lanceolatum</i>																						
<i>Carex riparia</i>																						
<i>Carex pendula</i>	G																					
<i>Epilobium hirsutum</i>																						
<i>Equisetum palustre</i>																						
<i>Eupatorium cannabinum</i>	G																					
<i>Iris pseudacorus</i>	G																					
<i>Impatiens glandulifera</i>	G																					
<i>Juncus effusus</i>																						
<i>Lycopus europaeus</i>	G									1	1			1								10
<i>Lythrum salicaria</i>																						
<i>Mentha aquatica</i>	G									1	1			1								10
<i>Myosotis scorpioides</i>	G																					
<i>Oenanthe crocata</i>																						
<i>Phragmites australis</i>																						
<i>Ranunculus flammula</i>										1												
<i>Salix sp.</i>	G																	1	1			
<i>Solanum dulcamara</i>	G																					
<i>Sparganium erectum</i>	G									1	2	2	2					1	1			
<i>Stachys palustris</i>																						
<i>Veronica catenata</i>																						
FLOATING LEAVED																						
<i>Lemna minor</i>																	1					
<i>Lemna trisulca</i>																						
<i>Persicaria amphibia</i>																						
SUBMERGED																						
<i>Ceratophyllum demersum</i>	S										1	1		1	1	1						
<i>Elodea nuttallii</i>											1	1				1					1	7,9,10
<i>Potamogeton crispus</i>																					1	
<i>Potamogeton berchtoldii</i>										1												1,2
<i>Potamogeton pusillus</i>																						6
<i>Sparganium emersum</i>																						10
<i>Stuckenia pectinatus</i>	S			1	1					2	2	2		2	1					2	1	2,4,5,6
TERRESTRIAL																						
<i>Ajuga reptans</i>	G																					
<i>Alnus glutinosa</i>	G																					
<i>Cirsium spp.</i>																						
<i>Calystegia sepium</i>										1	1											
<i>Crataegus monogyna</i>																						
<i>Dipsacus fullonum</i>	G																					
<i>Fraxinus excelsior</i>	G																					
<i>Galium aparine</i>	G																					
<i>Prunella vulgaris</i>																						
<i>Rubus fruticosus</i>	G																					
<i>Ranunculus repens</i>	G																					
<i>Rumex obtusifolius</i>	G																					
<i>Urtica dioica</i>																						
Total D rank (D1-3)		1	1	1	1	1	0	0	0	2	3	2	2	2	2	2	1	1	1	2	1	
Distance 75m depth (m)																						
Depth boat transect one (m)																						3.7

Key: 1m2 Quadrat at: a= 0m deep, b=<25cm deep, c=25-77cm deep, d= >75cm. % Cover: 1=<25%, 2= 25-75%, 3=>75%

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