Environmental Scientific Services

ENSIS

Heath Lake SSSI, Berkshire

ENSIS Report on ecological lake monitoring 2016

Goodrich, S. and Goldsmith, B.

January 2017

Blank page

Heath Lake SSSI, Berkshire:
Report on ecological lake monitoring 2016

Final Report to Atkins, 2017

Stefania Goodrich and Ben Goldsmith

ECRC Research Report Number 178

Ensis Ltd.
Environmental Change Research Centre
University College London
Pearson Building, Gower St.
London, WC1E 6BT

Tel: +44 (0)20 7679 9248

info@ensis.org.uk
www.ensis.org.uk

Cover Photo: Eastern margin of Heath Lake.

Contents

1. Introduction and Project Objectives 3
1.1. Study Rational 3
1.2. Overall objective 4
1.3. Specific objectives 4
2. Methods 4
2.1. WFD Aquatic Macrophyte Survey 4
2.2. Phytobenthos survey 5
2.3. Aquatic Invertebrate Survey 5
3. Survey Results 6
3.1. WFD Aquatic Macrophyte Survey 6
3.2. Phytobenthos Survey 9
3.3. Aquatic Invertebrate Survey 11
4. References 12

List of Tables

Table 1 Sample details for the phytobenthos survey 5
Table 2 LEAFPACCS 2 metrics applied to Heath Lake 7
Table 3 Macrophyte frequency summary for survey years 2007, 2013 and 2016 at Heath Lake, where n=90. Historical records included for comparison for 1994, 1995 and 1996 8
Table 4 Diatom taxa recorded from Heath Lake, 13/12/2017. 10
Table 5 Aquatic invertebrates: Heath lake 13/12/2016 11

List of Figures

Figure 1 Map to show the location of Heath Lake in southeast England. 3
Figure 2 Macrophyte extent and abundance at Heath Lake. 6

1. Introduction and Project Objectives

1.1. Study Rational

Heath Lake is located in the county of Berkshire (Figure 1) and was designated as a Site of Special Scientific Interest (SSSI) in 1989 for its “specialist communities of native plants and animals...[and] populations of some uncommon and rare aquatic plant species” (Natural England, 2016). Described as a lowland acid lake with nutrient poor waters, it has historically been habitat to both aquatic and marginal plant communities which are more characteristic of upland lakes in Wales, northern England and Scotland.

The SSSI citation lists alternate water-milfoil (*Myriophyllum alterniflorum*) to be growing abundantly, alongside floating club-rush (*Eleogiton fluitans*), six-stamened waterwort (*Elatine hexandra*), blunt-leaved and lesser pondweeds (*Potamogeton obtusifolius* and *Potamogeton pusillus*) and shoreweed (*Litorella uniflora*). In addition to this, Coral Necklace (*Illecebrum verticillatum*), was reported as present at Heath Lake in Crawley’s 2004 edition of The Flora of Berkshire, and there are records of Pillwort (*Pilularia globulifera*) (Porley 1994). The distribution of Coral Necklace is currently in decline due to increasingly restricted ranges of heathland habitat and has not been recorded at Heath Lake in recent years.

Heath Lake is currently in unfavourable condition due to nutrient enrichment and increased base levels of the lake. This has resulted in a significant and rapid change to the aquatic macrophyte communities both submerged and marginal to the lake.

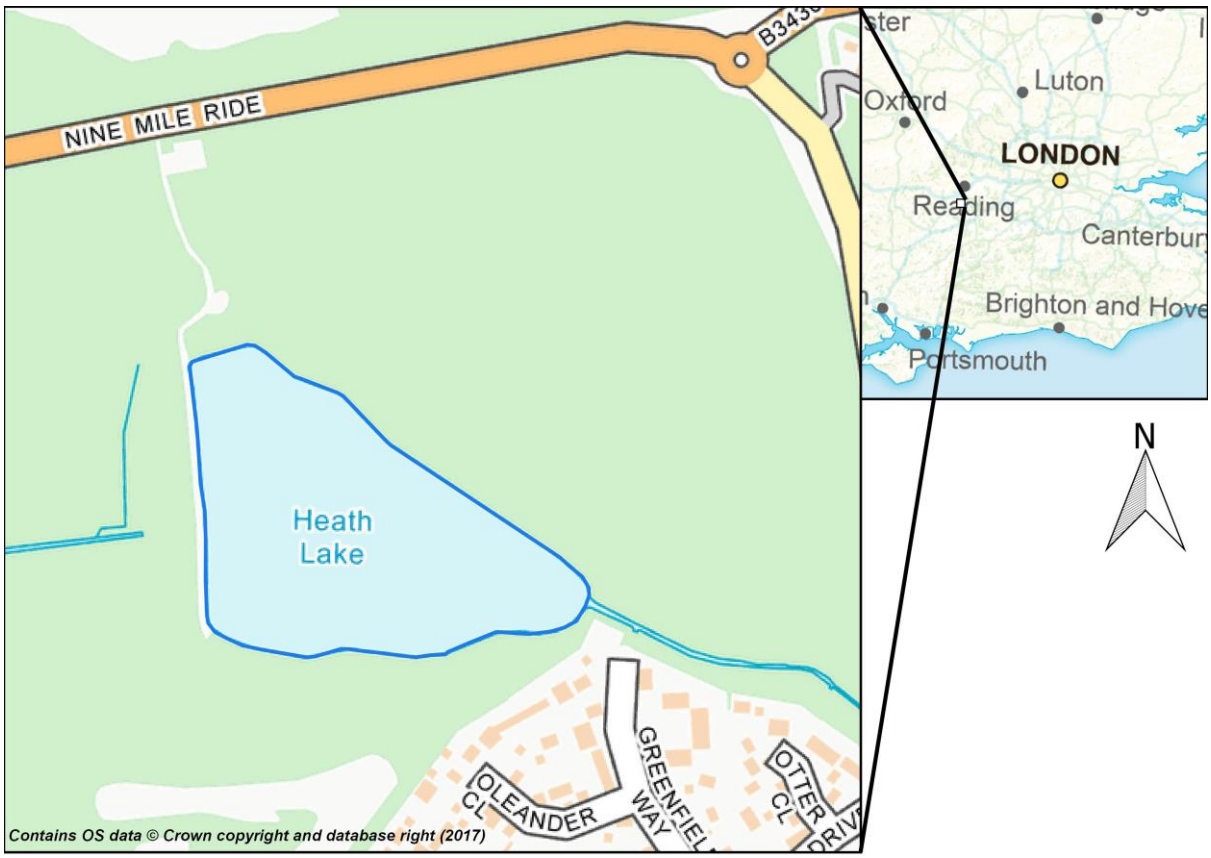

Figure 1 Map to show the location of Heath Lake in southeast England.

1.2. Overall objective

In order to understand the mechanisms behind the deterioration of the lake, ENSIS Ltd were commissioned by Atkins to undertake a series of ecological and physical assessments of the lake and its catchment. The data collected, along with historical data, will inform the recommendations made for restoration of Heath Lake to return it to its designated SSSI status.

1.3. Specific objectives

Undertake a WFD compliant lake macrophyte survey (WFD survey) on Heath Lake and assess the extent of macrophyte bed cover.

Carry out a phytobenthos survey to help classify the lake of its current ecological status.

Take a representative sample of aquatic invertebrates to help classify the lake of its current ecological status.

2. Methods

2.1. WFD Aquatic Macrophyte Survey

A WFD macrophyte survey of Heath Lake was carried out on 2nd September 2016, using the methods detailed in the UKTAG method statement (UKTAG 2014).

In brief, the survey consisted of four components; a strandline survey of species uprooted and washed to the shore, a survey of the emergent and marginal species, a wader survey of the shallow littoral zone and a boat survey encompassing species in open water and extending to the point of maximum depth of colonisation. These were carried out on four discrete 100 m sections of shoreline which are considered to be representative of the lake and give good geographical coverage. In order to reduce disturbance, a maximum of 25% of the shoreline was surveyed.

Where possible, surveying was performed using a bathyscope, but a double-headed rake was also deployed where poor water clarity restricted visibility. The location of all survey sections and boat transects was recorded using Global Positioning System (GPS), backed up with digital photographs, all of which are provided in the data appendices. All boats and survey equipment were cleaned before and after survey using an approved aquatic disinfectant (Virkon AQ), with additional care being taken where alien plant species were present (e.g. *Elodea* spp.).

In-situ macrophyte identifications were made by Ben Goldsmith and Ewan Shilland. Voucher specimens were collected for taxonomically ambiguous species and identifications confirmed either from fresh materials (on the evening of the survey) or at a later date from pressed specimens. Vouchers of charophytes were preserved in alcohol and sent to Nick Stewart (BSBI Charophyte Referee and expert on aquatic botany) for confirmation. Quality control was performed in-house with reference to previously collected herbaria specimens. Botanical nomenclature follows Stace (1997) for higher plants, Moore (1986) for Stoneworts (updated by N. Stewart, pers. comm.).

2.2. Phytobenthos survey

A diatom sample was collected on 13th December 2016. A total of five sampling locations were chosen from around the lake to give good spatial coverage. In reality, the choice of sampling site was governed mainly by the availability of suitable habitats; in this case cobbles or stones. Ideally areas with heavy shade should be avoided, but at Heath Lake, most of the margin has partial shade. No samples were taken along the south shore due to heavy shade. Details are given in Table 1.

Up to three stones were sampled at each of the five locations, care being taken to select only stones without significant deposits of silt or growths of filamentous algae. Stones ranged in size from approximately 1.5 to 5.0 cm across the longest axis.

Diatoms were removed by gently brushing the upper surface of each stone with a soft toothbrush over a tray. The material from all samples was combined into a 250 ml bottle, mixed thoroughly and an aliquot of 30 ml transferred into a Sterilin sample tube and preserved with 0.5 ml of Lugol's Iodine.

Grid reference	Number of stones	Comment
SU8298865239	3	Very little obvious diatom growth
SU8289265306	2	Light algae covering – not filamentous
SU8279065339	1	Heavy shade
SU8280165239	3	Next to outflow
SU8281965174	2	Small stones only

Table 1 Sample details for the phytobenthos survey

Samples were prepared by digesting 0.5 ml of the well mixed sample in 30% hydrogen peroxide in a water bath at 65 °C. Samples were then washed with distilled water, and a subsample of the cleaned diatoms allowed to settle out on a 13 mm cover slip. When dry, the coverslip was mounted onto a microscope slide and fixed using a high refractive index mountant (Naphrax RI = 1.73).

Diatoms were identified and counted by Dr Ben Goldsmith using a Zeiss Standard 16 microscope under a phase contrast (x1250, NA1.4).

2.3. Aquatic Invertebrate Survey

Aquatic invertebrates were sampled during the visit on 13/12/2016. This falls outside the normal sampling period, but nonetheless provides a baseline for invertebrate taxa. Sampling followed the methods used in PSYM for invertebrates (FHT 2002), whereby the site was divided up into the main littoral habitats present and a total of three minutes was divided equally between the different habitats at various locations around the lake. The habitats samples were: Sand, Silt, Leaf litter, aquatic plants (mainly stranded *M. spicatum*) and marginal plant / tree roots. Sampling was undertaken with a standard FBA invertebrate net (0.5 mm mesh) and achieved by disturbing the habitat with either the net or the feet before sweeping the net through the water. Samples were preserved in the field with denatured alcohol (approx. 60 %).

On return to the laboratory, the bulked sample was sieved at 0.5 mm and the entire sample sorted on a white tray and all invertebrates counted. Due to the high numbers of Chironomid larvae, these were only counted from 25% of the total sample and the final number estimated. Taxa were identified to family level.

All maps presented in this report are derived from Ordnance Survey OpenData.

3. Survey Results

3.1. WFD Aquatic Macrophyte Survey

In addition to the current survey, Ensis has conducted two previous macrophyte surveys using standard WFD methods at Heath Lake, in 2007 and 2013. The macrophyte assemblages varied considerably between the three surveys, and also show significant changes to the aquatic flora recorded in the original SSSI citation and subsequent reviews. In 2007, the site was extremely turbid and no aquatic vegetation was recorded. In 2013, the site was clear and dominated by Rigid hornwort *Ceratophyllum demersum*, with very extensive beds of Six-stamened waterwort *Elatine hexandra* occurring as an understory, particularly on the sandier substrates within the littoral zone, and Small pondweed *Potamogeton berchtoldii*, common within the Rigid hornwort.

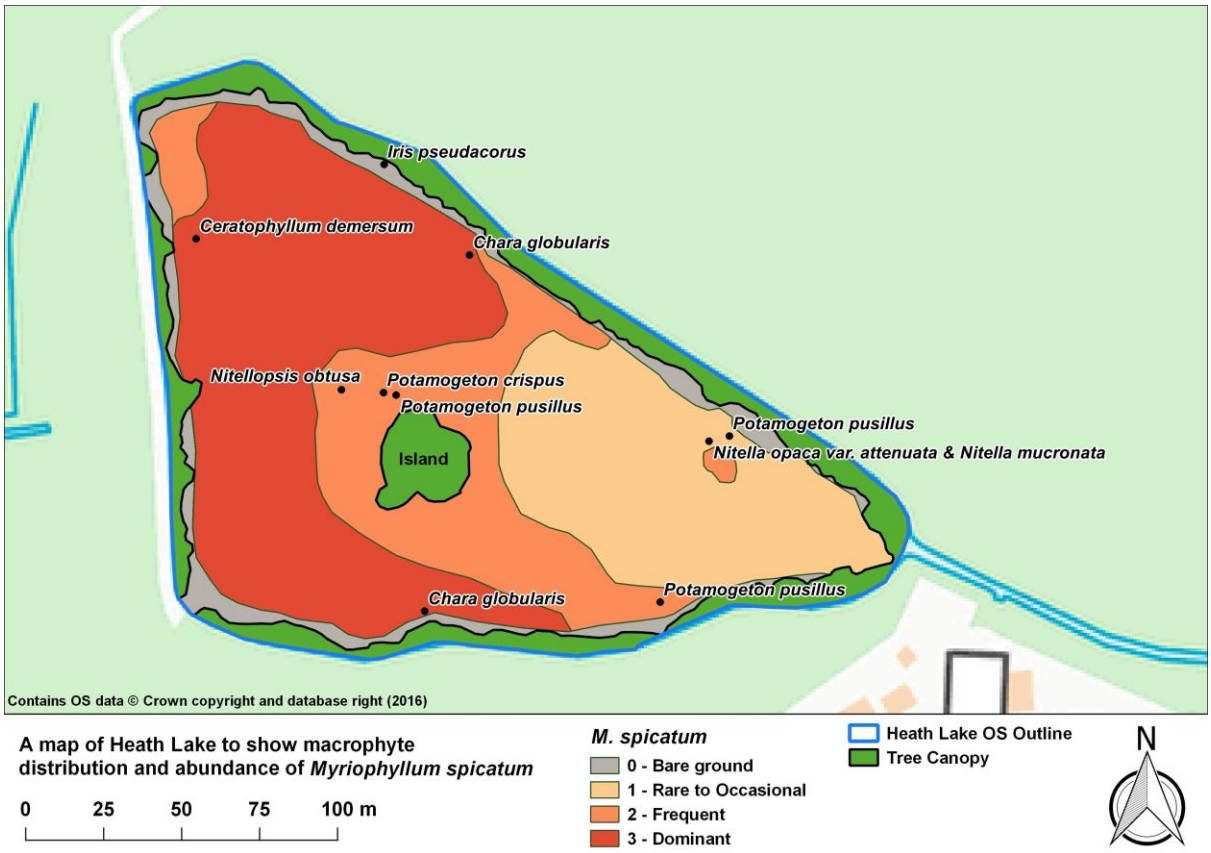

Figure 2 Macrophyte extent and abundance at Heath Lake.

The 2016 assemblage was different again, this time dominated throughout the lake by Spiked water milfoil *Myriophyllum spicatum*, with only very few occurrences of Rigid hornwort, lesser pondweed *Potamogeton pusillus* and curly-leaf pondweed *Potamogeton crispus*. Figure 2 demonstrates the aquatic plant distribution across Heath Lake. Fragile Stonewort *Chara globularis* and *Nitella* were recorded sporadically but with rare abundance while Six-stamened waterwort was observed on one occasion on the strandline.

With the exception of Six-stamened waterwort and the occasional occurrence of Smooth Stonewort, these assemblages are generalist and indicative of hyper-eutrophic waters and a long way removed from the flora expected from a shallow, low alkalinity lake. The dynamic nature of the vegetation also suggests the site to be influenced by multiple environmental stressors. Table 3 provides a summary of species recorded in 2007, 2013 and 2016 while the LEAFPAC 2 metrics is provided in Table 2.

Historical records from 1994, 1995 and 1996 are also included in Table 3 to demonstrate the significant changes in flora assemblage over the past two decades. It is encouraging to note that although recorded previously in the site (Porley 1994) no Canadian Pondweed *Elodea canadensis* or Curly Waterweed *Lagarosiphon major* have been recorded by Ensis. Of concern however, is the apparent loss of the more typical low alkalinity species Shoreweed *Littorella uniflora* and the shift from *Myriophyllum alterniflorum* to *M. spicatum*. The nationally rare species, Pillwort *Pilularia globulifera* and Coral Necklace *Illecebrum verticillatum* have not been recorded from Heath Lake in recent years.

Although rare within the site, the occurrence of four different stonewort species (confirmed by Nick Stewart, BSBI Stonewort referee) is worthy of note. *Chara globularis* has been previously recorded in the site (ENSIS 2013), but the occurrence of two relatively rare *Nitella* species (*N. opaca var. attenuata* and *N. mucronata*) is more typical of the oligo-mesotrophic flora recorded in the past; their presence possibly coming from viable oospoores within the sediments. *Nitellopsis obtusa* is a very unusual record for the site. This species is nationally rare, and known from only about 15 other lake sites in the UK. Typically it is found in deeper, clear-water, alkaline sites, often in flooded gravel pits. Its presence in Heath Lake is thought likely to be from recent dispersal of oospores by birds, with other known sites within 30 km.

More generally, the marginal areas are almost entirely shaded by encroaching willow and to the east, large pines. With the exception of very sparse areas with Pennywort *Hydrocotyle vulgaris*, Yellow flag *Iris pseudacorus*, Gypsywort *Lycopus europaeus*, Yellow loosetrife *Lysimachia vulgaris* and Lesser skullcap *Scutellaria minor*, the marginal wetland flora was poor.

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
6.73	8	6	5.8	0.18

Table 2 LEAFPACCS 2 metrics applied to Heath Lake

ID	Description	1994	1995	1996	2001	2007	2013	2016
Callitriche stagnalis	Common water starwort	-	-	-	+rare	-	-	-
Ceratophyllum demersum	Rigid hornwort	+	+occasional	+occasional	-	0	83.1	1.1
Chara globularis	Fragile Stonewort	+	-	-	-	0	30.5	2.2
Cladophora sp.	Green algae	-	+abundant	+abundant; but decrease	+frequent but sparse	-	-	-
Elatine hexandra	Six-stamened waterwort	+	+rare and local	+rare and local	-	0	81.4	+
Eleogiton fluitans	Floating club-rush	-	-	-	-	-	-	-
Elodea canadensis	Canadian pondweed	+	+occasional	+abundant; increase	-	-	-	-
Elodea nuttallii	Nuttall's waterweed	-	+dominant	+abundant; decrease	-	-	-	-
Illecebrum verticillatum	Coral Necklace	-	-	-	-	-	-	-
Iris pseudacorus	Yellow Iris	-	-	-	+Frequent but sparse	-	-	-
Lagirosiphon major	Curly waterweed	+	-	-	-	-	-	-
Lemna minor	Common duckweed	+	+rare	+rare	-	-	-	-
Litorella uniflora	Shoreweed	+	+locally frequent	+apparent decrease	-	-	-	-
Menyanthes trifoliata	Bogbean	+	+locally frequent	+locally frequent	-	-	-	-
Myriophyllum alterniflorum	Alternate water-milfoil	+	+occasional	+apparent increase	-	-	-	-
Myriophyllum spicatum	Spiked water milfoil	-	-	-	-	0	3.4	76.7
Nitella flexilis agg.	Smooth stonewort	+	-	-	+ occasional	0	3.4	-
Nitella opaca var. attenuata	Dark stonewort	-	-	-	-	-	-	1.1
Nitella mucronata	Pointed stonewort	-	-	-	-	-	-	1.1
Nitellopsis obtuse	Starry stonewort	-	-	-	-	-	-	1.1
Nymphaea alba	White waterlily	+	+rare but increasing	+rare	+rare	-	-	-
Pilularia globulifera	Pillwort	-	-	-	-	-	-	-
Potamogeton berchtoldii	Small pondweed	-	-	-	-	0	44.1	-
Potamogeton crispus	Curly-leaf pondweed	-	-	-	-	0	0	1.1
Potamogeton obtusifolius	Blunt-leaved pondweed	+	-	+increase but still rare	-	0	5.1	0
Potamogeton pusillus	Lesser pondweed	+	+rare	+rare	-	-	-	4.4
Typha latifolia	Bulrush	+	+local	+local	+rare	-	-	-
Zannichellia palustris	Horned pondweed	-	-	-	+rare	-	-	-

Table 3 Macrophyte frequency summary for survey years 2007, 2013 and 2016 at Heath Lake, where n=90. Historical records included for comparison for 1994, 1995 and 1996.

3.2. Phytobenthos Survey

A total of 35 taxa were recorded from a count of 668 individual diatom valves. *Rhoicosphenia abbreviata* accounted for over 50% of the sample, hence the rather high count which ensured at least 300 individuals of the non-dominant taxa were recorded. The full species count is in Table 4.

Overall the assemblage is indicative of moderate alkalinity and relatively high trophic status. *Rhoicosphenia abbriviata* is however a somewhat generalist species, more often associated with filamentous algae. *Achnanthidium minutissimum* was also abundant and is a species also widespread and often abundant in circumneutral or alkaline lakes with low or moderate concentrations of nutrients and organic pollution.

The metric used to classify lakes using diatoms is called Lake Trophic Diatom Index 2 (LTDI2). Diatom taxa are each assigned a score based on their ecological preferences, from 1 (nutrient sensitive) to 5 (nutrient tolerant) and the computed LTDI 2 scores range from 0 (very low nutrients) to 100 (very high nutrients). The WFD requires derivation of ecological status as an Ecological Quality Ratio (EQR). The LTDI 2 EQR is calculated based on observed data and predicted reference values, resulting in an overall EQR representing an ecological status class of either High, Good, Moderate, Poor or Bad. The EQR scale ranges 0 (bad ecological status) to 1 (high ecological status).

The LTDI2 was calculated using the DARLEQ 2 software tool (Kelly et al. 2014) in order to assign a WFD-relevant status to the diatom results. The calculated metrics give an EQR of 0.32 and place Heath Lake in the “Poor” status category.

It should however be stressed that normally one would expect to take diatom samples on two occasions during the year and not normally in winter. While the results do reflect what we know to be relatively poor water quality in Heath Lake, the confidence in the results would be increased by additional sampling in spring and autumn.

Diatcode	Species	Count	Per cent
AC023A	*Achnanthes conspicua*	9	1.35
AC008A	*Achnanthes exigua*	5	0.75
AC001A	*Achnanthes lanceolata*	1	0.15
AC001R	*Achnanthes lanceolata* subsp. *frequentissima*	4	0.60
AD009A	*Achnanthidium minutissimum*	108	16.17
AM012A	*Amphora pediculus*	10	1.50
CO005A	*Cocconeis pediculus*	2	0.30
CO001B	*Cocconeis placentula* var. *euglypta*	53	7.93
CO001C	*Cocconeis placentula* var. *lineata*	6	0.90
YH001A	*Ctenophora pulchella*	2	0.30
EY011A	*Encyonema minutum*	3	0.45
EY016A	*Encyonema silesiacum*	1	0.15
EP001A	*Epithemia sorex* var. *sorex*	6	0.90
EU002A	*Eunotia pectinalis* var. *pectinalis*	1	0.15
FR009A	*Fragilaria capucina* var. *capucina*	1	0.15
SR001A	*Fragilaria construens* var. *construens*	1	0.15
SR002A	*Fragilaria elliptica*	2	0.30
SS002A	*Fragilaria pinnata* var. *pinnata*	2	0.30
GO013A	*Gomphonema parvulum* var. *parvulum*	4	0.60
GO023A	*Gomphonema truncatum* var. *truncatum*	1	0.15
NA066A	*Navicula capitata* var. *capitata*	6	0.90
NA050A	*Navicula clementis* var. *clementis*	1	0.15
NA007A	*Navicula cryptocephala* var. *cryptocephala*	1	0.15
NA317A	*Navicula decussis*	1	0.15
NA433D	*Navicula ignota* var. *acceptata*	1	0.15
SL003A	*Navicula minima* var. *minima*	22	3.29
NA128A	*Navicula schoenfeldii*	1	0.15
NI014A	*Nitzschia amphibia* var. *amphibia*	3	0.45
NI002A	*Nitzschia fonticola*	9	1.35
NI008A	*Nitzschia inconspicua*	15	2.25
PS001A	*Pseudostaurosira brevistriata*	10	1.50
RC002A	*Rhoicosphenia abbreviata*	369	55.24
SL001A	*Sellaphora pupula* var. *pupula*	1	0.15
TA001A	*Tabellaria flocculosa* var. *flocculosa*	1	0.15
TU003A	*Tabularia fasciculata*	5	0.75

Table 4 Diatom taxa recorded from Heath Lake, 13/12/2017.

3.3. Aquatic Invertebrate Survey

A total of 17 families were recorded (Table 5), with *Chironomidae* dominating the sample. The majority of taxa are generalist and live either in the sediments or they are commonly associated with leaf litter (e.g. hoglice and shrimps). Damselfly larvae were present, but no dragonfly larvae were recorded. Overall the assemblage suggests relatively poor ecological quality, typified by the lack of good marginal habitats for invertebrates.

Type	Common name	Family	Count
Water bugs	Water boatman	*Corixidae*	3
	Pond skater	*Gerridae*	1
Mayflies	Mayfly larvae	*Baetidae*	41
Caddis Flies	Micro-caddis fly larvae	*Hydroptilidae*	13
	Cased-caddis fly larvae	*Limnephilidae*	5
Damselfly	Damselfly nymph	*Coenagrionidae*	19
True-Flies	Non-biting midge larvae	*Chironomidae*	636
	biting midge larvae	*Ceratopogonidae*	3
Crustaceans	Hoglice	*Asellidae*	13
	Freshwater shrimp	*Crangonyctidae*	23
Leeches		*Glossiphonidae*	4
	Fish leech	*Piscicolidae*	5
Molluscs	Ramshorn snails	*Planorbidae*	18
	Bladder snails	*Physidae*	24
	Spire shells	*Hydrobidae*	5
	Pea/Orb mussels	*Sphaeridae*	6
Flatworms		*Planariidae*	5
	Total Individuals		**753**
	Number of Taxa		**17**

Table 5 Aquatic invertebrates: Heath lake 13/12/2016

We recommend that additional invertebrate samples are undertaken in spring and summer to build up a more comprehensive baseline list of taxa.

While on site, the remains of the non-native signal crayfish (*Pacifastacus leniusculus*) were recorded **(photo attached if required)**. The presence of this species is undesirable within the site and has implications for management. Signal crayfish are listed under Schedule 9 to the Wildlife and Countryside Act 1981 (England, Wales and Scotland). It should be noted during any management operations that it is an offence to allow the escape of this species from the site to other wild sites. If trapping of signal crayfish is planned, a license application should be sort from the Environmental Agency. Further details of the legislation can be gained from: www.nonnativespecies.org/legislation.

Furthermore, while bio-security should be mandatory between any freshwater sites, extra vigilance should be exercised at sites where crayfish are present. Signal crayfish carry and transmit the “crayfish plague” (*Aphanomyces astaci*), a fungal pathogen that can be fatal to native white-clawed crayfish (*Austropotamobius*

pallipes). Spores of the plague can be spread between sites on damp survey equipment of machinery, and therefore disinfection is essential (using iodine based disinfectant) or washing (clean tap water) followed by drying completely.

4. References

Bennion H, Kelly MG, Juggins S, et al. (2014) Assessment of ecological status in UK lakes using benthic diatoms. Freshwater Science 33: 639-654.

Freshwater Habitats Trust (2002) A guide to monitoring the ecological quality of ponds and canals using PSYM. Pond Action, Oxford

Kelly, M.G., Juggins, S., Bennion, H., Burgess, A., Yallop, M., Hirst, H., Jamieson, J., Guthrie, R., Rippey, B. (2014) DARLEQ2: Diatom Assessment of River and Lake Ecological Quality. Online at https://www.staff.ncl.ac.uk/stephen.juggins/DARLEQII.htm

Moore, J.A. (1986) *Charophytes of Great Britain and Ireland*. Botanical Society of the British Isles (Handbook No.5).

Natural England (2014) Designated Sites View. Heath Lake SSSI - 005507. https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=S1005507

Natural England (2016) Heath Lake SSSI Citation [pdf] Available at: https://necmsi.esdm.co.uk/PDFsForWeb/Citation/1005507.pdf [Accessed 01.12.2016]

Porcella, D. B. & Sorenson, D. L. (1980). *Characteristics of Nonpoint Source Urban Runoff and its Effect on Stream Ecosystems.* EPA-60013-80-032, U.S.E.P.A., Corvallis Environmental Reserch Laboratory, Corvallis. 110 PP.

Porley, R.D. (1994) A Botanical Assessment of the Macrophytes of the Heath Lake SSSI, Berkshire, Natural England. Newbury. October 1994

Stace, C. A. (1997) *New Flora of the British Isles*. Cambridge: Cambridge University Press.

WFD-UKTAG 2014. UKTAG Lake assessment methods: macrophyte and phytobenthos. Macrophytes (Lake Leafpacs2). ISBN: 978-1-906934-45-3. Available online: http://wfduk.org/resources/lakes-macrophytes