LEICESTERSHIRE ENTOMOLOGICAL SOCIETY

A Two-year Study of the Water Bugs (Hemiptera: Heteroptera) of Priory Water NR, Leicestershire

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Introduction

Water bugs have been the subject of numerous ecological studies, many of which have focused on the distribution of species in relation to particular features of aquatic habitats. Macan (1954) suggests that the Corixidae is an attractive family for ecological studies because most of the species (nearly 40 in the UK) are common and widely distributed but have restricted habitats. The abiotic and biotic habitat characteristics that influence water bug distributions are complex, involving water chemistry, competition and predation among others. Macan (1938) examined the relationship between corixids and the amount of organic material present in the sediment of lakes and ponds in the Lake District and showed some species occurred only in oligotrophic habitats while others were confined to later successional, eutrophic habitats with higher levels of organic material. Looking at this association from a different point of view, Popham (1943) suggested that the background colour of different habitats influenced distribution with lighter coloured species in low organic matter habitats and *vice versa*.

Savage (1982, 1990) investigated the correlation between corixid distribution and the conductivity of water bodies, conductivity being a measure of the concentration of dissolved ions. This varies widely in freshwater habitats along the oligotrophic–eutrophic spectrum, from below 50µS (micro-Siemens) to about 1,000µS. In saline conditions much higher values are obtained. Savage found significant correlations and was able to arrange the species found in a wide variety of habitats from various parts of the country along a gradient of conductivity. He also found that the size and shape of the water body influenced the distribution of a few species and that it was possible to distinguish open water species from those that occurred within reed-beds. Combining this information with data on the organic content of the substrate, Savage (1990) constructed a distribution model for 15 species of corixids in British lakes.

Local studies on Leicestershire water bugs have been published by Martin (1970) who dealt with corixids and by Clements & Evans (1973) who covered water bugs other than corixids.

Water bugs have been used, along with other groups of macroinvertebrates, to monitor water quality in both lotic and lentic habitats and, more recently, for the assessment of macroinvertebrate communities (Chadd & Extence, 2004). The conservation value of a species is based on its rarity and Chadd & Extence provide a scale between 10 (RBB1 - endangered) and 1 (a very common species) as a basis for the assessment. Although this scheme was intended to assess the conservation value of macroinvertebrate communities as a whole, it has been used to assess the value of habitats for particular groups (Chadd, *pers. com*). As far as we are aware this has not been attempted for water bugs.

Priory Water comprises a complex of lakes of various sizes in abandoned gravel pits, separated by woodland and grassland habitats, in the flood plain of the River Wreake near Kirby Bellars (grid reference SK7118). The pits were acquired by the Leicestershire Wildfowlers' Association in 1987 and managed by them as a reserve, principally for wildfowl. The reserve covers an area of 81 hectares, of which 32 hectares is open water. For further information on the reserve see the Priory Water Wildfowl Project handbook (Shelton, 2007).

The aims of this study were to record the species and seasonal abundance of water bugs present at Priory Water, to compare the species in different aquatic habitats within the reserve and to assess the conservation value of the reserve for this group of insects.

Materials and Methods

Six sites, providing a range of different habitats, were chosen for sampling. At each site abiotic variables were recorded and samples taken for aquatic Hemiptera. Three of these sites were located on the smaller Finger Lakes, two in a lake at the eastern end of the reserve and one in a lake further to the west. The other three sampling sites were located on the large Main Lake, one on the north shore and two on the south shore (Figure 1). Of the two on the south shore one was taken in deeper water several metres from the shore and the other close in to the shore. Samples were taken once in each month during the period February 2009 to February 2011, usually in the last week of each month. No sample was taken in December 2010 as the lakes were frozen with the ice too thick to break.

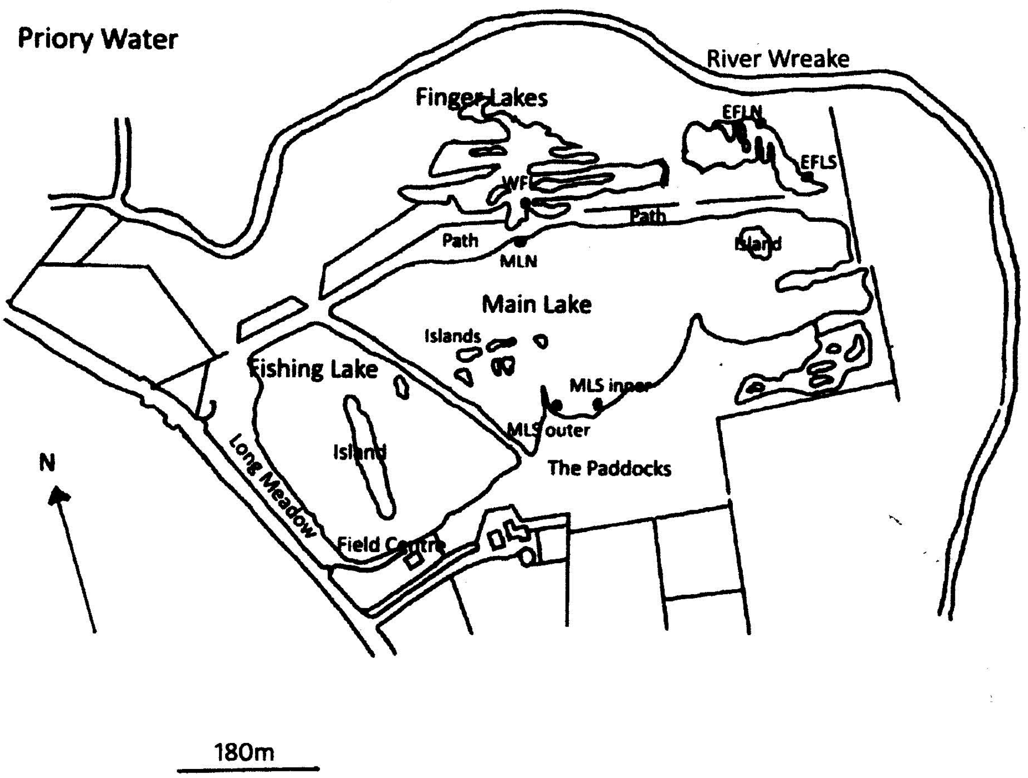


Figure 1. Priory Water NR showing sampling sites.

Abiotic readings were taken at each site with the exception of the two south lake sites which, because of their close proximity, were treated as one. A Data Harvest, Easy Sense Advanced Data logger was used for conductivity and temperature readings while a Hanna Checker meter was used for pH measurements. From the appearance of the water, the turbidity between sites over the sampling period was clearly different. A Palintest PT390 Micro 950 Turbidimeter became available after the two year sampling period and turbidity was measured (in Nephelometric Turbidity Units, NTU) at each site on three occasions (July-September 2011).

Samples for aquatic Hemiptera were taken at each site with a standard Freshwater Biological Association pond net. A sample consisted of five left and right sweeps, starting in open water and working the net toward the shore. Samples were transferred into labelled freezer bags, stored in a freezer at -15°C and sorted after thawing by searching small amounts at a time in a white tray with water. All aquatic Hemiptera were removed and stored in plastic specimen tubes containing 75%

Industrial Methylated Spirits. Specimens were identified and counted using a dissecting microscope and keys by Savage (1989) and Nau (2007).

Site descriptions

<u>East Finger Lake South</u> (**EFLS**) – at this site the lake edge was dominated by *Phragmites australis* and *Typha latifolia* while smaller amounts of *Glyceria fluitans* and *Equisetum fluviatile* grew from the water's edge into shallow water. *Nuphar lutea* dominated the open, deeper, water. The water at this site appeared cloudy and the substrate comprised mud and detritus. The maximum depth where samples were taken was 70cm. This site was open, south facing with no shading.

<u>East Finger Lake North</u> (**EFLN**) - here *P. australis* and *T. latifolia*, were more scattered along the lake edge than at EFLS, while *G. fluitans* and *E. fluviatile* were more abundant from the water's edge into shallow water. The open water was dominated by *Potomageton natans*. The water at this site was cloudy and the substrate comprised mud and detritus. Maximum depth at which the samples were taken was 70cm. This site was south facing but half shaded with Sallows, willows (*Salix* spp.) and Alder (*Alnus* spp.).

<u>West Finger Lake</u> (**WFL**) – a site where the water's edge was dominated with *G. fluitans* and the open water by *Potomageton* spp. The water at this site was clear and the substrate comprised hard mud/stones. The site faced north-west with no shading. The maximum depth where samples were taken was 45cm.

<u>Main Lake North</u> (**MLN**) - a site with extensive marginal vegetation comprising *Sparganium erectum*, *T. latifolia*, *G. fluitans*, *Lycopus europaeus* and *Epilobium hirsutum*. The substrate comprised soft mud and detritus. All samples at this site were taken within the marginal vegetation in clear water with a maximum depth of 35cm. This site was south facing with no shading.

<u>Main Lake South Open Water</u> (**MLSOW)** - the substrate at this site comprised silt and stones which, in summer, was partly covered with *Elodea canadensis*. Samples were taken in clear water with a maximum depth of 30cm.

<u>Main Lake South Edge</u> (**MLSE)** – here samples were taken close to, or within, a stand of *G. fluitans* at the lake margin. The substrate comprised silt and stones, which, in summer, was covered with *E. canadensis*. Samples were taken in clear water with a maximum depth of 15cm. Both of the Main Lake South sites were open with no shading.

Results

Abiotic

<u>Table 1: Mean and range values of abiotic factors at each sample site</u>

Site	Conductivity (µS)	pH	Temperature (°C)
EFLS	389 (280 – 445)	7.00 (6.70 – 7.75)	10.8 (3.0 - 17.6)
EFLN	377 (306 – 454)	7.13 (6.80 – 8.07)	10.5 (2.4 -17.5)
WFL	273 (215 – 330)	7.13 (6.70 – 7.83)	11.5 (2.2 – 19.8)
MLN	325 (230 – 397)	7.75 (6.70 – 10.72)	11.9 (2.9 – 19.5)
MLSOW	317 (230 – 363)	8.33 (6.60 – 11.26)	12.2 (1.6 – 20.0)

*As MLSOW and MLSE were close together, readings were only taken at MLSOW. The raw data is detailed in Appendix 1

The abiotic results for the five sites are summarised in Table 1. To test for any significant differences between sites for abiotic factors an Analysis of Variance (ANOVA) was performed using Minitab. The One-Way ANOVA for conductivity was significant ($F = 27.79_{(4, 110)}$ $P < 0.001$) and the 95% confidence intervals (CI) showed that EFLS and EFLN have significantly higher conductivity than all the other sites. WFL has a significantly lower conductivity than all the other sites while the north and south Main Lake sites are not significantly different from each other.

For pH the ANOVA was also significant ($F = 11.7_{(4, 109)}$, $P < 0.001$) and the 95% CI showed that the three Finger Lake sites are not significantly different from each other but have significantly lower pH values than the two Main Lake sites which are not significantly different from each other. A One-Way ANOVA on the temperature data between sites showed no significant differences ($F = 0.35_{(4, 114)}$, $P > 0.05$). The full ANOVA analyses are presented in Appendix 2.

Table 2 details the turbidity levels measured at each sample site during the period July-September 2011. The results showed that East Finger Lake had the highest average turbidity, West Finger Lake the lowest and the Main Lake sites intermediate.

Table 2: Mean and range values of turbidity levels at each sample site July-September 2011

Site	Turbidity (NTU)
EFLS	6.59 (6.11 – 6.74)
EFLN	11.7 (10.88 – 12.64)
WFL	3.15 (2.51 – 4.20)
MLN	4.44 (4.20 – 4.82)
MLSOW	7.53 (6.95 – 8.15)
MLSE	5.39 (4.64 – 6.38)

Sites and species

A total of 26 water bug species were recorded at Priory Water (Table 3), the majority being found in the Main Lake. The northern site (MLN) had the highest species richness (19 species) followed by the southern sites (MLSOW with 16 and MLSE with 17). In all three Main Lake sites the dominant species, numerically, was *Cymatia coleoptrata* followed by *Plea minutissima* in the two vegetated lake edge sites (MLN and MLSE) and *Sigara falleni* in the open water site (MLSOW) (Figure 2a). These abundant species were virtually absent in the neighbouring Finger Lake sites, which had relatively few species (12 in EFLS, 11 in EFLN and 10 in WFL) and a different species composition (Figure 2b). *Notonecta glauca* was dominant in all three Finger Lake sites and *Hesperocorixa linnaei* sub-dominant in the two east Finger Lake sites.

The similarity between the sites, in terms of water bug species presence and abundance, was analysed using a simple ordination technique (Wratten & Fry 1980). The results, given in Appendix 3, show that the main lake sites and the two East Finger Lake sites form two distinct groups with West finger lake an outlier but closer to the East Finger Lake sites than to the Main Lake sites.

The two *Hesperocorixa* species (*H. linnaei* and *H. sahlbergi*) were only found in the two East Finger Lake sites. Two other relatively abundant species that showed a clear preference for particular sites were *Sigara fossarum* (EFLN) and *Sigara lateralis* (MLSOW). Nearly all the more notable species, i.e. those that have been recorded infrequently in VC55, occurred in low numbers in the southern Main Lake sites; *Arctocorisa germari* and *Micronecta sholtzi* in MLSOW and *Sigara iactans* in both sites.

Another species in this category, *Notonecta viridis*, occurred in both Main Lake and Finger Lake sites.

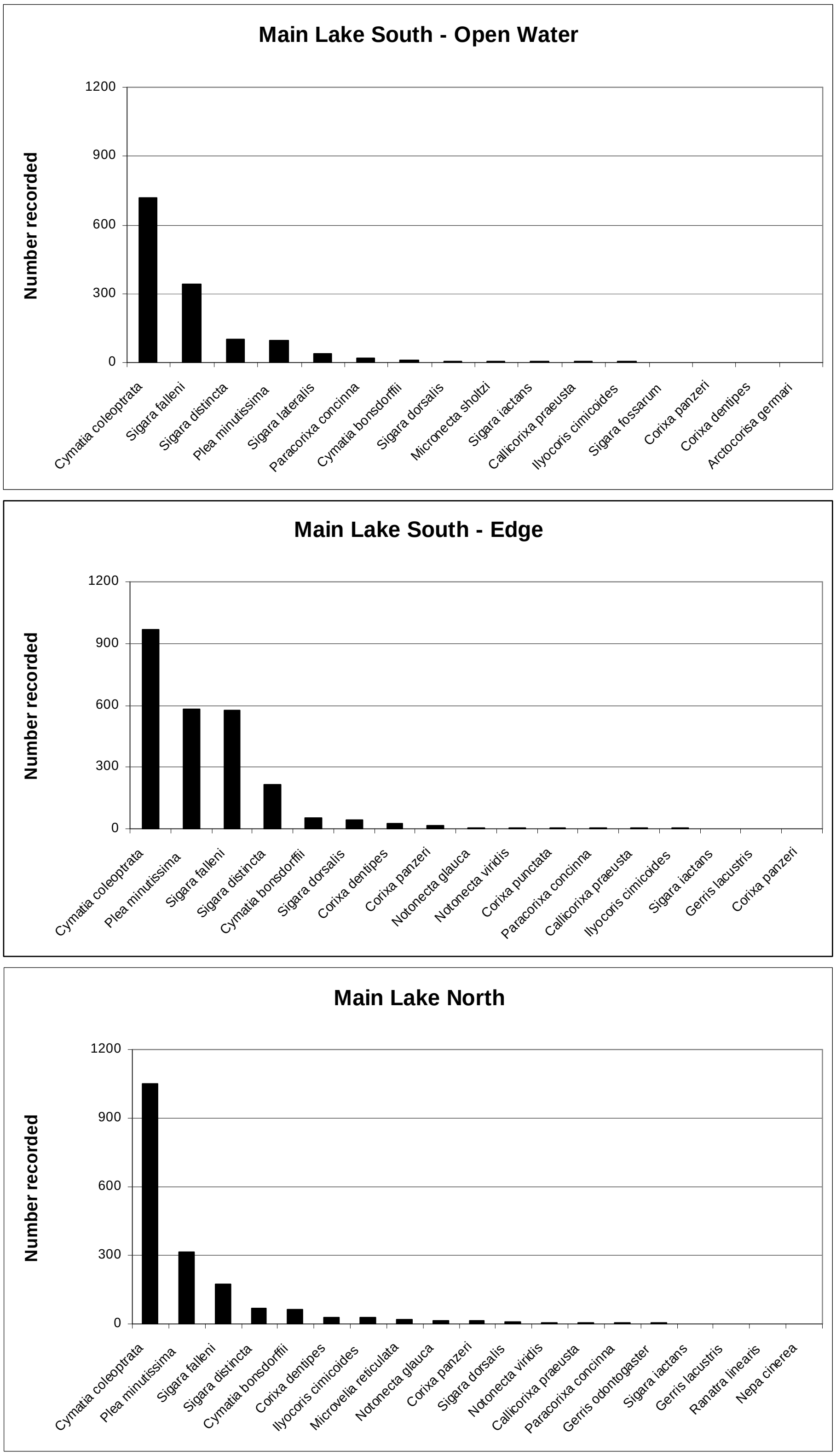
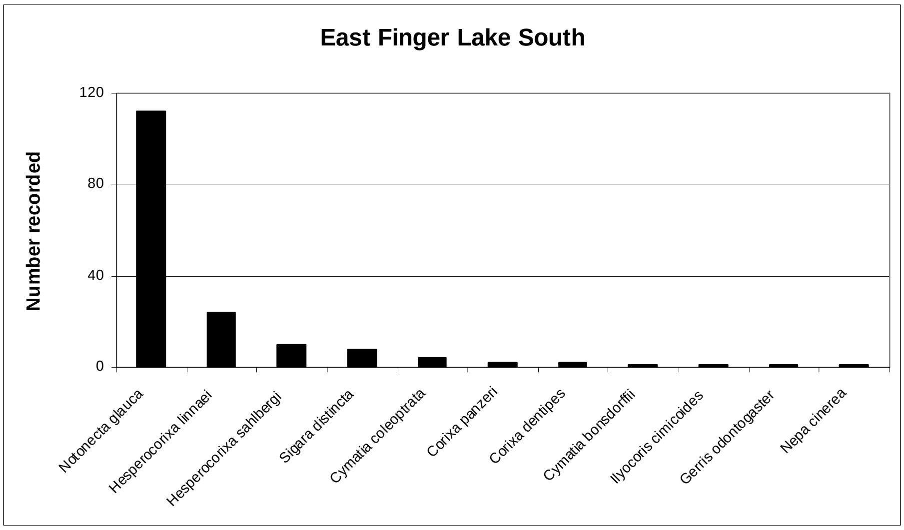
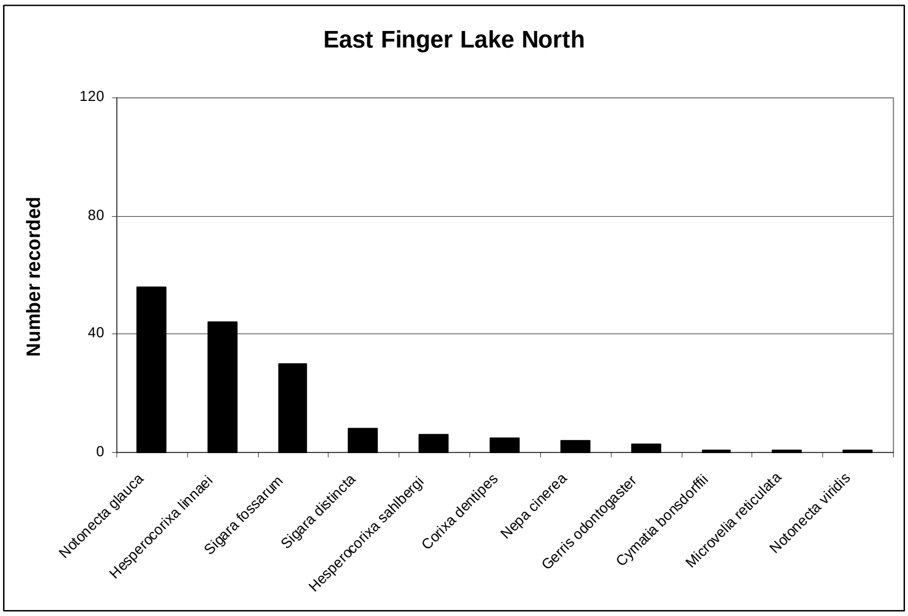


Figure 2a: Water bugs present in the Main Lake at Priory Water





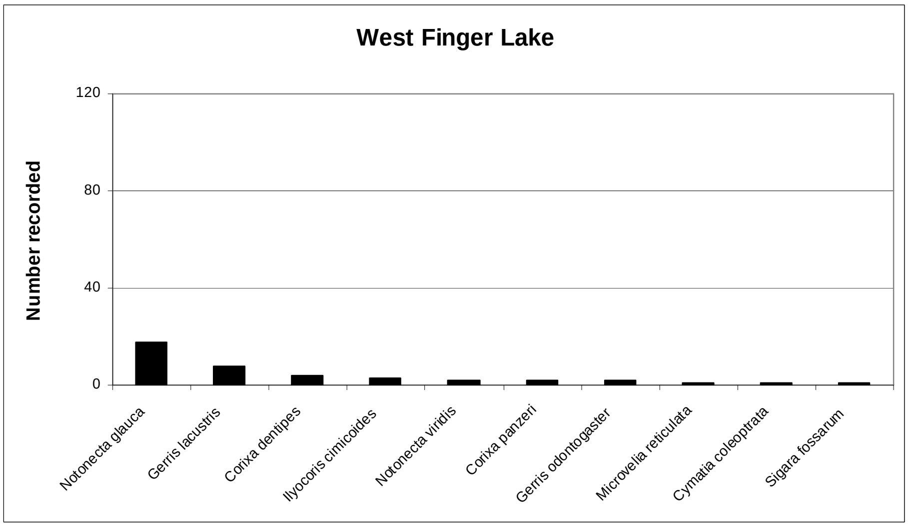


Figure 2b: Water bugs present in the Finger Lakes at Priory Water

Table 3: Numbers of each species recorded at each site (February 2009 – February 2011)

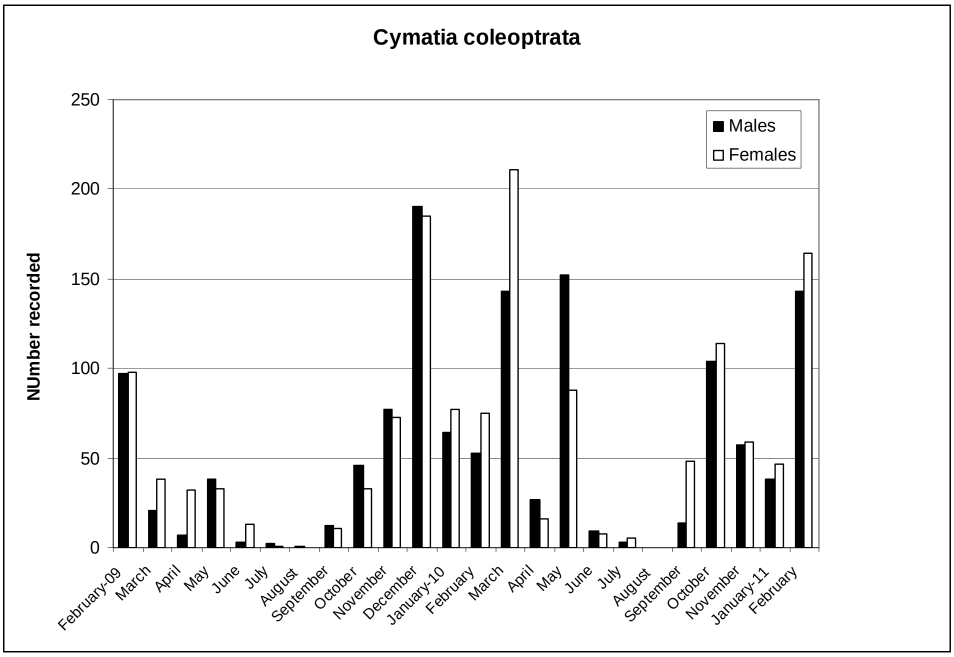
Species	EFLS	EFLN	WFL	MLN	MLSOW	MLSE
Corixoidae: Corixidae						
Arctocorisa germari					1	
Callicorixa praeusta	2			3	3	4
Corixa dentipes	2	5	4	28	1	26
Corixa panzeri	2		2	14	1	17
Corixa punctata						5
Cymatia bonsdorffii	1	1		65	10	53
Cymatia coleoptrata	4		1	1048	720	968
Hesperocorixa sahlbergi	10	6				
Hesperocorixa linnaei	24	44				
Micronecta scholtzi					5	
Paracorixa concinna				3	18	4
Sigara distincta	8	8		66	102	213
Sigara dorsalis				11	7	45
Sigara falleni				174	342	578
Sigara fossarum		30	1		1	
Sigara iactans				1	3	2
Sigara lateralis					40	
Notonectoidea: Notonectidae						
Notonecta glauca	112	56	18	14		8
Notonecta viridis		1	2	7		6
Naucoroidea: Naucoridae						
Ilyocoris cimicoides	1		3	27	3	3
Pleoidea: Pleidae						
Plea minutissima				315	98	581
Geomorpha: Vellidae						
Microvelia reticulata		1	1	19		
Geomorpha: Gerridae						
Gerris lacustris			8	1		2
Gerris odontogaster	1	3	2	3		1
Nepoidea: Nepidae						
Nepa cinerea	1	4		1		
Ranatra linearis				1		
Number of species/site	12	11	10	19	16	17

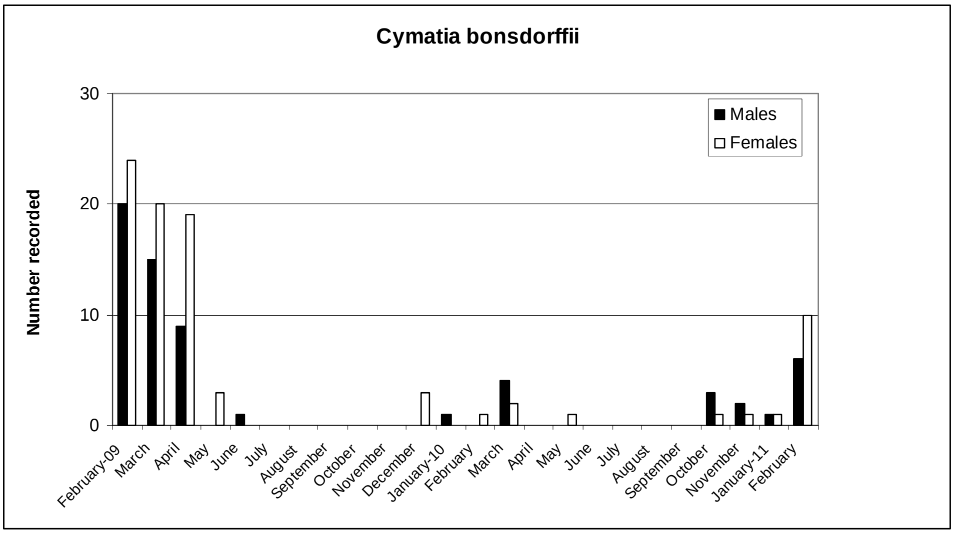
Seasonal occurrence

Those water bugs recorded in sufficient numbers to allow analysis, mainly corixids, showed the familiar pattern of seasonal abundance with autumn, winter and spring maxima followed by a summer decline of adults after breeding (Figure 3). During the period of study a few species declined in number after the first winter (2009) and either remained at low numbers for the rest of the sampling period (*C. bonsdorffii*, *S. distincta* and *C. dentipes*) or recovered by the second winter (*S. falleni*). Other species showed little change or a slight increase in numbers (*C. coleoptrata, P. minutissima* and *H. linnaei*). The complete data set showing the monthly records is given in Appendix 4.

Conservation classification

The conservation value of the assemblage of water bugs at Priory Water was assessed using the scheme of Chadd & Extence (2004). As described under Methods, each species is given a score between 1 and 10 based on national rarity. The scores for Priory Water, taken as a single site, follow those in Chadd & Extence (*op. cit*.) with a few adjustments for local application to the Midlands (Chadd, *pers. com.*). The scores for the 26 species recorded at Priory Water NR are given in Table 4.





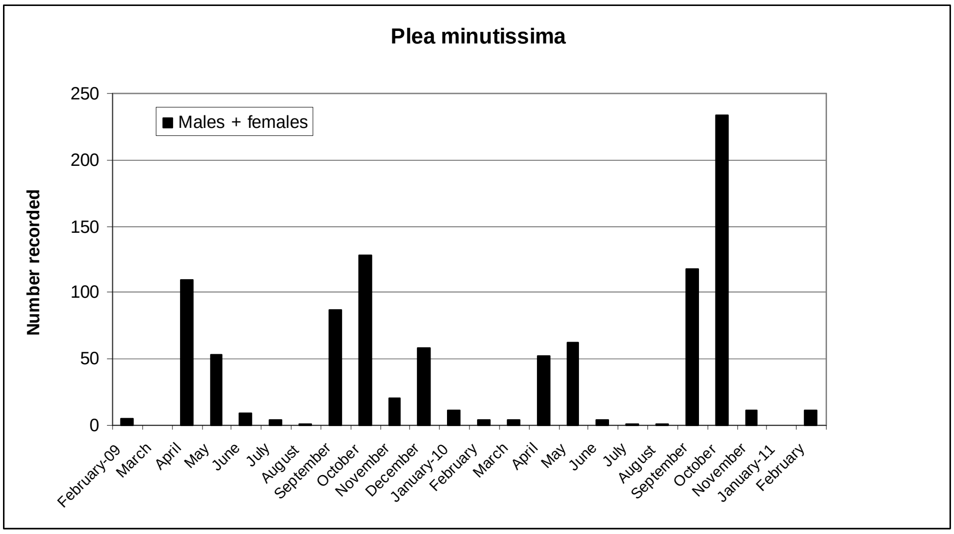
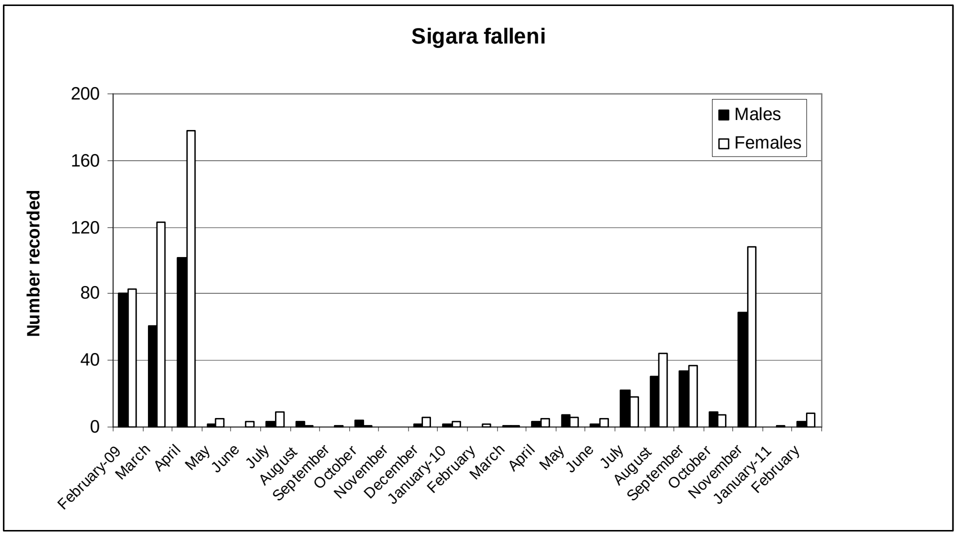
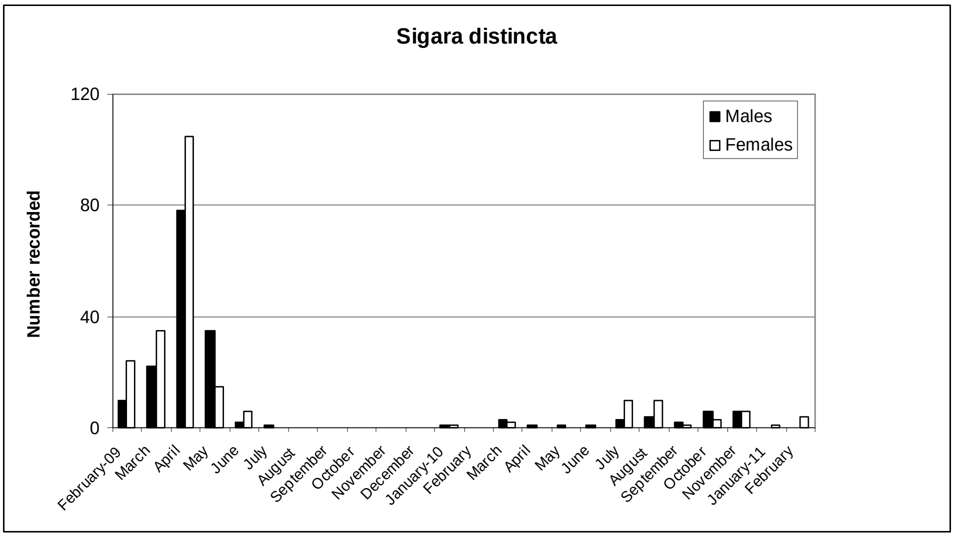


Figure 4a: Seasonal occurrence of common species at Priory Water





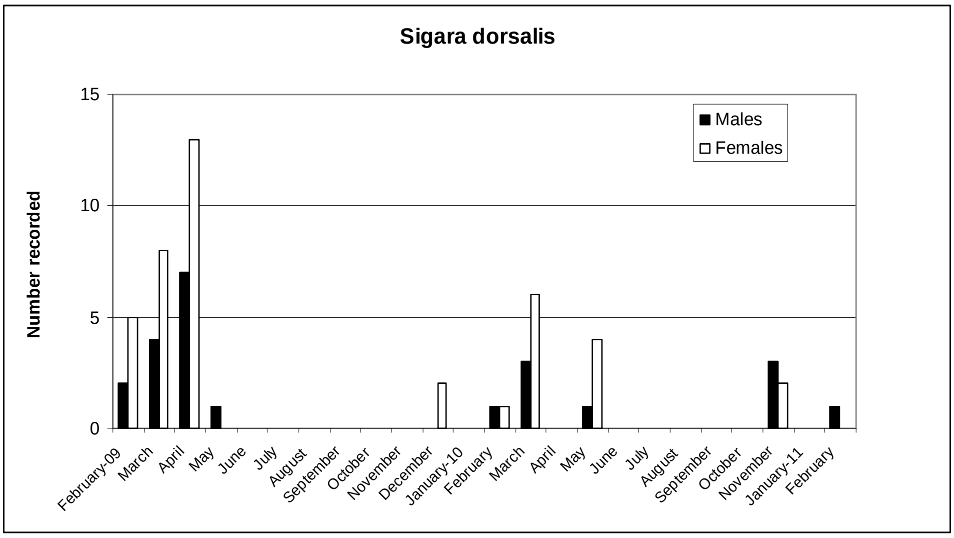


Figure 4b: Seasonal occurrence of common species at Priory Water

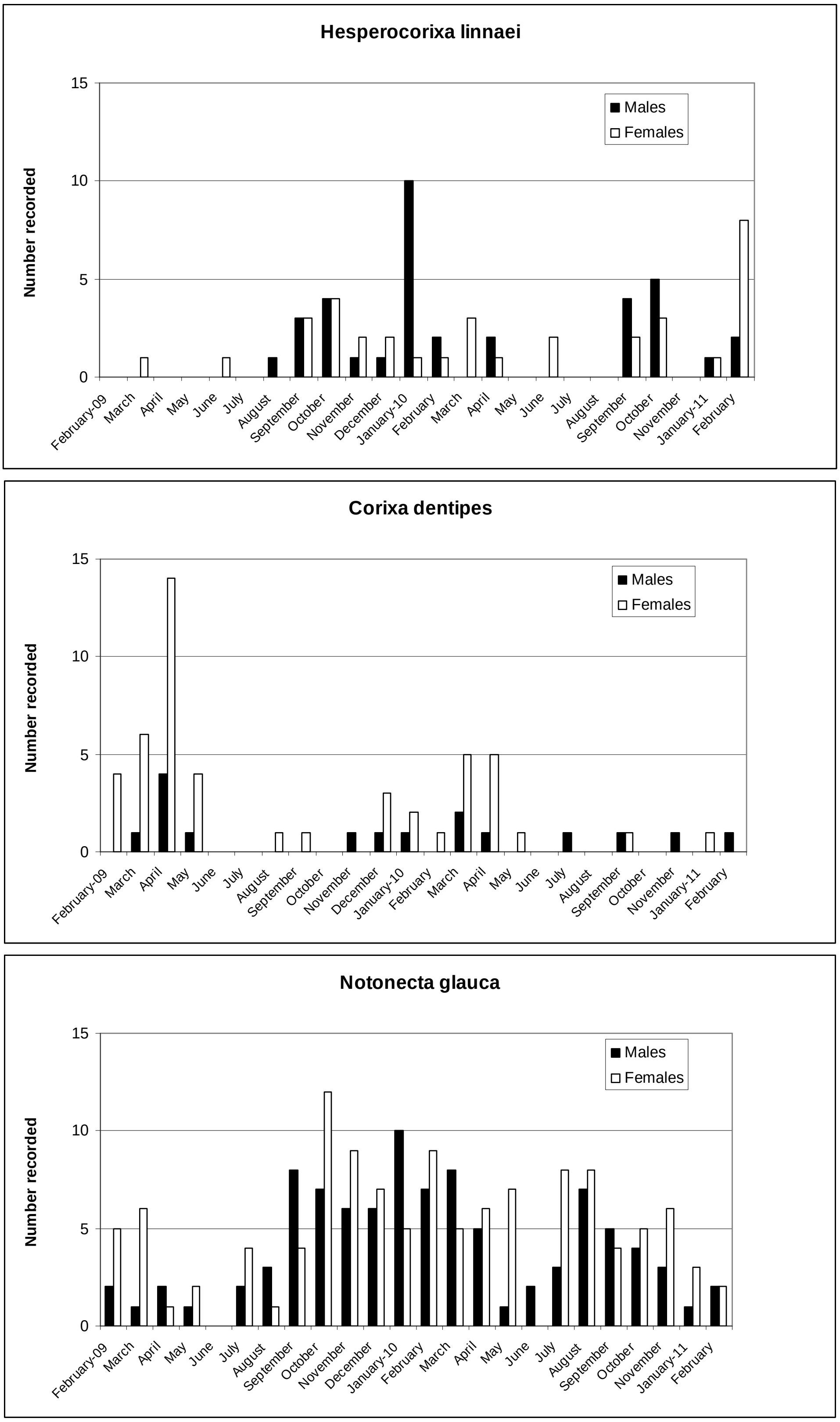


Figure 4c: Seasonal occurrence of common species at Priory Water

The Community Conservation Index (CCI) is given by:

$$CCI = \frac{\sum CS}{n} \times CoS$$

where CS is the Conservation Score, CoS the Community Score and n the number of species. In this case, the CoS is given by the highest CS score, i.e. 6.

$$CCI = \frac{91}{26} \times 6 = 21.0$$

The score of 21.0 is based on a number of sites within the reserve rather than a single site and this approach could give an inflated score for a group of unexceptional sites. However, the score for the Main Lake alone (three sites) comes to 21.9 and for the two adjacent southern Main Lake sites 21.3. The highest score, 23.25, is obtained for the southern open water site (MLSOW) alone.

Table 4: National rarity score for species recorded at Priory Water NR

National Rarity Score					
6	5	4	3	2	1
A. germari *S. iactans* *M. scholtzi*	*C. dentipes* *P. concinna* *C. panzeri* *N. viridis* *M. reticulata* *R. linearis*	*C. bonsdorffii* *C. coleoptrata* *H. linnaei* *I. cimicoides* *P. minutissima*	*C. praeusta* *S. distincta* *S. fossarum* *N. cinerea*	*H. sahlbergi* *S. lateralis* *G. odontogaster*	*S. dorsalis* *S. falleni* *N. glauca* *G. lacustris* *C. punctata*

Discussion

The species recorded

The results show a reasonably clear difference between the smaller Finger Lakes and the larger Main Lake, both in terms of the few abiotic characteristics measured (pH, conductivity and turbidity) and the water bugs sampled (see Appendix 3). It is very likely that the differences in abiotic conditions have an influence on the distribution of the water bug species present, either by directly affecting their physiology, or through indirect effects on other aspects of the aquatic environments such as the presence of predators, prey, competitors and suitable microhabitats. Although the data obtained for this study are insufficient to draw firm conclusions about these relationships they do provide a basis for discussing the presence and distribution of water bug species at Priory Water in relation to other published studies and observations.

The numerical dominance of *Cymatia coleoptrata* in the Main Lake and its virtual absence from the Finger Lakes was an interesting contrast. Whether or not its dominance is an unusual finding for this region is hard to assess. Although there are few records of *C. coleoptrata* for VC55, it is a species that has been spreading from its original southerly base (Hammond, 2006) where it has been recorded as common or dominant in some ponds with dense submerged vegetation, especially *Myriophyllum* and *Ceratophylum* (Lansbury, 1956). At Priory Water NR *C. coleoptrata* was abundant in reed beds in shallow water with no submerged vegetation, a habitat that does not correspond to any of those described by Lansbury as being most suitable for the species. The virtual absence of *C. coleoptrata* from the Finger Lakes may be due to the direct influence of abiotic factors but it is also possible that this predatory species is excluded from these sites by the absence of suitable zooplankton. It is known to feed on *Cladocera* and other small invertebrates (Southwood & Leston, 1959). The larger *Cymatia bonsdorffii* also showed a marked preference for the Main Lake but, unlike *C. coleoptrata,* which was equally abundant in all the Main Lake sites, was more or less confined to the two edge sites with dense emergent vegetation. Analysis of the gut contents of *C. bonnsdorffii* using immunological techniques has shown that dipteran larvae form over 90% of the diet (Reilly & McCarthy 1990).

Cymatia bonnsdorffii is widely distributed throughout Britain in lakes, ponds and pools and, according to Savage (1989), is most likely to be found in habitats with increasing plant and organic matter and in waters with a wide range of conductivity (<100 - 1000µS) and pH. There are six previous records for VC55 and 777 national records. For *C. coleoptrata* there are nine previous records for VC55 and 783 national records.*

Sigara falleni and *S. dorsalis*, both occurred exclusively in the Main Lake, the former in large numbers and the latter in much lower numbers. Savage (1982) has shown that these two common species have different responses to conductivity and to the size and shape of the water body. In North West Midland meres and ponds, where this work was carried out *S. dorsalis* showed a negative correlation with conductivity and *S. falleni* a positive correlation, although there was a good deal of overlap in the conductivity of the habitats in which they were found. The mean conductivity measured in the Main Lake varied between 320 and 327 µS, which is within the range given by Savage (1982) for both species, although, perhaps, more suitable for *S. falleni*. The size and shape of the Main Lake may be a more important determinant of the relative abundance of these two species. Savage (1989) plotted the percentage occurrence of the two species in North West Midland meres and ponds against a 'shelter factor' defined as

Shelter factor of water body = Area (hectares) x Width (m)/Length (m)

He found *S. dorsalis* predominated at smaller and larger values while *S. falleni* predominated at intermediate values. The shelter factor for the Main Lake is between 2 and 3, depending on whether the adjacent Fishing Lake is included (the two are separated by a narrow causeway) which is firmly within the intermediate size range. However, *S.dorsalis* is absent from the small Finger Lakes where it might be expected to dominate as is *S. falleni*, so other factors are clearly involved in determining their distribution. How these insects are responding to the size and shape of water bodies is unclear although, as 'shelter factor' suggests, wave action may be involved.

Sigara falleni is found throughout Britain in clear water preferring non-acidic, non-saline lakes ponds and ditches. There are 37 previous records for VC55 and 1,679 national records. *S. dorsalis*, probably the commonest species of corixid in Britain, is found in lakes, ponds, canals, streams and rivers. It prefers neutral to alkaline water with little fouling from animal excreta (Kirby, 1990). There are 51 previous records for VC55 and 2,256 national records.

S. falleni and the very similar *S. distincta* showed little separation at site level. They occurred together at all Main Lake sites where they were among the most common species, although *S. distincta* was always less abundant than *S. falleni*. Like *S. falleni*, *S. distincta* appears to be more common in water bodies of intermediate size (Macan, 1954; Savage, 1982) and at Priory Water NR the two species had a similar distribution, being most numerous in, or close to, the emergent vegetation of MLSE. This suggests a preference for shelter rather than open water although they are described by Savage as open water species. Unlike *S. falleni*, *S. distincta* occurred in low numbers in both East Finger Lake sites. *Sigara distincta* is common throughout Britain in many different types of water bodies with varying amounts of organic matter. There are 16 previous records for VC55 and 1,779 national records.

*All records given in this account are a combination of those obtained from national records (courtesy Sheila Brooke), VC55 county records (courtesy David Budworth and Gareth Price) and NBN Gateway. We are aware that these records may not include all those given in older publications e.g. Martin (1970) and so may underestimate the abundance of some species. Comments on species habitat preferences are taken from Huxley (2003) unless otherwise stated.

Sigara lateralis and *Paracorixa concinna* were found exclusively or predominantly in open water (MLSOW). Both these species are associated with eutrophic conditions, especially *S. lateralis*, which is often found in ponds fouled by animals. The south lake sites were adjacent to a field grazed by horses and also close to exposed banks in the water used by numerous birds (e.g. gulls, cormorants and waders). The area must have been subject to some enrichment although this had no marked effect on conductivity and was not sufficient to deter more sensitive species such as *S. falleni*. Williams (1995) found, from both field and laboratory observations, that *S. lateralis* was associated with open water habitats. It is found throughout Britain, with 13 previous records for VC55 and 1,515 national records. *Paracorixa concinna* is also widespread in Britain in a range of still waters with four records for VC55 and 1,044 national records.

Callicorixa praeusta was found in very low numbers at all Main Lake sites and is another species often found in eutrophic habitats. It is widely distributed throughout Britain with 25 previous records for VC55 and 2,006 national records.

Sigara iactans is a species new to Britain, first recorded on the North Norfolk coast at Snettisham in 2005 (Brooke, 2005) and since then at other sites (Bedfordshire, Lincolnshire, Northamptonshire and Sussex). In the present study, the species was recorded for the first time in VC55 during March 2009 being found at all three sites in the Main Lake in low numbers.

A single male *Arctocorisa germari* was recorded at MLSOW in May 2009. The open water habitat at this site, with a substrate of silt, gravel and larger stones is typical for this species (Crisp, 1962). Crisp (*op. cit*.) has shown that *A. germari* lays its eggs on stones, unlike many corixids which tend to oviposit on plants, and has a preference for deeper water (>1m). This latter factor may explain why more specimens were not found, although a few subsequent samples taken in deeper water near this site have, so far, proved negative. There are four previous records for this species in VC55 and approximately 700 nationally.

The East Finger Lake was characterised by the presence of the two corixids *Hesperocorixa linnaei* and *Sigara fossarum*. The former is known to be a species of reed beds with a high sediment organic content, while the latter is described by Savage (1989) as an open water species having an intermediate requirement for organic matter. This small lake supported a far greater biomass of emergent, floating and submerged plants than the others and, although organic content was not measured, the assumption that it was comparatively higher here is reasonable. Another feature of the East Finger Lake was the slightly milky appearance and greater turbidity of the water in contrast to the lower turbidity and clear water of the other sites sampled. Whether or not this turbidity is linked to the presence of suspended organic material has not been investigated. As far as we are aware it is a feature that has not been considered as a possible determinant of corixid distribution. Another species associated with high sediment organic content, *Hesperocorixa sahlbergi*, was also confined to the East Finger Lake.

Hesperocorixa linnaei is widely distributed throughout Britain in small lakes, ponds and canals especially in the southern half of Britain. There are eight previous records for VC55 and 1,461 national records. Records for *S. fossarum* are concentrated in the English Midlands, with a scattering of records elsewhere in England, Wales and Scotland. It is found in slow-flowing as well as lentic habitats. There are 23 previous records for VC55 and 1,213 national records. *Hesperocorixa sahlbergi* is a common species found throughout Britain with 46 previous records for VC55 and 2,299 national records.

Two of the less common larger corixid species, *Corixa dentipes* and *C. panzeri*, were recorded in moderate numbers during the survey while the commonest species of the genus (*C. punctata*), both in VC55 (29 records) and nationally (2,229 records) was very scarce. *C. dentipes* and *C. panzeri* both showed a marked preference for the emergent vegetation habitats in the Main Lake (MLN and MLSE). *Corixa dentipes* is widely distributed throughout Britain in a wide range of still and flowing water habitats and is generally found in low numbers (Kirby, 1990). There are seven previous records for VC55 and 661 national records. *Corixa panzeri* is found mainly in the central, southern and eastern England with a scattering of records in the west and north and a few in Scotland. It prefers deeper water habitats (~60cm; Kirby *op.cit.)* which are neutral to alkaline with extensive plant growth. There are seven previous records for VC55 and 1,034 national records.

Notonecta glauca was the dominant water bug in Finger Lakes but relatively scarce in the Main Lake. It was especially abundant in the East Finger Lake. Giller & McNeill (1981) have shown that different species of *Notonecta* have different habitat preferences based on their feeding strategies. They found that *N. glauca* is most likely to occur in well-vegetated habitats with submerged vegetation (for use as perch sites while feeding), cloudy water and an abundance of suitable prey (a range of small invertebrates). The first two characteristics fit the East Finger Lake well but we have no information on the abundance of prey. *N. glauca* is the commonest species in the genus *Notonecta* being found throughout Britain. There are 71 previous records for VC55 and 2,084 national records.

Notonecta viridis appeared to have a contrasting distribution to that of *N. glauca*, at Priory, although low numbers make any assessment very tentative. It was more or less confined to the Main Lake, with two occurrences in the West Finger Lake and one in the East Finger Lake. *N. viridis* is often associated with areas of raised salinity (Southwood & Leston 1959) and, according to Huxley (2003), is found mainly in non-organic, silt-bottomed waters. Although the Main Lake was probably less organically rich than the East Finger Lake, these observations don't offer much of an explanation for the distribution at Priory Water. Unfortunately it was not one of the species covered in the study reported by Giller & McNeill (1981) although it is perhaps relevant to note that *N. maculata* (a species not found at Priory Water) had a very different feeding strategy to that of *N .glauca* and was adapted to simple habitats, sometimes temporary, with little vegetation. The preferred habitat of *N. viridis* probably lies somewhere between these extremes. There are only three previous records of *N. viridis* for VC55 and 958 national records.

Plea minutissima was an abundant species at the study site but almost entirely confined to the Main Lake. It had a very marked preference for sheltered edge sites, occurring in or near emergent *Gylyceria fluitans* on the south side and among *Sparganium erectum* on the north side. This tiny predator is recorded over much of England north to Cumbria and in north Wales, chiefly in weed rich lakes, ponds and ditches. There are 23 previous records for VC55 and 1,859 national records.

Micronecta scholtzi was found in large numbers on the silty substrate at MLSOW in preliminary samples taken in 2008, prior to the regular sampling that started in 2009. Since then it was only recorded five times at the same site. It is a species known for erratic fluctuations in abundance (Brooke *pers. com*.). *M. scholtzi* has been recorded mainly in central and southern England with a few records from Wales. It is confined to water bodies with bare, silty substrates. There are two previous records for VC55 and 460 national records.

The predatory species *Ilyocoris cimicoides* was found in most of the sampling sites at Priory Water but showed a very marked preference for MLN (Table 3). This reed-bed habitat, with shallow water and a soft muddy substrate is a fairly good fit to the description of the species' typical habitat as muddy substrates with dense vegetation given by Southwood & Leston (1959). *I. cimicoides* was confined to the southern half of Britain until fairly recently but is now spreading further north. The northern limit given by Huxley (*op.cit.)* is north east Yorkshire, but it now occurs at least as far north a Newcastle (NBN Gateway). There are 38 previous records for VC55 and 1,647 national records.

Nepa cinerea was taken infrequently from both the Main Lake and the East Finger Lake. It has been recorded throughout much of Britain in weedy shallows of slow or still water. There are 50 previous records for VC55 and 2,081 national records.

Ranatra linearis was recorded only once during the survey in MLN. This is a local species, often abundant where it occurs in a range of habitats, including gravel pits, with emergent vegetation. Nationally it appears to be confined to the Midlands and the south of England with one record in Scotland. There are four previous records for VC55 and 910 national records.

The two species of gerrid recorded during the survey, *Gerris lacustris* and *Gerris odontogaster,* were sampled in low numbers from most habitats. Their rapid movement and acute sensitivity to disturbance makes them difficult to sample even semi-quantitatively. *Gerris lacustris* is a common and widespread species found in a wide variety of waters e.g. ditches, canals, ponds and slow flowing stretches of rivers. There are 39 previous records for VC55 and 2,084 national records. *Gerris odondogaster* is also common and widespread in similar habitats but can tolerate more acidic waters e.g. moorland pools. There are 11 previous records for VC55 and 1,681 national records.

Microvelia reticulata is a species characteristic of 'thick emergent vegetation with clear patches of water in between, especially when sheltered by steep banks or trees' (Southwood & Leston 1954). This is a good description of MLN, where this species was chiefly found. It has been recorded from much of Britain, living on the surface of various types of still water amongst marginal vegetation. There are 21 previous records for VC55 and 1,633 national records.

The conservation index

The values obtained for the conservation index are fairly high according to the guidelines given by Chadd & Extence (2004) especially for a single group of macroinvertebrates. The scheme was originally intended as a measure for all macroinvertebrate groups. They considered a score of over 20 indicated a site of high conservation value, which places Priory Water firmly in this category for water bugs. The 26 species found at Priory constitute 79% of the species recorded in VC55.

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Appendix 1: Priory Water NR monthly abiotic data

Date	Temperature °C					pH					Conductivity µS				
	EFLS	EFLN	WFL	MLN	MLS	EFLS	EFLN	WFL	MLN	MLS	EFLS	EFLN	WFL	MLN	MLS
26/02/09	7.1		7.1	7.2	7.1	6.74		6.77	7.40	6.66	380		302	372	350
26/03/09	10	8.9	9.8	9.9	9.0						412	411	318	357	350
23/04/09	13.1	15.0	15.7	18.0	18.3	7.26	7.30	7.40	7.40	8.30	430	383	330	377	363
26/05/09	15.2	15.4	16.0	18.0	18.2	6.98	7.07	7.50	7.34	8.11	435	416	311	361	358
22/06/09	17.6	16.2	18.7	19.5	19.9	6.8	6.93	6.9	7.63	8.0	392	394	275	337	325
23/07/09	16.3	17.5	19.2	18.5	20.0	6.70	6.80	7.00	10.10	9.60	380	360	230	270	230
18/08/09	16.5	17.5	19.8	19.3	19.5	7.32	7.32	7.41	10.72	10.40	330	318	215	230	240
24/09/09	13.5*	12.6*	14.8	14.0	15.2	7.20*	7.25*	7.45	9.46	11.26	345*	335*	230	266	285
27/11/09	7.4	6.3	6.5	7.4	6.1	6.85	7.11	6.93	7.02	7.57	356	357	268	347	334
15/12/09	4.5	4.1	4.3	5.7	4.6	6.91	6.98	6.87	7.00	7.24	355	354	260	362	345
26/01/10	3.0	2.7	3.0	3.3	3.3	6.75	6.80	6.85	6.97	7.12	280	306	242	352	344
23/02/10	3.8	3.7	3.9	3.4	3.3	6.80	6.90	6.90	7.01	7.45	364	350	280	368	340
26/03/10	10.2	10.7	10.6	11.5	11.4	6.85	7.05	6.94	7.06	7.39	404	403	300	347	337
30/04/10	13.8	14.0	14.7	15.5	15.9	6.83	7.00	7.16	7.24	7.93	436	440	315	357	351
27/05/10	16.5	14.7	16.6	16.9	17.5	6.92	7.15	7.30	7.33	7.64	445	454	302	366	356
16/06/10	14.7	13.9	16.9	17.7	18.2	7.14	7.22	7.36	7.50	8.20	440	440	284	283	265
28/07/10	17.5	17.1	19.3	18.6	21.7	6.93	7.15	7.02	9.44	9.97	428	386	234	244	266
26/08/10	15.1	14.1	16.2	14.7	15.0	6.83	6.96	6.91	6.90	9.50	388	322	233	282	236
30/09/10	12.0	11.4	12.9	12.5	15.7	7.02	6.95	6.90	7.40	9.29	379	343	242	255	244
28/10/10	7.6	8.6	8.4	10.0	9.9	7.10	7.16	7.08	7.13	7.37	378	372	253	311	298
26/11/10	3.5	2.0	2.3	2.9	1.6	7.38	7.58	7.75	7.82	8.03	392	405	285	397	358
27/01/11	2.8	2.4	2.2	3.3	3.0	7.75	7.80	7.60	7.94	8.45	380	350	282	364	362
24/02/11	6.4	6.0	6.2	6.7	6.7	7.70	8.07	7.83	7.79	9.02	407	390	290	376	353
Fishing lake – taken for comparison with main lake				14.9					8.07					287	

*Water level dropped below level of *Phragmites*

Appendix 2: One-way Analysis of Variance (ANOVA) of abiotic factors at Priory Water Nature Reserve

One-way ANOVA: EFN, EFS, WFL, MLN, MLSOW - Conductivity

```
Source   DF      SS     MS      F      P
Factor    4  204462  51116  27.79  0.000
Error   110  202324   1839
Total   114  406786

S = 42.89   R-Sq = 50.26%   R-Sq(adj) = 48.45%


                          Individual 95% CIs For Mean Based on
                          Pooled StDev
Level   N    Mean  StDev  ------+---------+---------+---------+---
EFS    23  388.52  39.88                               (---*----)
EFN    23  377.17  40.35                            (---*----)
WFL    23  273.09  33.22  (---*----)
MLN    23  325.26  51.66               (---*----)
MLSOW  23  316.96  46.97             (---*----)
                          ------+---------+---------+---------+---
                              280       320       360       400

Pooled StDev = 42.89
```

One-way ANOVA: EFN, EFS, WFL, MLN, MLSOW - pH

```
Source   DF      SS     MS      F      P
Factor    4  27.901  6.975  11.70  0.000
Error   105  62.605  0.596
Total   109  90.506

S = 0.7722   R-Sq = 30.83%   R-Sq(adj) = 28.19%


                           Individual 95% CIs For Mean Based on
                           Pooled StDev
Level   N    Mean   StDev  ------+---------+---------+---------+---
EFS    22  7.0091  0.2883  (-----*------)
EFN    22  7.1364  0.2995    (------*-----)
WFL    22  7.1377  0.2932    (------*-----)
MLN    22  7.7536  1.1118                 (-----*------)
MLSOW  22  8.3382  1.2191                            (------*-----)
                           ------+---------+---------+---------+---
                               7.00      7.50      8.00      8.50

Pooled StDev = 0.7722
```

One-way ANOVA: EFN, EFS, WF, MLN, MLS -Temperature

Source	DF	SS	MS	F	P
Factor	4	47.9	12.0	0.35	0.843
Error	110	3756.4	34.1		
Total	114	3804.3			

S = 5.844   R-Sq = 1.26%   R-Sq(adj) = 0.00%

```
                               Individual 95% CIs For Mean Based on
                               Pooled StDev
Level   N    Mean  StDev  ---------+---------+---------+---------+
EFN    23  10.787  5.157   (-----------*-----------)
EFS    23  10.543  5.264  (-----------*-----------)
WF     23  11.526  6.097       (-----------*-----------)
MLN    23  11.930  5.944         (-----------*-----------)
MLS    23  12.222  6.628          (-----------*-----------)
                          ---------+---------+---------+---------+
                                10.0      12.0      14.0      16.0
```

Pooled StDev = 5.844

Appendix 3: Ordination of sites

The first step in this basic ordination procedure (Wratten & Fry, 1980) is to calculate the similarity between the sites from the data in Table 2 using the formula:

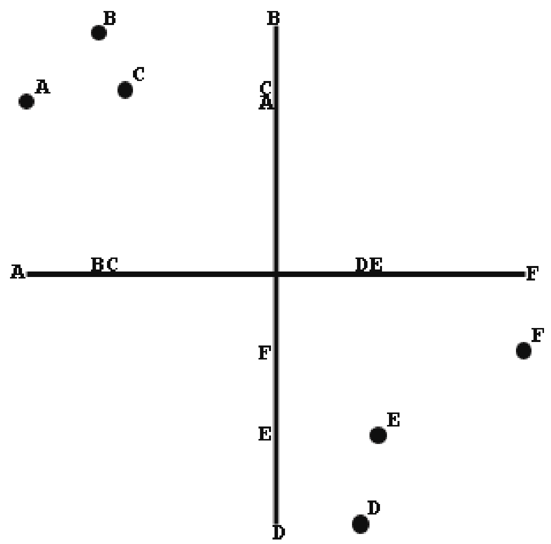
$$\text{Similarity Coefficient} = \frac{2w}{A+B}$$

where: ***A*** is the sum of values for all species in site A
B is the sum of all values in site B
w is the sum of lower values for species common to both sites.

The similarity values are shown in the bottom half of the table below. Dissimilarity values, shown in the top half of the table, are then calculated by subtracting the similarity values from 1.

Similarity	Dissimilarity (1 – Similarity)					
	A (MLSOW)	B (MLSE)	C (MLN)	D (EFLS)	E (EFLN)	F (WFL)
A (MLSOW)		0.30076839	0.027601501	0.9865501	0.98653199	0.98983297
B (MLSE)	0.99923161		0.25749424	0.98291989	0.98290598	0.9804172
C (MLN)	0.72398499	0.74250576		0.96563574	0.96100917	0.9596577
D (EFLS)	0.0134499	0.01708011	0.03436426		0.4	0.77083333
E (EFLN)	0.01346801	0.01709402	0.03899083	0.6		0.74736842
F (WFL)	0.01016703	0.0195828	0.0403423	0.22916667	0.25263158	

The dissimilarity values are then used to ordinate the sites. The first axis is drawn with a length proportional to the greatest dissimilarity between two sites, that between A and F, and the other sites are arranged on the line according to their distance (dissimilarity) from the two marker sites. Two other sites with a high dissimilarity are then used to set up a second axis resulting in a two-dimensional ordination as shown below.



Appendix 4a: Monthly species counts of water bugs at Priory Water NR – East Finger Lake South

Species	2009											2010											2011	
	26/02	26/03	23/04	26/05	22/06	23/07	18/08	24/09	23/10	27/11	15/12	26/01	23/02	26/03	30/04	27/05	16/06	28/07	26/08	30/09	28/10	26/11	22/01	24/02
Arctocorisa germari																								
Callicorixa praeusta																								
Corixid nymphs							1												1		1			
Corixa dentipes																				1♂1♀				
Corixa panzeri										1♀										1♂				
Corixa punctata																								
Cymatia bonsdorffii																						1♂		
Cymatia coleoptrata											2♀												1♀	
Gerrid nymphs																			1					
Gerris lacustris																			1					
Gerris odontogaster														1♂										
Hesperocorixa linnaei								1♂2♀	1♂	1♂1♀		5♂1♀	2♂	1♀	1♂		2♀			1♀		1♀	1♀	2♂4♀
Hesperocorixa sahlbergi	1♂3♀	1♂	2♀																1♀				1♂1♀	
Ilyocoris cimicoides																1♀								
Micronecta scholtzi																								
Microvelia reticulata																								
Nepa cinerea																				1				
Notonecta nymphs				2	6	2									1	7		2						
Notonecta glauca	2♂2♀	1♂3♀					1♂1♀	8♂1♀	6♂5♀	2♂5♀	3♂3♀	1♂1♀	4♂4♀	3♂2♀	1♂	3♀	1♂	3♂8♀	7♂8♀	3♂4♀	4♂4♀	2♂5♀	1♂2♀	1♂
Notonecta viridis																								
Paracorixa concinna																								
Plea minutissima							1										1							
Plea nymphs																								
Ranatra linearis																								
Sigara distincta					5♀							1♀											2♀	
Sigara dorsalis																								
Sigara falleni																								
Sigara fossarum																						1♂		
Sigara iactans																								
Sigara lateralis																								

♂ = male ♀ = female n = nymph

Appendix 4b: Monthly species counts of water bugs at Priory Water NR – East Finger Lake North

Species	2009											2010											2011	
	26/02	26/03	23/04	26/05	22/06	23/07	18/08	24/09	23/10	27/11	15/12	26/01	23/02	26/03	30/04	27/05	16/06	28/07	26/08	30/09	28/10	26/11	22/01	24/02
Arctocorisa germari																								
Callicorixa praeusta																								
Corixid nymphs							4												11					
Corixa dentipes							1♀	1♀						1♂1♀	1♂							1♂		1♂
Corixa panzeri																								
Corixa punctata																								
Cymatia bonsdorffii												1♂												
Cymatia coleoptrata																								
Gerrid nymphs																								
Gerris lacustris																								
Gerris odontogaster														1♀	1♂				1					
Hesperocorixa linnaei			1♀		1♀		1♂	2♂1♀	3♂4♀	1♀	1♂2♀	5♂	1♀	2♀	1♂1♀					4♂1♀	5♂3♀	1♀	1♂	4♀
Hesperocorixa sahlbergi	1♀											1♀		1♀						1♀	1♂1♀			
Ilyocoris cimicoides																								
Micronecta scholtzi																								
Microvelia reticulata																		1						
Nepa cinerea							1n												1	2			1	
Notonecta nymphs				3	17												4							
Notonecta glauca	3♀	2♀		1♀		1♀	1♂		4♀	2♂1♀	2♂4♀	9♂3♀	3♂5♀	1♂1♀	2♂4♀	3♀				1♂		1♂1♀	1♀	1♀
Notonecta viridis																								1♀
Paracorixa concinna																								
Plea minutissima																								
Plea nymphs																								
Ranatra linearis																			1					
Sigara distincta																					4♂3♀			1♀
Sigara dorsalis																								
Sigara falleni																								
Sigara fossarum					1♂		1♀			1♂						1♂			3♂	1♂1♀	10♂6♀	3♀	4♀	
Sigara iactans																								
Sigara lateralis																								

♂ = male ♀ = female n = nymph

Appendix 4c: Monthly species counts of water bugs at Priory Water NR – West Finger Lake

Species	2009											2010											2011	
	26/02	26/03	23/04	26/05	22/06	23/07	18/08	24/09	23/10	27/11	15/12	26/01	23/02	26/03	30/04	27/05	16/06	28/07	26/08	30/09	28/10	26/11	22/01	24/02
Arctocorisa germari																								
Callicorixa praeusta																								
Corixid nymphs				1			5												2					
Corixa dentipes		1♀													3♀									
Corixa panzeri			1♂								1♀													
Corixa punctata																								
Cymatia bonsdorffii																								
Cymatia coleoptrata												1♀												
Gerrid nymphs					1														4					
Gerris lacustris						1♂2♀		1♀	1♂									2♀	1					
Gerris odontogaster						1♂													1					
Hesperocorixa linnaei																								
Hesperocorixa sahlbergi																								
Ilyocoris cimicoides								1									1n		1♂					
Micronecta scholtzi																								
Microvelia reticulata																		2						
Nepa cinerea																								
Notonecta nymphs				6	5												4							
Notonecta glauca			1♀			1♂2♀	1♂	1♀	1♂1♀	1♂3♀		1♀		1♂	2♀									
Notonecta viridis									1♂1♀															
Paracorixa concinna																								
Plea minutissima																								
Plea nymphs																								
Ranatra linearis																								
Sigara distincta		1♂1♀																						
Sigara dorsalis																								
Sigara falleni																								
Sigara fossarum																								
Sigara iactans																								
Sigara lateralis																								

♂ = male ♀ = female n = nymph

Appendix 4d: Monthly species counts of water bugs at Priory Water NR – Main Lake North

Species	2009											2010											2011	
	26/02	26/03	23/04	26/05	22/06	23/07	18/08	24/09	23/10	27/11	15/12	26/01	23/02	26/03	30/04	27/05	16/06	28/07	26/08	30/09	28/10	26/11	22/01	24/02
Arctocorisa germari																								
Callicorixa praeusta	2♀	1♂																						
Corixid nymphs				2		1												3						
Corixa dentipes		1♂6♀	3♂3♀	1♀								1♂1♀	1♀	2♂4♀	1♀									
Corixa panzeri		1♂1♀	2♀								1♀	1♀	1♂	3♂2♀										
Corixa punctata																								
Cymatia bonsdorffii	11♂14♀	11♂18♀	4♂12♀											2♂2♀									1♀	2♂6♀
Cymatia coleoptrata	17♂15♀	1♂2♀	6♀	2♂2♀					43♂33♀	39♂49♀	93♂68♀	29♂40♀	17♂24♀	112♂158♀	1♂1♀	1♂6♀				10♂35♀	5♂19♀	7♂20♀	20♂33♀	64♂74♀
Gerrid nymphs					1													1						
Gerris lacustris																								
Gerris odontogaster				1♂1♀			1♂																	
Hesperocorixa linnaei																								
Hespero. sahlbergi																								
Ilyocoris cimicoides			2♂	1n	1n			1	9	1	1♂1♀				1♂	1♀	5n	2n		5	4	1		
Micronecta scholtzi																								
Microvelia reticulata						5	10+	4+																
Nepa cinerea						1+1n																		
Notonecta nymphs					1											8								
Notonecta glauca		1♀	2♂	1♀		1♂		2♀	2♀	1♂				2♂2♀		1♀	1♂							1♂1♀
Notonecta viridis			1♀				2♂		1♂1♀			1♂												
Paracorixa concinna	1♂	2♀																						
Plea minutissima	1		87	28	1			16	100	11	58	8	1		15	2	2		1	20	15			7
Plea nymphs																								
Ranatra linearis																								
Sigara distincta	6♂14♀	19♂24♀												2♀									1♀	
Sigara dorsalis	1♂2♀	2♂4♀											1♀	1♂										
Sigara falleni	22♂31♀	31♂79♀	1♀								4♀	2♀		1♂1♀								1♂		1♀
Sigara fossarum																								
Sigara iactans		1♂																						
Sigara lateralis																								

♂ = male ♀ = female n = nymph

Appendix 4e: Monthly species counts of water bugs at Priory Water NR – Main Lake Sout – Open Water

Species	2009											2010											2011	
	26/02	26/03	23/04	26/05	22/06	23/07	18/08	24/09	23/10	27/11	15/12	26/01	23/02	26/03	30/04	27/05	16/06	28/07	26/08	30/09	28/10	26/11	22/01	24/02
Arctocorisa germari				1♂																				
Callicorixa praeusta		1♀																1♀		1♀				
Corixid nymphs								1												24				
Corixa dentipes																								
Corixa panzeri			1♂																					
Corixa punctata																								
Cymatia bonsdorffii	1♀	1♀	1♂	3♀	1♂											1♀					1♂1♀			
Cymatia coleoptrata	52♂55♀	20♂35♀	3♂14♀	34♂31♀	3♂1♀	2♂1♀	1♂	12♂11♀		2♂	3♀	1♀	1♀		4♂8♀	148♂79♀		3♂4♀		3♀	32♂50♀	36♂22♀		3♂3♀
Gerrid nymphs																								
Gerris lacustris																								
Gerris odontogaster																								
Hesperocorixa linnaei																								
Hespero. sahlbergi																								
Ilyocoris cimicoides								3																
Micronecta scholtzi									1n									4						
Microvelia reticulata																								
Nepa cinerea																								
Notonecta nymphs																								
Notonecta glauca																								
Notonecta viridis																								
Paracorixa concinna	1♂	1♂		4♂2♀		2♀									1♂1♀									
Plea minutissima				1	1	1		65	2							17		1		1	8			
Plea nymphs								40										6						
Ranatra linearis																								
Sigara distincta	1♂1♀	3♀	7♂45♀	1♂4♀	2♂1♀									3♂	1♂			3♂10♀	4♂10♀	2♂1♀			1♀	
Sigara dorsalis		2♂																						
Sigara falleni	21♂12♀	11♂14♀	13♂35♀	5♂5♀	3♀	2♂3♀	3♂1♀		1♂			1♂			2♂2♀		1♂5♀	22♂17♀	30♂44♀	34♂37♀	4♂2♀	1♂		1♂
Sigara fossarum																			1♂					
Sigara iactans																			1♂	1♂				
Sigara lateralis																		8♂7♀	3♂	16♂6♀				

♂ = male ♀ = female n = nymph

Appendix 4f: Monthly species counts of water bugs at Priory Water NR – Main Lake South - Edge

Species	2009											2010											2011	
	26/02	26/03	23/04	26/05	22/06	23/07	18/08	24/09	23/10	27/11	15/12	26/01	23/02	26/03	30/04	27/05	16/06	28/07	26/08	30/09	28/10	26/11	22/01	24/02
Arctocorisa germari																								
Callicorixa praeusta			1♀								1♂			2♀										
Corixid nymphs				58			17								1	9	1	9	345		104			
Corixa dentipes			1♂11♀	1♂3♀						1♂	1♂3♀	1♀		1♀	1♀	3♂1♀		1♂					1♀	
Corixa panzeri	1♂		2♂7♀	1♀						1♀	1♂				3♀							1♀		
Corixa punctata														2♂3♀										
Cymatia bonsdorffii	9♂9♀	4♂1♀	4♂7♀								3♀		1♀	2♂							2♂	1♂1♀	1♂	4♂4♀
Cymatia coleoptrata	28♂27♀	1♀	4♂12♀	2♂	2♀				3♂	36♂24♀	87♂111♀	35♂35♀	36♂50♀	31♂53♀	22♂7♀	3♂3♀	9♂8♀	1♀		4♂10♀	67♂45♀	14♂17♀	9♂6♀	76♂87♀
Gerrid nymphs					1			1																
Gerris lacustris								1♀										1♂						
Gerris odontogaster																					1♂			
Hesperocorixa linnaei																								
Hespero. Sahlbergi																								
Ilyocoris cimicoides									2		1♀						7n							
Micronecta scholtzi																			1					
Microvelia reticulata																								
Nepa cinerea																								
Notonecta nymphs				2	1													1						
Notonecta glauca						1♀					1♂			1♂	2♂	1♂					1♀			
Notonecta viridis			1♂												1♀	1♂					2♂1♀			
Paracorixa concinna			2♂1♀	1♀										1♀		1♂3♀								
Plea minutissima	4		23	24	7	3		6	26	9		3	3	4	37	44	1			97	211	11		4
Plea nymphs								1	3									1		9	14			
Ranatra linearis																								
Sigara distincta	3♂9♀	3♂8♀	71♂60♀	34♂11♀		1♂						1♂				1♂	1♂				2♂	6♂6♀		
Sigara dorsalis	1♂3♀	4♀	7♂13♀	1♂							2♀		1♀	2♂6♀		1♂4♀						3♂2♀		1♂
Sigara falleni	37♂40♀	19♂30♀	89♂142♀			1♂6♀		1♀	3♂1♀		2♂2♀	1♂1♀	2♀		1♂3♀	7♂6♀	1♂	1♀			5♂5♀	67♂108♀	1♀	2♂7♀
Sigara fossarum																								
Sigara iactans			1♂													1♂						1♂		
Sigara lateralis																								

♂ = male ♀ = female n = nymph