

**LEICESTERSHIRE  
ENTOMOLOGICAL SOCIETY**

**A study of the water beetles of  
Priory Water NR,  
Leicestershire**

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*Rhantus grapii*

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## Introduction

The term 'water beetle' applies to a diverse range of beetles, from over twenty families, that spend at least part of their life cycle in water. Only a few beetles are confined to water throughout their life cycle (reed beetles in the genus *Macropilea*) while many others, including the familiar diving beetles, live in water as larvae and adults but pupate in damp ground away from water. A third group, which includes the Scirtidae and some species in the Chrysomelidae and Curculionidae, live in water as larvae but are terrestrial as adults (Foster, 2010). Water beetles are found in both sub-orders of the Coleoptera: the mainly predatory Adephaga (typified by the family Dytiscidae) and the Polyphaga (represented by a varied group of generally small beetles mostly within the family Hydrophilidae). The Hydrophilidae also includes the largest British water beetle *Hydrophilus piceus*.

Published work on the water beetles of Leicestershire & Rutland (VC55) dates back to the 19<sup>th</sup> century (Lott 2009). Robson (1879) recorded the predaceous water beetles he found in the Soar valley and notes in his introduction his concern about the lack of interest in the group:

*'Botany is regarded as being a very beautiful science, and Geology has powerful attractions; but, Beetles! why the very name is too much for the sensitiveness of ladies, and even gentlemen shrink from handling them. Butterflies and moths have many admirers of both sexes, but Beetles, particularly Water Beetles, live almost totally undisturbed in their native habitats.'*

One man who clearly was not squeamish about water beetles was Fredrick Bates, a naturalist active in the county for most of the latter half of the 19<sup>th</sup> century (1848-1896) and to whom many of the earliest water beetle records held by The Leicestershire & Rutland Environmental Records Centre (LRERC) are due. His publications, however, are confined to terrestrial species. Wallis (1919) gave a short account of the aquatic coleoptera of the Trent valley near Long Eaton on the Leicestershire border. He recorded 25 species in the outdoor swimming pool of Trent College (Nottinghamshire) but apart from this gave no habitat details for the species found which included some from Leicestershire. Mathias (1979) listed water beetles from a variety of habitats in his report of a biological survey of freshwater invertebrates of a North-East Leicestershire Coalfield. He recorded 32 species from Asfordby, Hose and Saltby, 18 of which were new to the county. Many of the more recent records of Leicestershire water beetles are due to the work of Derek Lott who, between 1980 and 2007, added many species to the county list.

Published accounts of detailed ecological surveys of water beetles in particular sites over an extended time period are hard to find, either for VC55 or for the UK generally. Since the days of Balfour-Browne, who played an important part in promoting the serious study of water beetles, their habitats and distribution in Britain (see Balfour-Browne, 1962), there have been numerous publications on water beetles, mainly of species records for particular sites (see, for instance, references in Foster, 2010). More detailed ecological studies include those on water beetle habitat classification (Eyre *et al*, 1986; Foster & Eyre, 1992), the relationship between water beetles and macrophytes in Norfolk Breckland water bodies (Palmer, 1981), the use of water beetles (with other groups of aquatic insects) in monitoring water quality (Hawkes, 1998) and in the classification of sites for their conservation value (Chadd & Extence, 2004). The ecology of scarce and threatened water beetles in Great Britain is described by Foster (2010).

Priory Water, the site of this study, 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 are open water. For further information see the Priory Water Wildfowl Project handbook (Shelton, 2007).

The aims of the study were to record the water beetles present at the site, to monitor seasonal abundance, 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 (for site map see Cook & Clark, 2011). At each site abiotic variables were recorded and samples taken for aquatic coleoptera. 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. 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 April 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.

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 coleoptera 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 coleoptera were removed and stored in plastic specimen tubes containing 75% Industrial Methylated Spirits (IMS). Specimens were identified and counted using a dissecting microscope and keys by Foster & Friday (2011). The similarity between water beetle assemblages at the different sampling sites was analysed using a single linkage cluster analysis (Minitab 14 statistical programme).

Additional sampling was carried out with submerged bottle traps. Bottle traps have been used successfully in a number of water beetle studies (for example Denton, 1996) and are particularly good for the capture of larger water beetles e.g. dytiscids. Bottle traps are also useful for catching water beetles in habitats where sampling with a hand net is difficult, for example in dense reed beds or other densely vegetated habitats. The trap in this study was constructed from two 1.5 litre plastic spring water bottles. The opening end of the one bottle was cut off so as to form a funnel. The bottom of the second bottle was removed and the funnel inserted and then stapled in position. The cap of the second bottle was left in place. A length of twine was attached to the funnel end of the trap so that after submergence in the habitat to be sampled it could be retrieved without loss of any contents. The traps were left in place for seven days and emptied by removing the screw top and pouring through a net above a bucket. Beetles that could easily be identified were released and the rest of the sample preserved in 70% IMS. All sites were trapped in September and October 2012.

The conservation value of Priory Water NR with respect to water beetles was assessed using the method of Chadd & Extence (2004). The assessment is based on the conservation scores given to each species on a scale of 1 to 10 (very common to endangered, respectively). 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).

## Site descriptions

East Finger Lake South (EFLS) (Grid ref. SK71706 18775) – 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.

East Finger Lake North (EFLN) (Grid ref. SK71674 18809) - 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 *Potamogeton 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 tallows, willows (*Salix* spp.) and alder (*Alnus* spp.).

West Finger Lake (WFL) (Grid ref. SK71365 18679) – a site where the water's edge was dominated with *G. fluitans* and the open water by *Potamogeton* 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.

Main Lake North (MLN) (Grid ref. SK71370 18683) - 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.

Main Lake South Open Water (MLSOW) (Grid ref. SK71451 18495) - 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.

Main Lake South Edge (MLSE) (Grid ref. SK7146185) – 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. Both south lake sites were probably subject to some nutrient enrichment from the large number of water birds that concentrate in that area.

## Results

### Abiotic

The abiotic results for the five sites are summarised in Table 1.

**Table 1: Mean and range values of abiotic factors at each sample site**

Site	Conductivity ( $\mu$ S)	pH	Temperature ( $^{\circ}$ 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.

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.

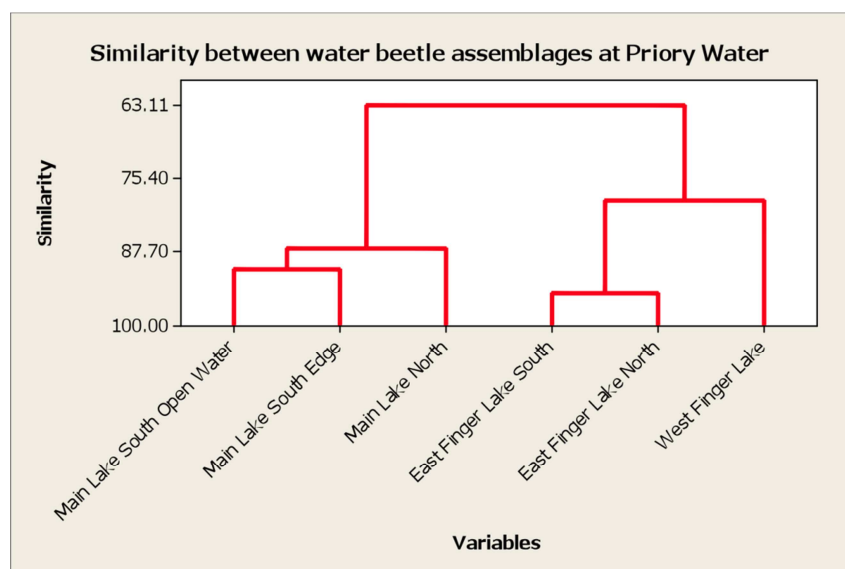
For pH the ANOVA was also significant ( $F = 11.7_{(4, 109)}$ ,  $P < 0.001$ ) and the 95% CI showed that the three Finger Lake sites are not significantly different from each other but have significantly lower pH values than the two Main Lake sites which are not significantly different from each other. 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 of Cook & Clark (2011). 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

Twenty nine species of water beetle were found during the study (Tables 3 and 4). The most species rich site was EFLN (16 species) followed closely by the other well-vegetated sites EFLS, MLSE and MLN. The open sites, MLSO and WFL had fewer species (5 and 9 species respectively).



**Figure 1: Dendrogram showing the similarity between water beetle assemblages at the six sampling sites at Priory Water NR**

The common species (*Hyphydrus ovatus*, *Noterus clavicornis*, *Haliphus lineolatus*, *Ilybius fenestratus*, *Helophorus brevipalpus* and *Gyrinus marinus*) all occurred in the majority of sites (Table 3) but showed a preference for either the Main Lake (e.g. *I. fenestratus*) or the Finger Lakes (e.g. *H. ovatus*). The cluster analysis (Figure 1) gives a fairly clear separation of the

Finger Lakes and the Main Lake in terms of their species composition. The relative abundance of the beetles at different sites is illustrated in Figure 2a & 2b.

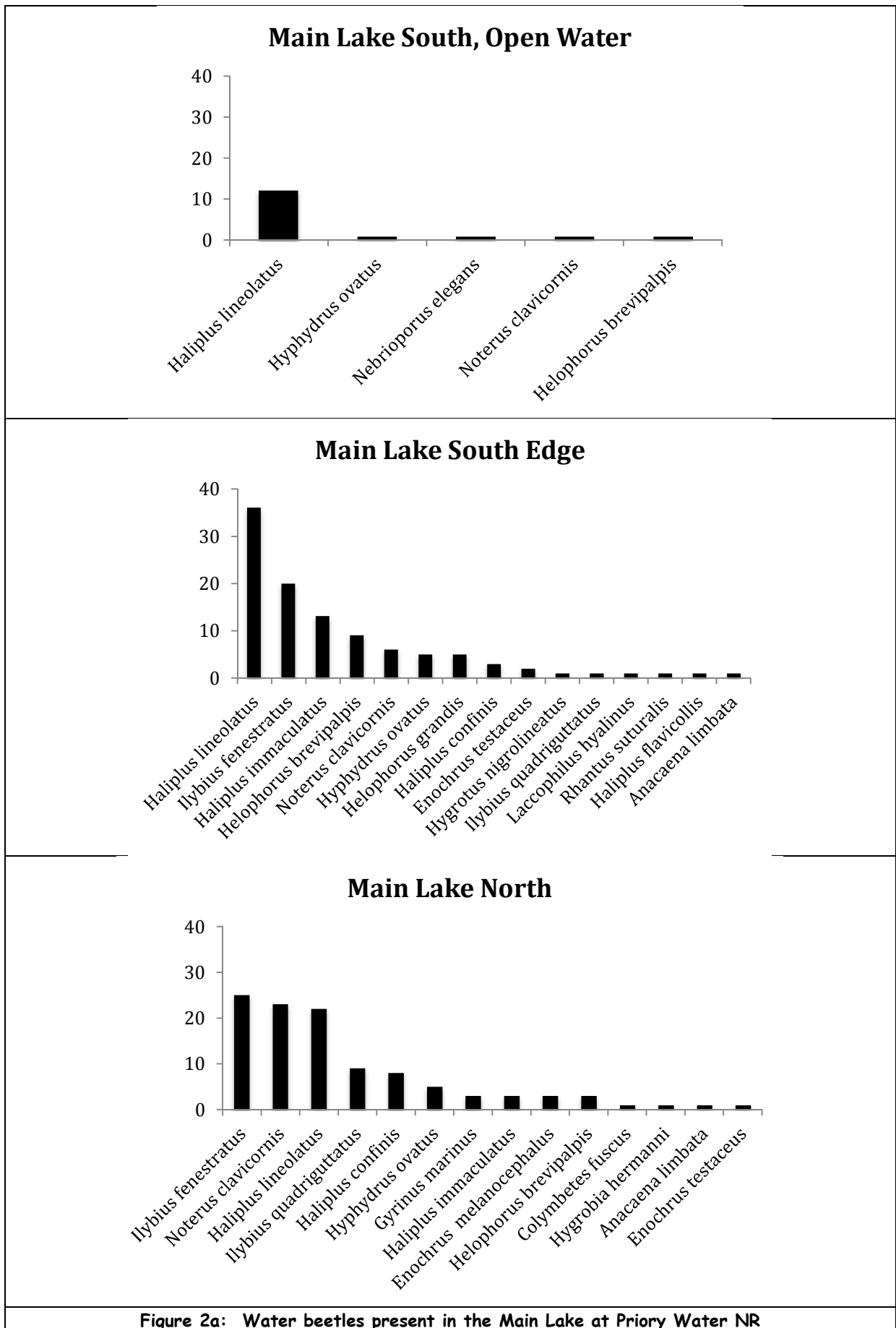
**Table 3: Numbers of each species recorded in net samples at each site  
April 2009 - October 2012**

Species	MLSOW	MLSE	MLN	EFLS	EFLN	WFL
<b>Dytiscidae</b>						
<i>Colymbetes fuscus</i>			1			
<i>Hygrotus nigrolineatus</i>		1				
<i>Hyphydrus ovatus</i>	1	5	5	130	69	15
<i>Ilybius ater</i>				1	1	
<i>Ilybius fenestratus</i>		20	25	12	4	4
<i>Ilybius quadriguttatus</i>		1	9	2	5	1
<i>Laccophilus hyalinus</i>		1		1		
<i>Nebrioporus elegans</i>	1					
<i>Rhantus grapii</i>					1	
<i>Rhantus suturalis</i>		1			1	
<b>Gyrinidae</b>						
<i>Gyrinus marinus</i>			3	8	28	43
<b>Halipidae</b>						
<i>Halipus confinis</i>		3	8		1	
<i>Halipus flavicollis</i>		1				
<i>Halipus immaculatus</i>		13	3	1		
<i>Halipus lineolatus</i>	12	36	22	16	3	1
<i>Halipus ruficollis</i>				2		
<b>Noteridae</b>						
<i>Noterus clavicornis</i>	1	7	24	31	34	9
<b>Paelobiidae</b>						
<i>Hygrobia hermanni</i>			1			
<b>Hydrophilidae</b>						
<i>Anacaena bipustulata</i>					3	1
<i>Anacaena limbata</i>		1	1	1	6	2
<i>Enochrus melanocephalus</i>			3			5
<i>Enochrus testaceus</i>		2	1	4	1	
<i>Helophorus brevipalpis</i>	1	9	3	7	24	
<i>Helophorus grandis</i>		5		2		
<i>Hydrobius fuscipes</i>					1	
<i>Laccobius minutus</i>					1	
Number of species/site	5	15	14	15	16	9

Submerged bottle traps yielded three species not found in net samples (*Dytiscus marginalis*, *Hydroporus palustris* and *Hygrotus inaequalis*) all in EFLS. Six individuals of *Rhantus grapii* were caught in EFLN in a single bottle trap sample while only one specimen had been previously recorded at this site by netting (Table 4).

**Table 4: Water beetles recorded in submerged bottle traps**

Species	MLSOW	MLSE	MLN	EFLS	EFLN	WFL
<b>Dytiscidae</b>						
<i>Dytiscus marginalis</i>				2	1	
<i>Hydroporus palustris</i>					1	
<i>Hygrotus inaequalis</i>				1		
<i>Hyphydrus ovatus</i>			1			
<i>Rhantus grapii</i>				2	6	
<b>Halipidae</b>						
<i>Halipus spp (ruficollis group )</i>			5			
<b>Noteridae</b>						
<i>Noterus clavicornis</i>					1	



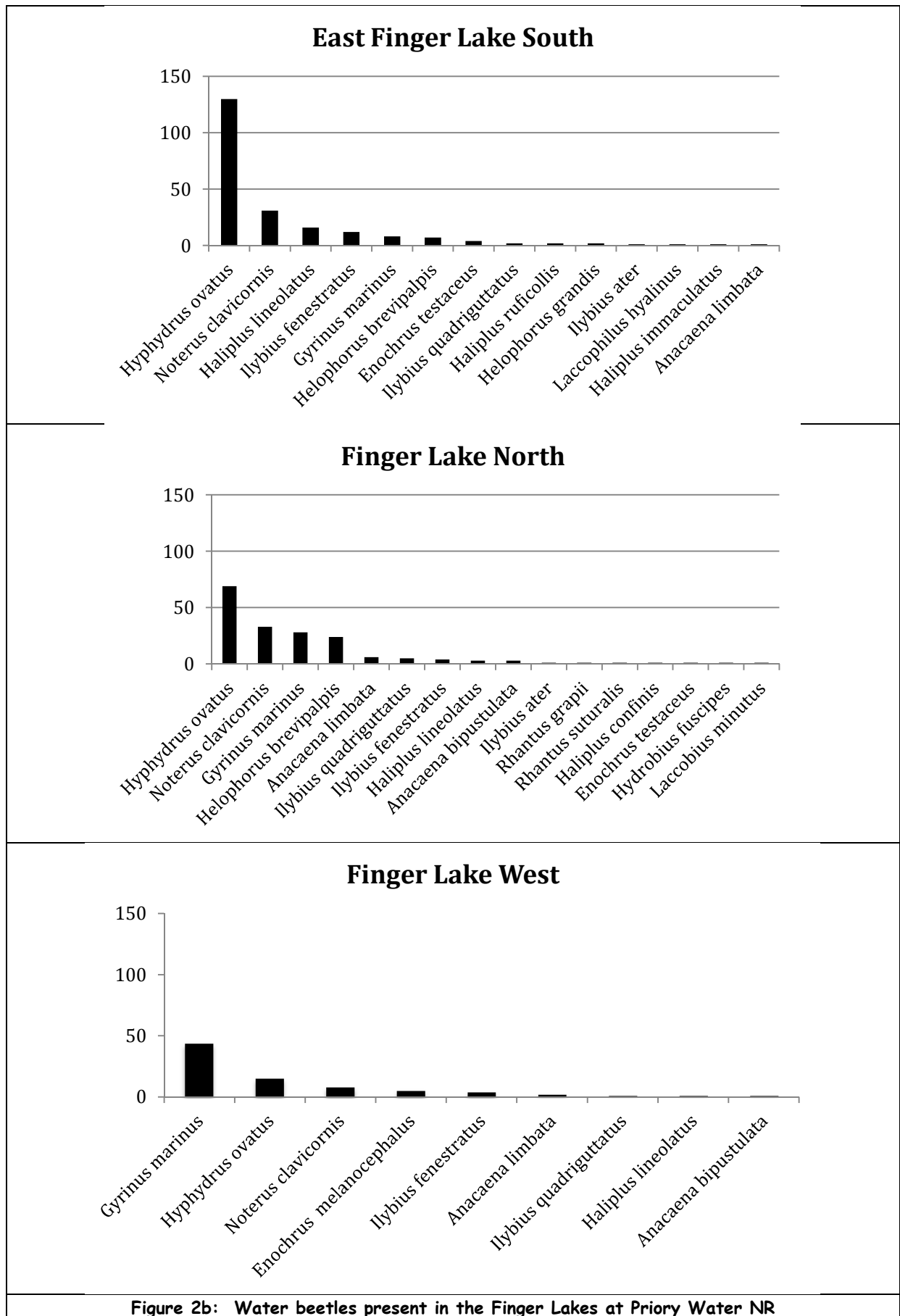
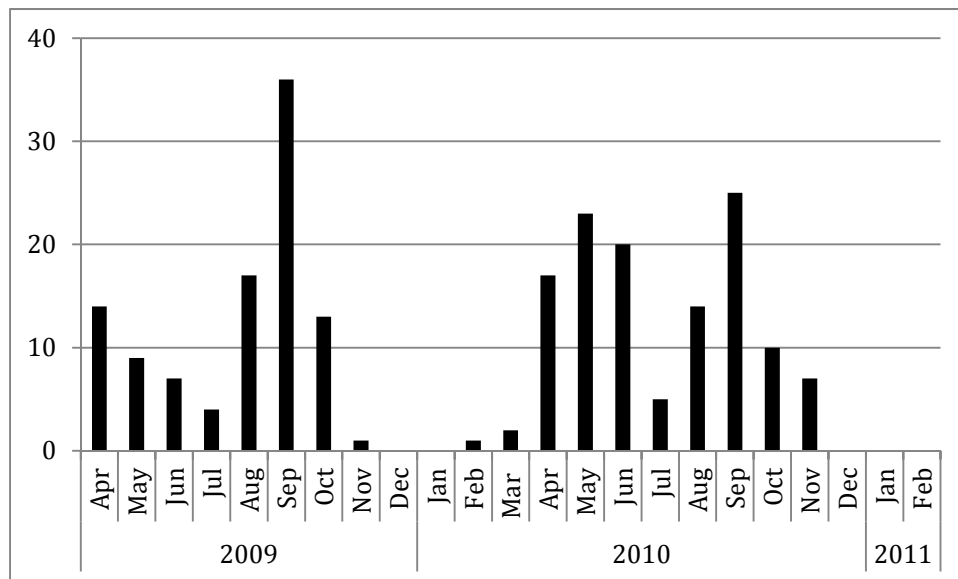


Figure 2b: Water beetles present in the Finger Lakes at Priory Water NR



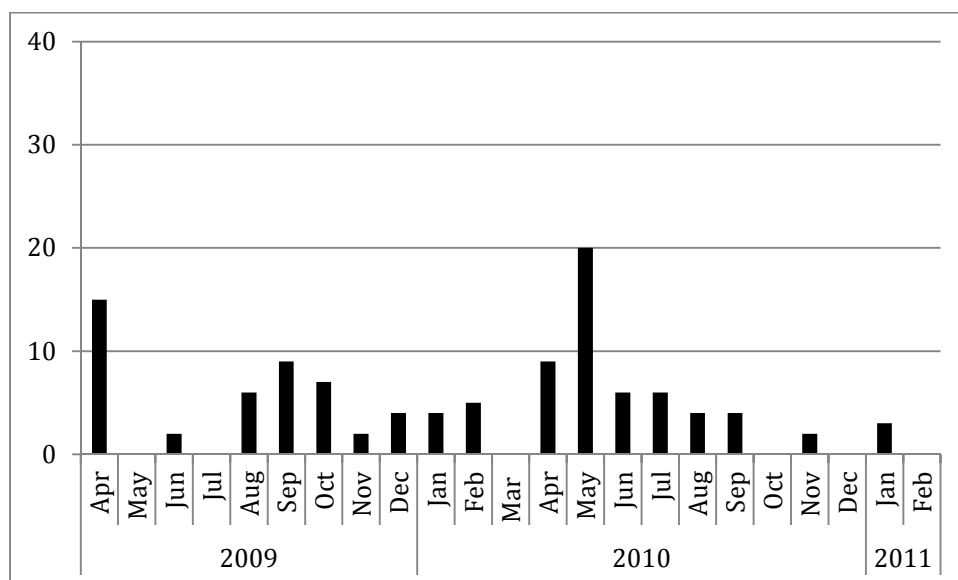
### Seasonal occurrence

Of the 26 species found in monthly net samples only five (*Hyphydrus ovatus*, *Ilibius fenestratus*, *Noterus clavicornis*, *Gyrinus marinus* and *Halipilus lineolatus*) were found in sufficient numbers to allow analysis. Different patterns of abundance were found between the five species and also within a species between years.



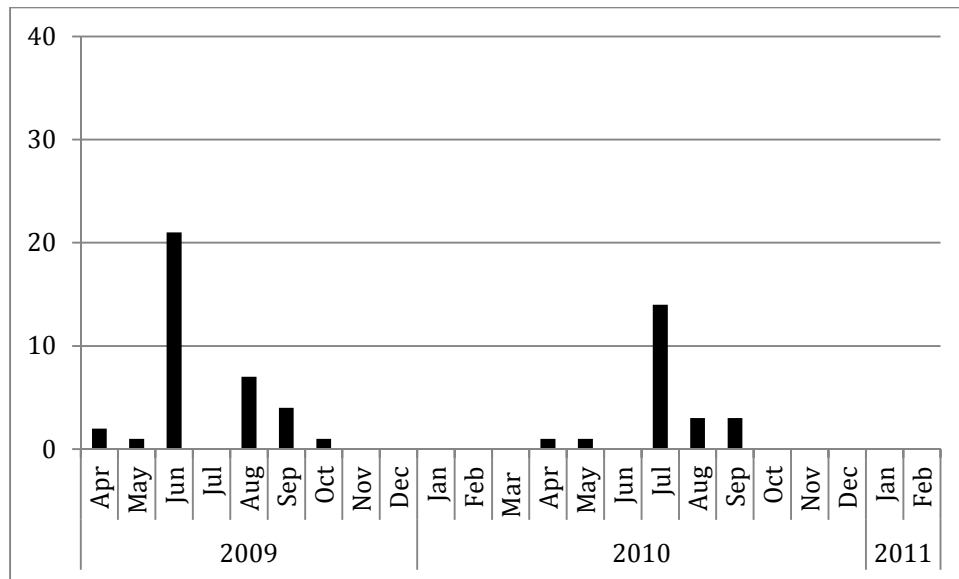
**Figure 3: Seasonal occurrence of *Hyphydrus ovatus* at Priory Water NR**

*Hyphydrus ovatus* numbers peaked in September of both 2009 and 2010 (Figure 3). Otherwise the pattern was different between years with numbers declining from April through to August in 2009 but increasing over the same period in 2010. It was not found in December and January of 2009 or in January and February of 2010.



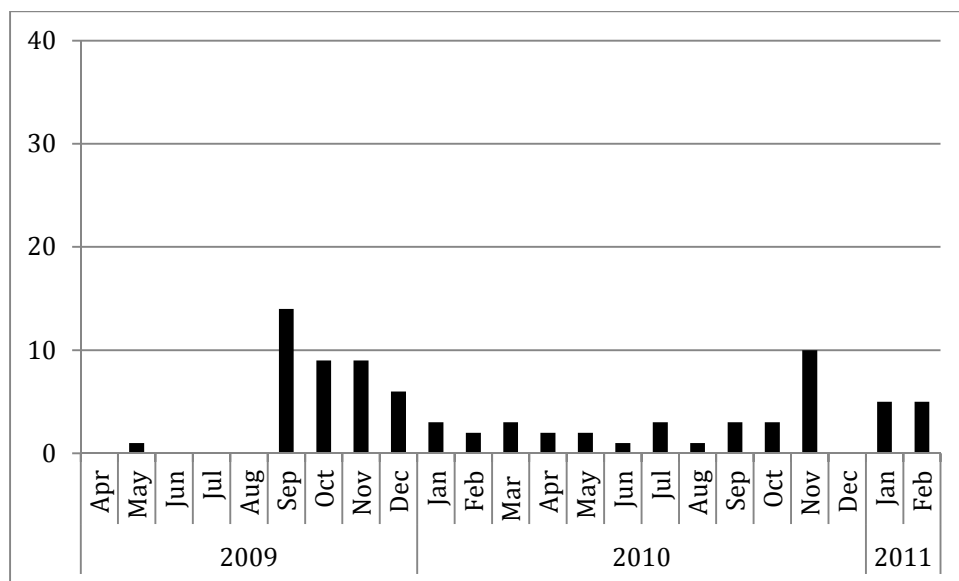
**Figure 4: Seasonal occurrence of *Noterus clavicornis* at Priory Water NR**

*Noterus clavicornis* numbers peaked in April 2009 and in May 2010, a similar pattern in both years (Figure 4).



**Figure 5: Seasonal occurrence of *Ilybius fenestratus* at Priory Water NR**

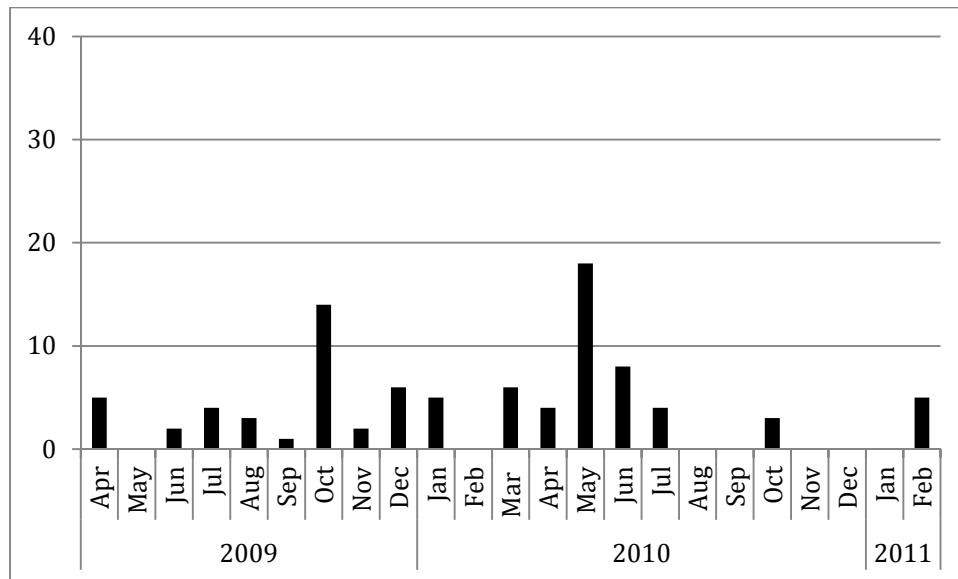
*Ilybius fenestratus* showed clear maxima in the summer months of both years peaking in June 2009 and in July 2010 (Figure 5).



**Figure 6: Seasonal occurrence of *Gyrinus marinus* at Priory Water NR**

In contrast to other species, *Gyrinus marinus* was most abundant in autumn and winter declining in spring (Figure 6).

*Halipus lineolatus* pattern of abundance differed markedly between years. In 2009 its numbers peaked in October and again in May 2010. It was not found in four months of 2010 (February, August, September and November) but was absent only in May 2009 and January 2011 (Figure 7).



**Figure 7: Seasonal occurrence of *Haliplus lineolatus* at Priory Water NR**

### Conservation classification

The conservation value of the assemblage of water beetles at Priory Water was assessed using the scheme of Chadd & Extence (2004). As described under Materials and 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 (2004) with a few adjustments for local application to the Midlands (Chadd, *pers. com.*). The scores for the 29 species recorded at Priory are given in Table 5.

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. 7.

$$CCI = \frac{86}{29} \times 7 = 20.8$$

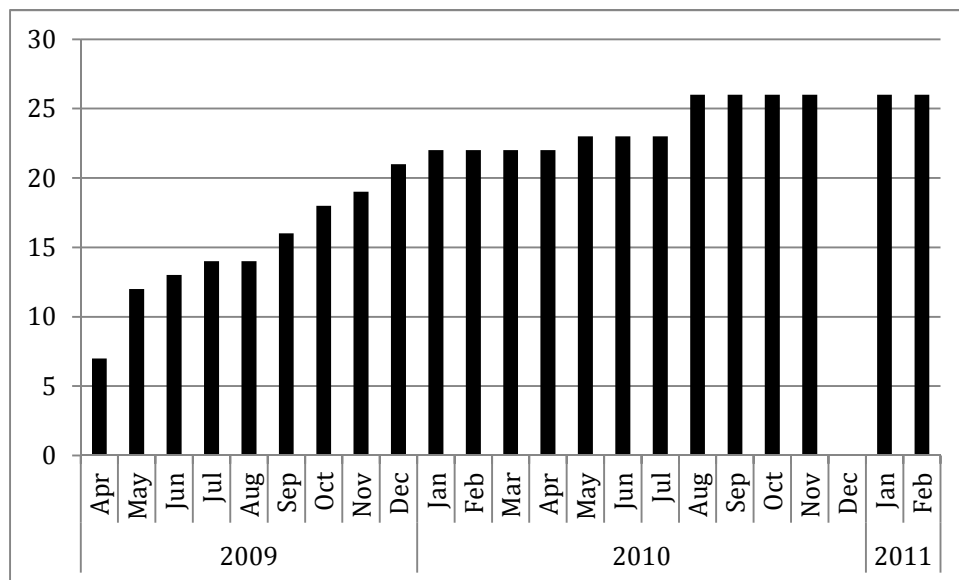
The score of 20.8 is based on a number of sites within the reserve rather than a single site and this approach could give an inflated score for a group of unexceptional sites. However, Main Lake North and Main Lake South Edge score 24 and 22.9 respectively and the Finger lake South and Finger Lake North score 17.9 and 21.4 respectively.

**Table 5. Conservation scores for the species of water beetle recorded at Priory Water**

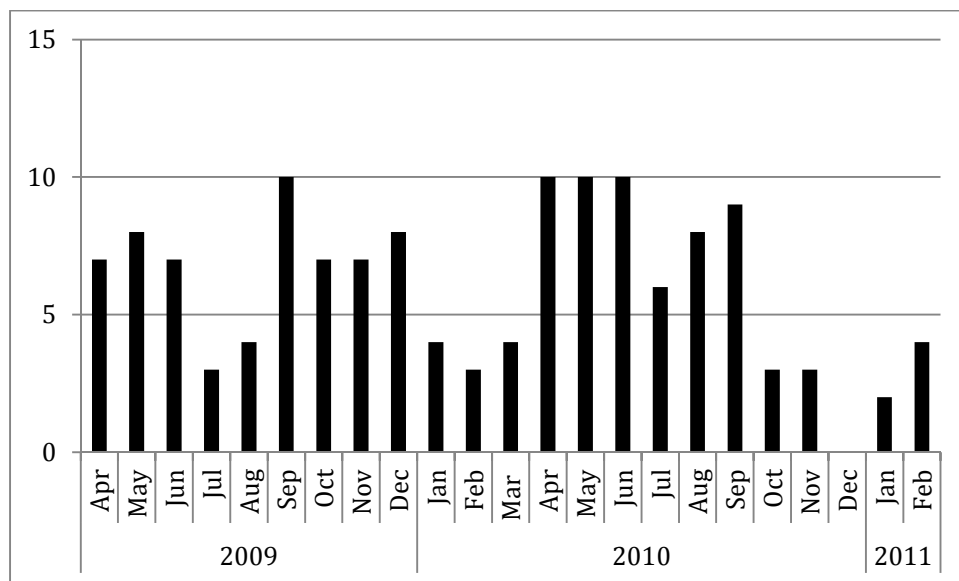
National rarity scores for species recorded at Priory Water NR						
7	6	5	4	3	2	1
<i>H. nigrolineatus</i>	<i>R. grapii</i>	<i>I. quadriguttatus</i>	<i>H. flavicollis</i>	<i>Ilybius ater</i>	<i>H. ovatus</i>	<i>C. fuscus</i>
<i>I. fenestratus</i>	<i>E. melanocephalus</i>	<i>R. suturalis</i>	<i>H. lineolatus</i>	<i>E. testaceus</i>	<i>G. marinus</i>	<i>L. hyalinus</i>
		<i>A. bipustulata</i>	<i>H. hermanni</i>		<i>H. confinis</i>	<i>N. elegans</i>
					<i>N. clavicornis</i>	<i>H. ruficollis</i>
					<i>H. grandis</i>	<i>A. limbata</i>
					<i>L. minutus</i>	<i>H. brevivalpis</i>
					<i>H. immaculatus</i>	<i>H. fuscipes</i>
					<i>H. inaequalis</i>	<i>D. marginalis</i>
						<i>H. palustris</i>

**Species records**

The rate at which the species present at Priory Water NR were recorded, using a standard pond net (see Materials and Methods) is shown in Figure 8 and the number of species found on each sampling occasion in Figure 9.



**Figure 8: Accumulation of species over time based on net samples**



**Figure 9: Number of species sampled on different net sampling occasions**

The maximum number of species found on any one occasion was ten, of the 26 species obtained by netting.

## Discussion

### The species recorded

Twenty-nine species of water beetle were recorded at Priory Water NR during the survey, of which six are regarded as either notable or local (CS of between 5 & 7; Table 5). A few years ago all six were designated Nationally Notable (Chadd & Extence, 2004) with a CS of 7 but changes in the distribution and abundance of some of these species has resulted in a revision of their status (Foster, 2010; Chadd, pers. com.). The only species among the six still regarded as Nationally Scarce (the term that has now replaced Nationally Notable) is *Hygrotus nigrolineatus* (Foster, 2010); *Ilybius fenestratus* retains a Conservation Score of 7 and is regarded as Regionally Highly Notable although it is fairly common in VC55 (see Appendix). Two of the six species, *Rhantus grapii* and *Enochrus melanocephalus* now score 6 and are designated Regionally Notable. The remaining two species, *Rhantus suturalis* and *Anacaena bipustulata*, score 5 and are regarded as Local.

All of the above species occurred in low numbers at Priory Water NR with the exception of *Ilybius fenestratus*, which was relatively abundant (Table 3). This species was characteristic of the Main Lake occurring in the emergent vegetation in both Main Lake South Edge (MLSE) and Main Lake North (MLN). This species is said to be incapable of flight and, according to Foster & Eyre (1992), occurs in a range of older aquatic habitats and is variously described as being associated with sparse vegetation (Foster & Friday, 2011) and open water with rich vegetation (Foster & Eyre, 1992). Denton (1997) expressed doubts about the inability of *I. fenestratus* to fly based on evidence of dispersal between water bodies in Woolmer Forest although he didn't observe flight.

Co-dominant with *I. fenestratus* in the Main Lake were *Noterus clavicornis* (in MLN) and *Haliplus lineolatus* (in both MLN & MLSE) a grouping of species that does not appear to correspond to any of the water beetle assemblages for the Midlands described by Foster & Eyre (1992). The beetle assemblage of their habitat category that included gravel pits and quarry ponds, the closest approximation to the Main Lake, did not include *I. fenestratus* and was partly characterised by the virtual absence of *Haliplus* and *Noterus*. The open water site in the Main Lake (MLSOW) yielded only five species during the study period, the commonest being *Haliplus lineolatus*. It is worth noting that this was the richest site at Priory Water NR for water bugs (Cook & Clark, 2011).

Although *I. fenestratus* is classed as Regionally Highly Notable, there are recent (post-1980) records for this species from about 30 sites in VC55, many from canals and one from a gravel pit close to Priory Water NR. *H. nigrolineatus* was first recorded in England in 1983 and occurs in recently created or disturbed water which may be polluted (Lott, 1999, Foster & Friday, 2011). The single record of this species was from MLSE, a site bordering open water and probably subject to some enrichment, being close to exposed banks used by numerous birds (e.g. gulls, cormorants and waders) and bordering grassland grazed by horses. The record for *R. grapii* was the first for VC55 according to records supplied by LRERC. The distribution and number of site records for VC55 for all species found during the survey are given in the Appendix.

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 beetle assemblages. Although most of the common species were found in both the Finger Lakes and the Main Lake the groupings given by the cluster analysis (Figure 1) reflect, to some extent, their relative abundance in the different sites.

The dominant species of the East Finger Lake and the most numerous species at Priory Water NR during the sampling period was *Hyphydrus ovatus*. It occurred less abundantly in the West Finger Lake and in very low numbers in the Main Lake. This contrast may be explained by the beetle's preference for deep well-vegetated lakes and ponds (Foster & Friday, 2011). The East Finger Lake had the richest aquatic flora of any of the sites sampled and EFLS, where *H. ovatus* was most numerous, was comparatively deep. Sub-dominant species in the East Finger Lake sites were *Noterus clavicornis*, *Gyrinus marinus*, *Haliphus lineolatus* and *Helophorus brevipalpus*. *Hyphydrus ovatus* is a common and widespread species but there is little information, that we are aware of, on its ecology or relative abundance in beetle assemblages. Foster & Eyre (1992) list it as occurring fairly frequently in assemblages from stagnant and slow flowing water in the Midlands. However, there is no information on abundance and it is not mentioned in any of their habitat descriptions. The Watford Coleoptera Group ([www.thewcg.org.uk](http://www.thewcg.org.uk)) state that, when found, adults usually occur as single specimens or as male/female pairs. In VC55 the species is very common, with records from 90 sites (Appendix).

The whirligig beetle *Gyrinus marinus* was common in the Finger Lakes but virtually absent in the Main Lake. Described as a "species of open waters on base-rich lakes and large ponds" (Foster & Friday, 2011) and the most abundant species by far in the sparsely vegetated West Finger Lake, its occurrence at the well-vegetated East Finger Lake but virtual absence from open sites in the Main Lake is hard to explain. *G. marinus* occurred in highest numbers during winter months (November-January) in contrast to other relatively abundant species which had spring or autumn peaks (Figure 6). It is a relatively local species in VC55 with recent (post 1980) records from approximately 20 sites.

Submerged bottle traps have been reported as being more effective than netting for catching larger dytiscids but less effective in the case of smaller water beetles (Hilsenhoff, 1987). The results from Priory Water NR appear to support this to some extent, as bottle traps caught *Dytiscus marginalis* for the first time as well as relatively large numbers of *Rhantus grapii*, a species only found on a single occasion in net samples. Hilsenhoff (1987) suggests that horizontal swimming habits, nocturnal activity and acoustic communication may be reasons for the effectiveness of bottle traps. Denton (1996) suggests that *Rhantus grapii* may be nocturnal, which may explain its scarcity in day-time collections taken with a net. The traps at Priory Water NR also caught two smaller species for the first time (*Hydroporus palustris* and *Hygrotus inaequalis*). A proper test of the difference between the methods would require that they both be used at the same time as in Hilsenhoff's study in Wisconsin USA.

### Reliability of sampling

Seasonal variation and the inherent random element in sampling clearly indicates that it is necessary to visit a site on a number of occasions to obtain a reasonable species list – let alone data on relative abundance. The graph of accumulative species against date (Figure 8) shows that at Priory Water NR most of the species present had been recorded after the end of the first year. The maximum number of species caught during a single visit to the site was 10 out of a current total list of 29. Netting alone may also give a biased picture of beetle assemblages if the method fails to sample some of the larger dytiscids effectively.

### Seasonal occurrence

Most of the species that occurred in sufficient numbers to provide a picture of seasonal abundance were sampled in larger numbers in the spring, summer and autumn, with the exception of *Gyrinus marinus* that had a clear winter peak. Fairly consistent patterns between the two years were shown (i) by *H. ovatus*, which had spring and autumn peaks, (ii) by *Noterus clavicornis* with a spring peak (although absent from samples in May 2009) and (iii) by *I. fenestratus* with a summer peak. The graph for total number of species sampled at different dates (Figure 9) shows a winter minima and, in 2009 especially, a decline in the summer.

### 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 present at a site. They considered a score of over 20 indicated a site of high conservation value, which places Priory Water NR in this category for water beetles.

### Acknowledgements

We wish to thank The Leicestershire Wildfowlers' Association, in particular Tim Goodlife, for allowing us access to Priory Water and for permission to take samples for water beetles. We also thank Kirsty Gamble (LRERC) for making the VC55 water beetle records available to us and Richard Chadd for advice on the use of the conservation index. Thanks also to Ray Morris for his help in editing the text and reformatting the figures.

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## Appendix: VC55 records of water beetles found at Priory Water

### Key

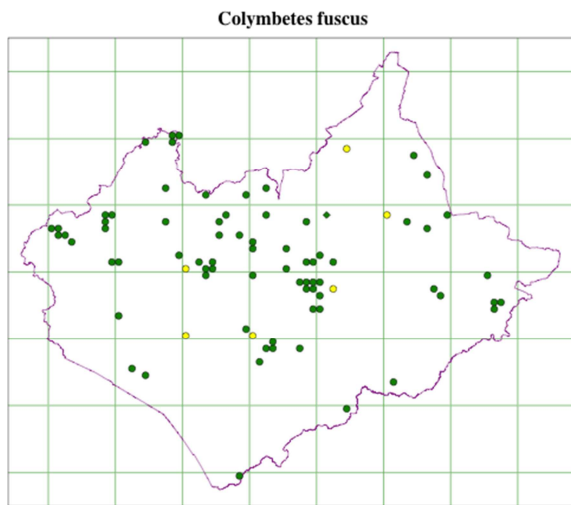
Open circles (yellow) show pre-1980 site records and filled circles (green) show post-1980 site records. All maps are based on data from LRERC. Priory Water NR is shown by a filled (green) diamond.

The number of VC55 site records quoted for each species refers only to those post-1980. Habitat and distribution notes are from Foster & Friday (2011) and the NBN Gateway unless otherwise referenced.



**DYTISCIDAE: *Colymbetes fuscus***

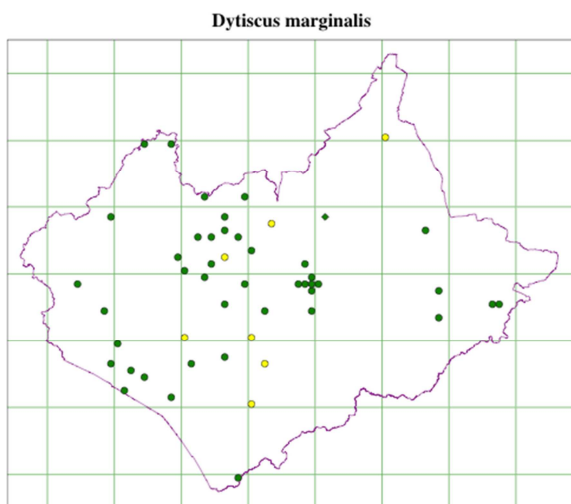
VC55 sites: 73



Although common throughout lowland Britain, the species was only found once at Priory Water NR among emergent vegetation in the Main Lake.

**DYTISCIDAE: *Dytiscus marginalis***

VC55 sites: 41

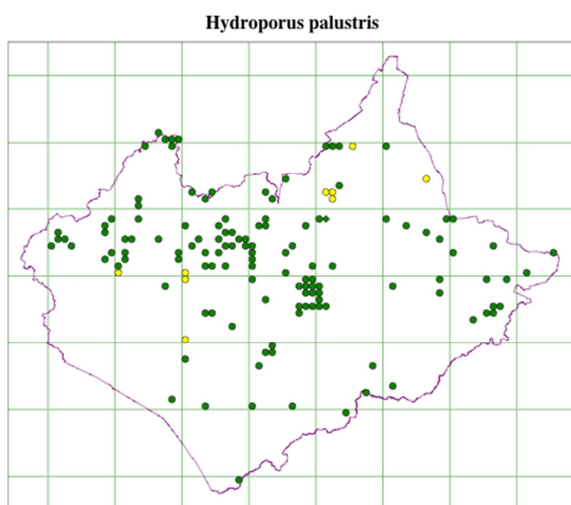


At Priory Water NR the adult was only taken in bottle traps in East Finger Lake.

The species has a preference for smaller ponds and is a widespread species in the UK,

**DYTISCIDAE: *Hydroporus palustris***

VC55 sites: 126

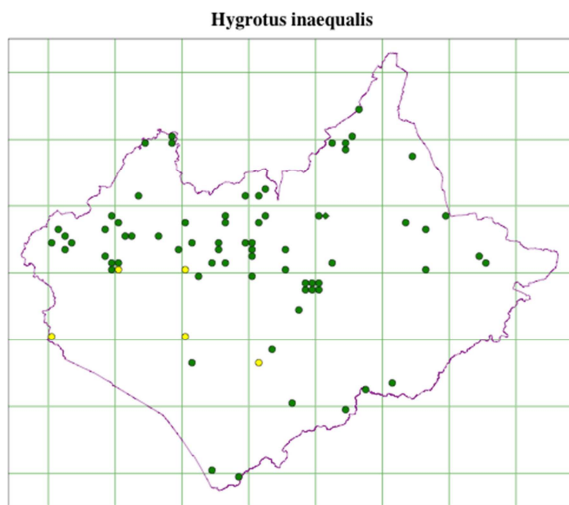


At Priory Water NR one specimen was taken in a bottle trap in EFLN.

The species is a very common beetle occurring throughout the UK in a wide range of habitats.

**DYTISCIDAE: *Hygrotus inaequalis***

VC55 sites: 71

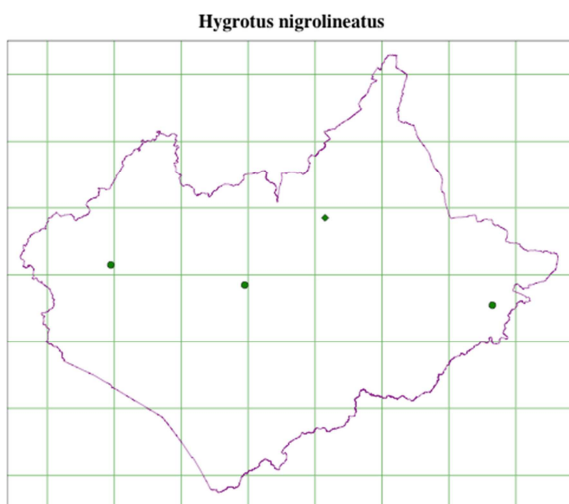


At Priory Water NR one specimen was taken with a bottle trap in EFLS.

*H. inaequalis* is widespread in the UK and occurs in a wide range of habitats with a preference for well vegetated ponds.

**DYTISCIDAE: *Hygrotus nigrolineatus***

VC55 sites: 4

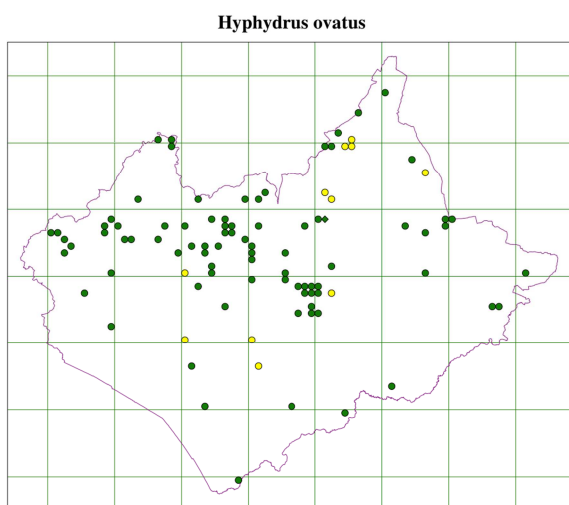


A Nationally Scarce species found once at Priory Water NR, amongst emergent vegetation in the Main Lake.

First recorded in England in 1983 in East Kent it now occurs in Scotland and Wales but is most frequent in the Midlands. It has a preference for recently created or disturbed still water, often polluted, and with sparse vegetation

**DYTISCIDAE: *Hyphydrus ovatus***

VC55 sites: 90



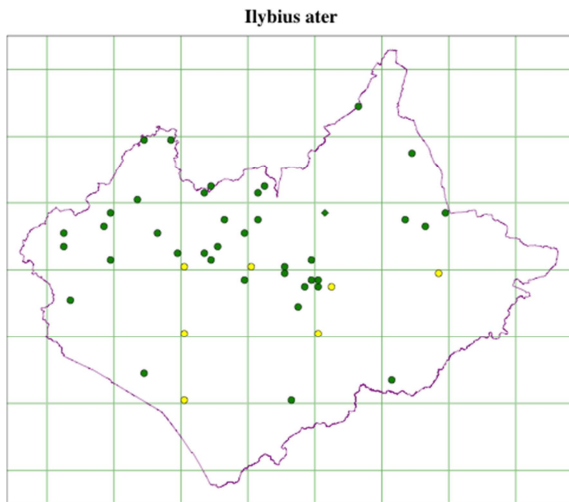
Abundant at Priory Water NR, where it was the dominant species in the well-vegetated East Finger Lake.

A species of deep and richly vegetated lakes, ponds and canals being widespread in the UK reaching to southern Scotland.

*H. ovatus* shows marked sexual dimorphism, the males being larger than females and differently shaped (Juliano, 1992).

**DYTISCIDAE: *Ilybius ater***

VC55 sites: 39



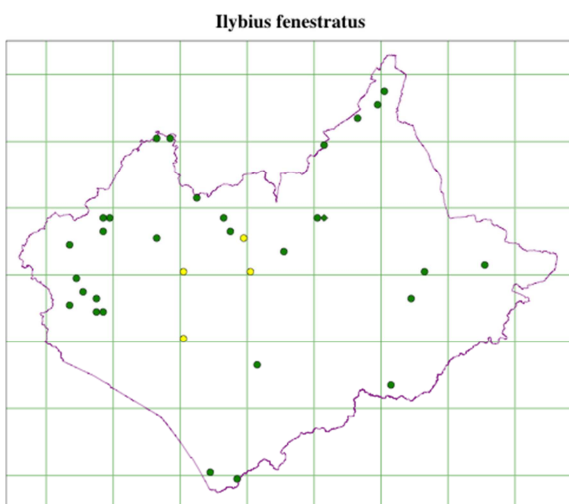
Found twice in the East Finger Lake.

The typical habitat is emergent vegetation in shallow water at the edge of ponds, lakes ditches etc ([www.thewcgc.org.uk](http://www.thewcgc.org.uk)).

A lowland species widespread throughout much of the UK. An account of egg laying behaviour is given by Jackson (1960).

**DYTISCIDAE: *Ilybius fenestratus***

VC55 sites: 30



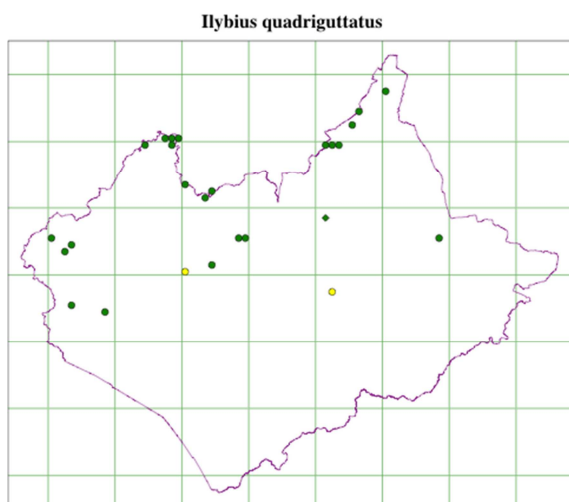
This was the dominant species in the Main Lake and is regarded as Regionally Highly Notable.

More or less confined to central and south-eastern England in lakes, large ponds and canals with sparse vegetation.

The beetle produces defensive steroids that give some protection from fish predation. An account of the life-history in a Norwegian lake is given by Dolmen & Solem (2002).

**DYTISCIDAE: *Ilybius quadriguttatus***

VC55 sites: 24



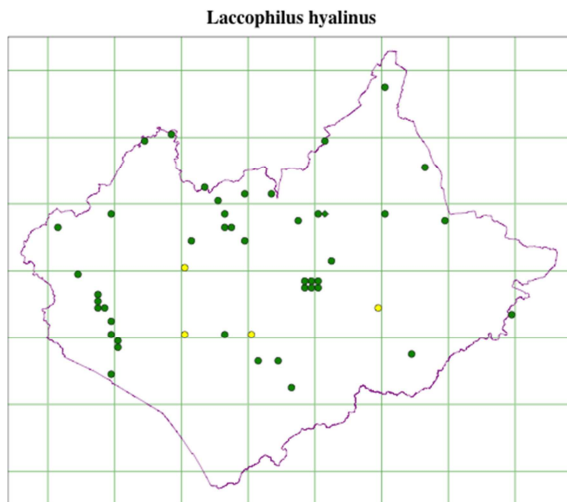
One of the more frequent species at the site occurring in both the Main Lake and Finger lakes.

It has a predominantly central and southern distribution in the UK being absent from Scotland and the south west.

*I. quadriguttatus* occurs in densely vegetated ponds, ditches and canals.

**DYTISCIDAE: *Laccophilus hyalinus***

VC55 sites: 44

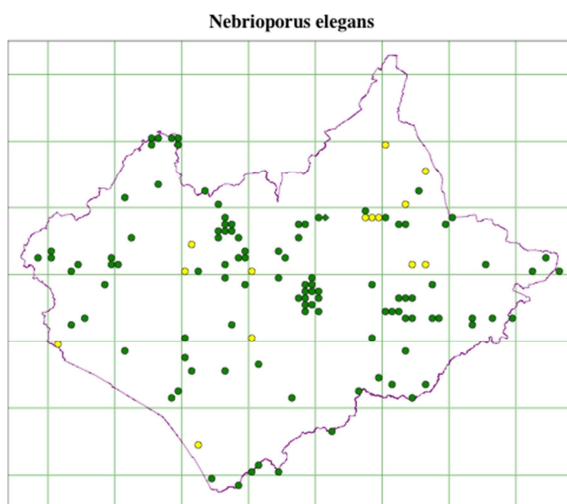


Found once in the Main Lake and once in the East Finger Lake.

Occurs throughout England, except for the extreme south west, with few records for Wales and southern Scotland. Mainly associated with slow moving water, especially canals, although many of the records for VC55 are from lentic habitats.

**DYTISCIDAE: *Nebrioporus elegans***

VC55 sites: 103



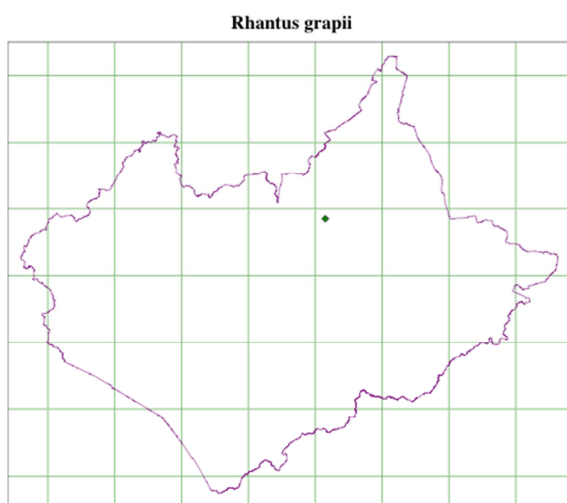
A single specimen was found at Priory Water NR, one of the few species to occur in MLSOW.

It typically occurs over exposed substrata in lakes and slow flowing rivers with little vegetation.

A common and widespread species occurring throughout the UK in suitable habitats.

**DYTISCIDAE: *Rhantus grapii***

VC55 sites: 1



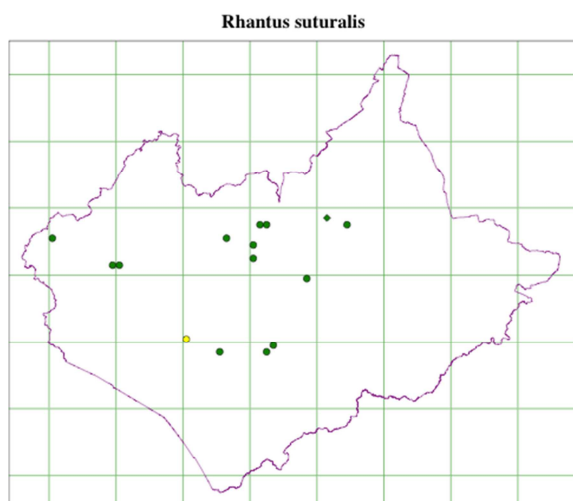
A single specimen in EFLN at Priory Water NR was the first for VC55.

The species is patchily distributed in England with concentrations of records in the south east, northern East Anglia, Derbyshire/Yorkshire and Somerset. However, it is scarce over much of the Midlands. It also occurs in South Wales and Anglesey.

It has a preference for shallow, vegetated and partly shaded lentic habitats.

**DYTISCIDAE: *Rhantus suturalis***

VC55 sites: 14

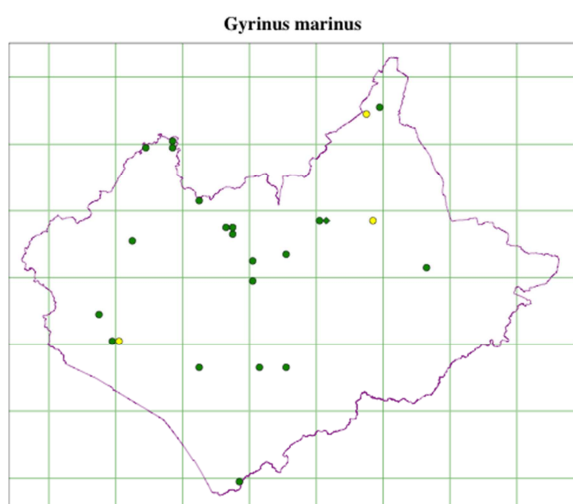


Two specimens were found at Priory Water NR, one from the Main Lake and one from East Finger Lake.

It occurs throughout much of England, with a few records in Wales and Scotland being a species of lentic habitats, often newly created and polluted.

**GYRINIDAE: *Gyrinus marinus***

VC55 sites: 21



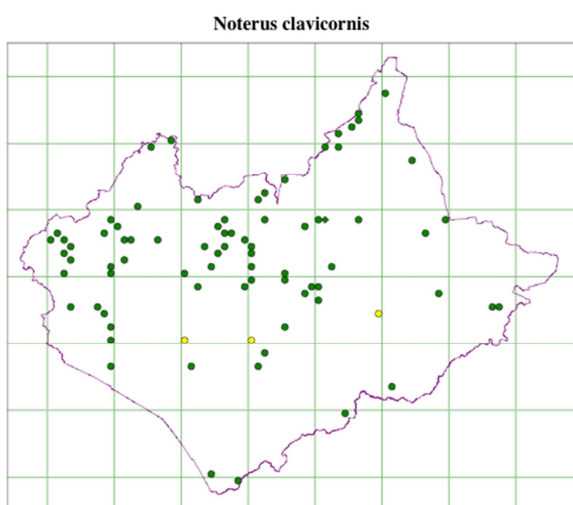
A common species but occurring almost exclusively in the Finger Lakes (especially FLW).

A widespread species of open water which occurs throughout lowland areas of the UK.

The flight activity of the beetle has been described by van der Eijk (1983) who found that dispersal by flight was very limited and strongly influenced by weather conditions.

**NOTERIDAE: *Noterus clavicornis***

VC55 sites: 80

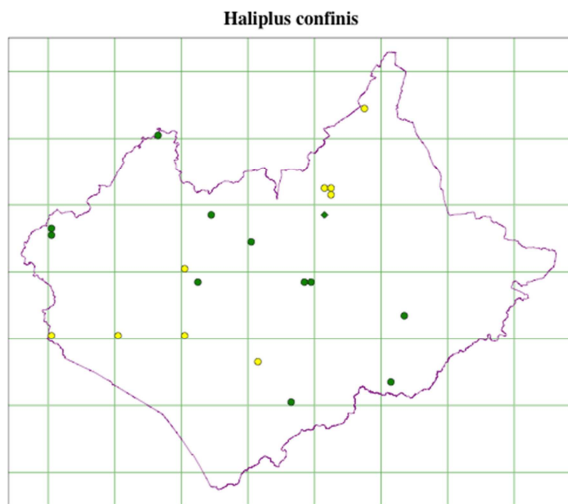


A common species at Priory Water NR, being most numerous in EFLS & EFLN.

It is a common species throughout much of the UK although absent in all but southern areas of Scotland.

**HALIPLIDAE: *Haliphus confinis***

VC55 sites: 12

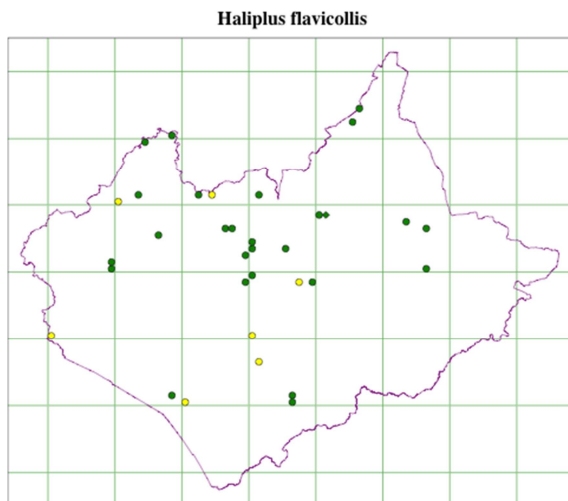


More or less confined to the emergent vegetation at the edge of the Main Lake.

Occurring throughout the UK in a wide variety of habitats, It is often associated with stoneworts, on which it feeds, although no stoneworts have been recorded at Priory Water NR.

**HALIPLIDAE: *Haliphus flavicollis***

VC55 sites: 27

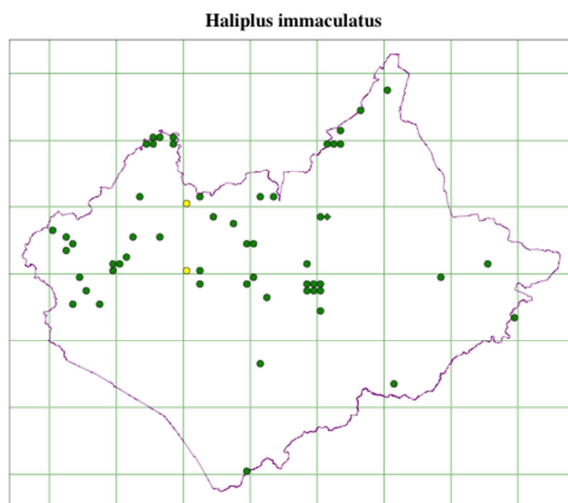


Recorded only once at Priory Water NR in the Main Lake.

A widespread species in the UK, although absent from most of northern Scotland, occurring in a range of lowland habitats.

**HALIPLIDAE: *Haliphus immaculatus***

VC55 sites: 55

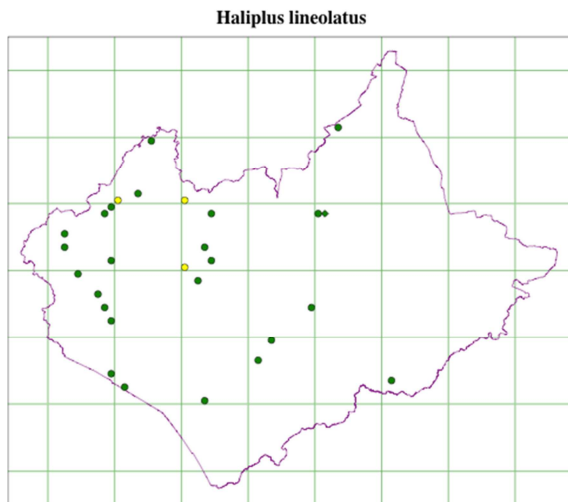


Most frequently encountered in emergent vegetation bordering open water in the Main Lake (MLSE).

*H. immaculatus* is often found in man-made lentic habitats (which may be polluted) and is widely distributed in lowland Britain.

**HALIPLIDAE: *Haliplus lineolatus***

VC55 sites: 25

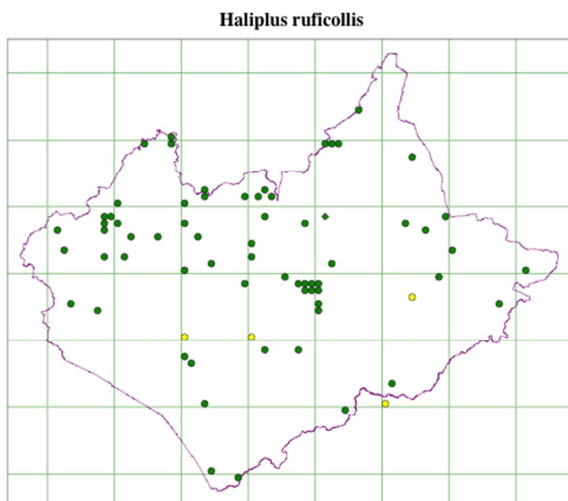


Occurred in all the sites sampled but showed a preference for marginal vegetation in the Main Lake.

*H. lineolatus* is common in the Midlands and further north but rarer in the south and south west. It occurs in larger ponds, lakes and slow sections of rivers and is known to feed on Hydrozoa and algae.

**HALIPLIDAE: *Haliplus ruficollis***

VC55 sites: 66

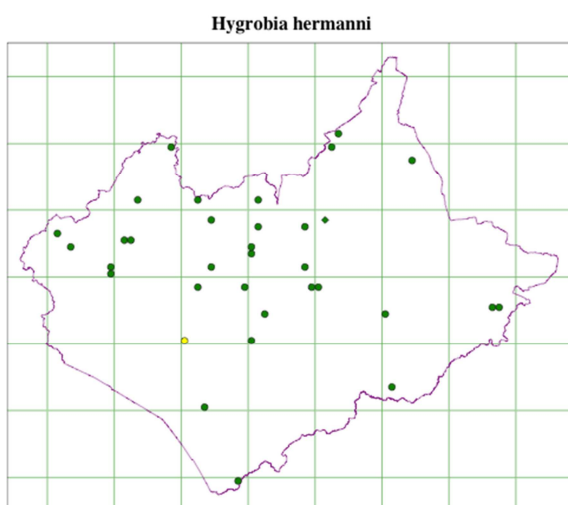


At Priory Water NR it was taken only twice, in EFLS.

*H. ruficollis* is one of the commonest haliplids in Britain occurring in a wide range of habitats, although it is typical of small well vegetated water bodies ([www.thewcg.org.uk](http://www.thewcg.org.uk)).

**PAELOBIDAE: *Hygrobia hermanni***

VC55 sites: 33



Single specimen at Priory Water NR.

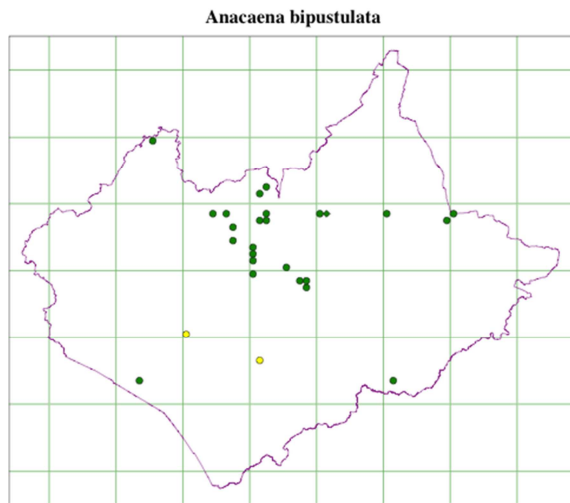
The species is widespread in lowland England and Wales with only one record from southern Scotland.

Painter (1999) quotes Balfour-Browne's comment (Balfour-Brown, 1962) on *H. hermanni* as 'seeming to appreciate ponds frequented by cattle where the water acquires a high ammoniacal content'.



**HYDROPHILIDAE: *Anacaena bipustulata***

VC55 sites: 25

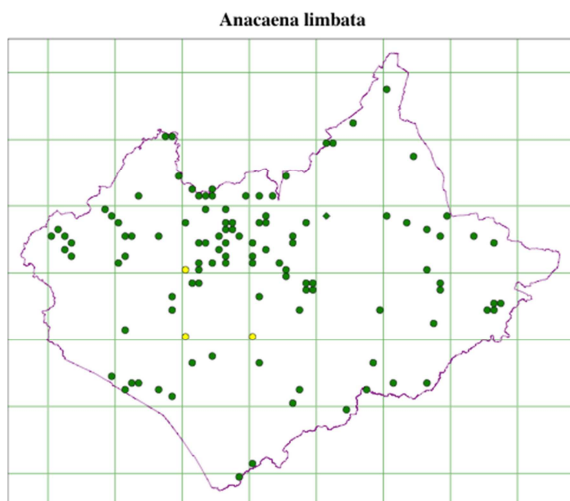


This local species was uncommon at Priory Water NR, where it was confined to the Finger Lakes (EFLN & WFL).

*A. bipustulata* has a predominantly south-easterly distribution in Britain, extending north to Yorkshire but being absent from Scotland and Ireland. Friday (1988) gives the habitats as streams, rivers and pits.

**HYDROPHILIDAE: *Anacaena limbata***

VC55 sites: 119



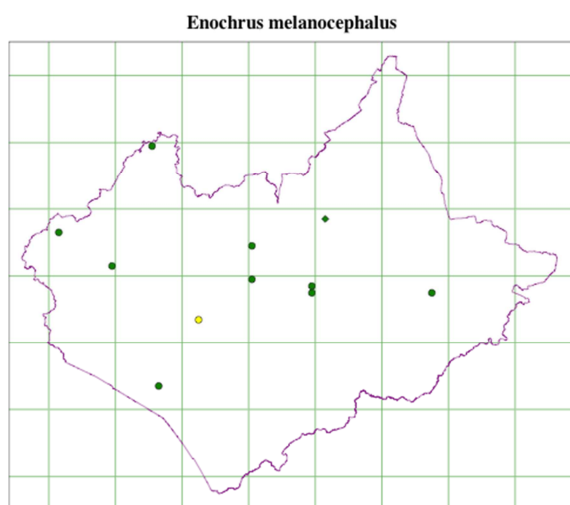
In low numbers at Priory Water NR most abundantly in EFLN.

A widespread species although scarce in Scotland and northern England.

Found in well vegetated still or slow flowing water and emergent vegetation ([www.thewcgc.org.uk](http://www.thewcgc.org.uk)).

**HYDROPHILIDAE: *Enochrus melanocephalus***

VC55 sites: 10



A Regionally Notable species, it most frequently occurred at Priory Water NR in EFLN.

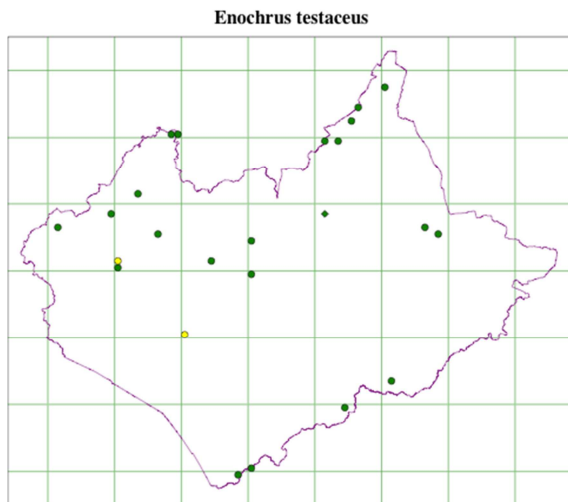
It is widespread in England to Northumberland but few records for the south west, Wales and Ireland with none for Scotland.

Foster & Eyre (1992) described it as being associated with richly vegetated ponds, sometimes shaded, in their section on the water beetle communities of the Midlands.



**HYDROPHILIDAE: *Enochrus testaceus***

VC55 sites: 22

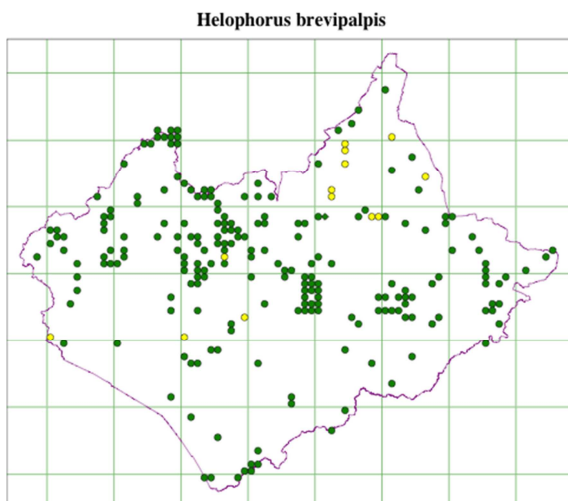


Found in low numbers in both the Main Lake and Finger Lakes.

*E. testaceus* is widespread in the Midlands and southern England but scarce in the north. There are a few records for southern Scotland, Wales, and the south-west.

**HYDROPHILIDAE: *Helophorus brevipalpis***

VC55 sites: 200



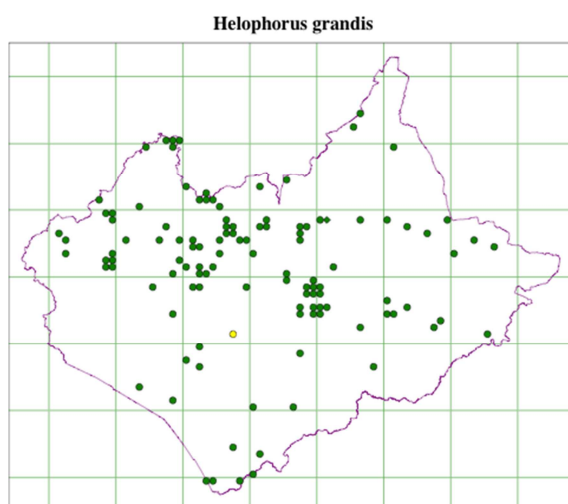
Recorded in the majority of sites at Priory Water NR but showed a clear preference for EFLN.

It is a widespread and common species in the UK particularly in well-vegetated ponds. Also found in other habitats including slow flowing water ([www.thewcgc.org.uk](http://www.thewcgc.org.uk)).

Angus (1973) gives an account of the life histories and habitats of *Helophorus*.

**HYDROPHILIDAE: *Helophorus grandis***

VC55 sites: 114



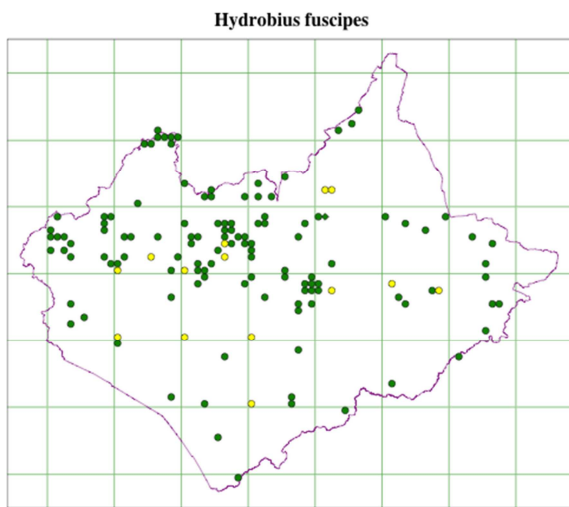
In low numbers at Priory Water NR mainly in MLSE.

*H. grandis* occurs throughout the UK (although scarcer in Scotland) in a variety of habitats, both still and flowing.

It is often found in temporary water bodies i.e. those that tend to dry out (Foster & Eyre, 1992).

**HYDROPHILIDAE: *Hydrobius fuscipes***

VC55 sites: 128

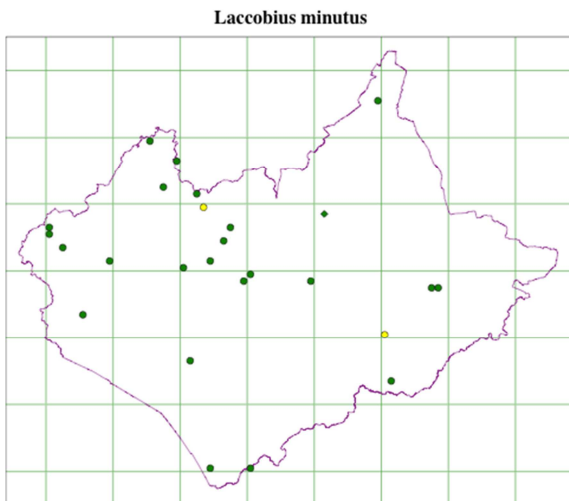


One specimen was recorded in net samples from EFLN at Priory Water NR.

A widespread and common species throughout the UK in detritus ponds with marginal vegetation, slow rivers and brackish water habitats ([www.thewc.org.uk](http://www.thewc.org.uk)).

**HYDROPHILIDAE: *Laccobius minutus***

VC55 sites: 24



One specimen was recorded at Priory Water NR in EFLN.

This is a widespread and common species throughout the UK occurring in a range of stagnant and slow flowing habitats, possibly with a preference for well vegetated ponds (Foster & Eyre, 1992).