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A survey of the aquatic macro-invertebrate communities of Isle of Wight Pond and Western Hollow Pond, Bookham Common

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Summary

The aquatic macro-invertebrate communities of the Isle of Wight Pond and the Western Hollow Pond at Bookham Common were surveyed in June 1993. Both ponds supported more than 40 taxa of macro-invertebrate, although the smaller pond supported more taxa than the larger water body. Analysis of community structure by Jaccard's Coefficient of Similarity indicates that the faunas were not dissimilar, although the coleopteran component of the two faunas was very different. The apparent similarity may have been an artefact caused by immigration of fauna via a feeder stream connecting the two ponds. It is suggested that the Isle of Wight Pond maintains a less diverse macro-invertebrate fauna than the Western Hollow Pond due to the presence of a high fish population and consequent lack of macrophytes.

Introduction

The macro-invertebrate communities in ponds within the London Area have received little attention by comprehensive survey (Biggs and Langley 1989). This deficiency is being remedied by some research groups (notably Pond Action, Oxford Brookes University). However, considerable work needs to be done in this field in order to elucidate the within-community interactions that influence the invertebrate populations of ponds.

The ponds of Bookham Common are exceptional because their fauna and flora have been the object of survey and study for many years. However, few surveys of the entire macro-invertebrate community in each pond have been carried out. With the aim of complementing the work already accomplished, a macro-invertebrate community survey of the Isle of Wight Pond and the Western Hollow Pond was carried out on 22 and 23 June 1993.

The Isle of Wight Pond (TQ126562) lies on a base of London Clay and is of irregular shape, covering approximately 0.34 hectares. The present shape was determined in the winter of 1972–3 when the pond was re-excavated due to encroaching scrub vegetation. An island was added at the same time to provide an area for birds (Beven and Radcliffe 1978). The pond is fairly shallow and the majority of the water basin is easily accessible with waders. From 1973 to 1975 the pond was dominated by broad-leaved pondweed *Potamogeton natans*, common water-crowfoot *Ranunculus peltatus* and blanketweed (algae). In the summer of 1976, however, almost no aquatic macrophytes grew within the pond except for small patches of *Myriophyllum* sp. and since that time macrophytes have been almost absent (Ashby 1991). A large population of stunted fish including bream *Abramis brama*, carp *Cyprinus carpio*, perch *Perca fluviatilis*, roach *Rutilus rutilis* and rudd *Scardinius erythrophthalmus* inhabit the pond and form the quarry of numerous anglers.

Western Hollow Pond (TQ127563) is also based on London Clay and is roughly rectangular in shape. It covers approximately 0.26 hectares and was excavated in 1977. In contrast to the Isle of Wight Pond, it is dominated by aquatic macrophytes, *Potamogeton* sp. and has several stands of emergent vegetation. Both ponds are surrounded by mixed deciduous woodland and have a proportion of their surface overhung by trees.

The ponds were surveyed in accordance with National Pond Survey techniques (Pond Action, Oxford Brookes University). The aims of the survey were to produce a species list of the macro-invertebrate fauna present within both ponds and to compare the differences between the fauna in the ponds in terms of the different environmental conditions. For the purposes of this study, the definition of a macro-invertebrate is one that is retained by a 1 mm mesh Freshwater Biological Association-pattern pond net.

Methods

A water sample from each pond was taken approximately 1 m from the shore and at a depth of 8.0 cm and was tested for pH and conductivity (in Micro-Siemens/cm) using Whatman micro-sensors. Water clarity and colour were assessed by eye. The occurrence and distribution of aquatic macrophytes in and around the two ponds were recorded so that distinct macro-invertebrate habitat zones could be identified (e.g. stands of emergent macrophytes and submerged macrophyte patches). Six habitat zones were distinguished in the Isle of Wight Pond (Table 1) and five zones in Western Hollow Pond (Table 2). Plants were identified using Clapham et al. (1981).

Macro-invertebrate samples were collected using a 1 mm mesh Freshwater Biological Association-pattern pond net during three minutes of concentrated hand netting. Sampling time was equally divided between each habitat zone within a pond (e.g. Isle of Wight Pond had six habitats, so each was sampled for 30 seconds). Two investigators worked in parallel so that two replicate samples were collected and combined from each habitat zone in each pond. Samples were partially sorted on site and were taken back to the laboratory for identification using specialized taxonomic keys.

TABLE 1. Macro-invertebrate taxa in Isle of Wight Pond.

Taxa	Swamp	*Salix*	*Iris*	*Juncus*	Littoral	Logs
TRICLADIDA						
Dugesia tigrina		×	×			
OLIGOCHAETA						
Aulodrilus pluriseta	×					
Stylaria lacustris	×		×			×
HIRUDINEA						
Helobdella stagnalis			×	×	×	
Hemiclepsis marginata						×
Piscicola geometra		×	×			
MOLLUSCA						
Acroluxus lacustris		×				
Ancylus fluviatilis	×					
Physa fontinalis	×	×	×	×		×
Pisidium sp.	×					
Planorbis vortex						×
Potamopyrgus antipodarum	×					
Sphaerium corneum	×					
ARACHNIDA						
Piona sp.	×	×				
Other mite sp.	×		×	×	×	×
CRUSTACEA						
Argulus foliaceus	×	×				
Asellus aquaticus						×
Crangonyx pseudogracilis	×		×	×		
INSECTA						
Ephemeroptera						
Caenis robusta		×				
Cloeon simile		×	×	×		
Megaloptera						
Sialis lutaria	×	×	×	×		

Taxa	Swamp	*Salix*	*Iris*	*Juncus*	Littoral	Logs
Trichoptera						
Limnephilidae larvae						×
Mystacides longicornis		×	×	×	×	
Odonata						
Aeshna mixta		×				
Coenagrion puella			×			
Ischnura elegans		×				
Hemiptera						
Corixidae nymphs	×	×	×			
Gerris sp.	×			×		
Ilyocoris cimicoides		×				
Micronecta scholtzi			×	×	×	
Nepa cinerea	×					
Notonecta sp.	×	×		×		
Sigara falleni		×				
Coleoptera						
Anacaena limbata	×					
Colymbetidae larvae	×					
Dytiscidae larvae				×		
Helophorus brevipalpis	×					
Hydrochus nitidicollis ~~angustatus~~	×					
Laccobius minutus angustatus	×					
Diptera						
Anopheles larvae	×					
Chironomidae larvae	×	×	×	×	×	×
Ptychoptera larvae	×					
Stratiomyidae larvae	×					
Total no. of taxa	25	17	14	12	5	8

TABLE 2. Macro-invertebrate taxa in Western Hollow Pond

Taxa	Submerged vegetation	Tree roots	*Sparganium*	*Iris*	Sediment
TRICLADIDA					
Polycelis tenius				×	
OLIGOCHAETA					
Stylaria lacustris	×				
HIRUDINEA					
Erpobdella octoculata		×	×	×	
Glossiphonia heteroclita	×	×			
Helobdella stagnalis		×			
Hemiclepsis marginata		×			×
Piscicola geometra	×				
Theromyzon tessulatum				×	
MOLLUSCA					
Acroluxus lacustris	×		×		
Lymnaea auricularia				×	
Lymnaea peregra			×	×	
Lymnaea palustris				×	
Physa fontinalis	×				
Pisidium sp.		×	×		
Planorbis albus	×	×	×	×	
Planorbis vortex	×	×	×	×	×
Segmentina complanata				×	
Sphaerium corneum		×	×		×
CRUSTACEA					
Asellus aquaticus	×	×	×	×	×
Crangonyx pseudogracilis	×	×	×	×	×
INSECTA					
Ephemeroptera					
Caenis robusta	×	×	×	×	×
Cloeon dipterum	×	×	×	×	×

Taxa	Submerged vegetation	Tree roots	*Sparganium*	*Iris*	Sediment
Cloeon simile	×				
Megaloptera				×	
Sialis lutaria			×	×	×
Trichoptera					
Athripsodes cinereus			×		
Odonata					
Aeshna cyanea					×
Aeshna mixta	×	×			
Coenagrion puella	×	×	×		
Hemiptera					
Corixidae nymphs				×	
Callicorixa praestra	×				
Corixa punctata	×				
Gerris sp.		×			
Hydrometra stagnalis		×			
Ilyocoris cimicoides	×			×	
Nepa cinerea				×	
Notonecta sp.	×	×	×	×	×
Plea leachi	×				
Sigara dorsalis			×		
Sigara falleni	×				
Sigara fossarum		×			×
Coleoptera					
Agabus sturmii				×	
Dytiscidae larvae	×	×	×	×	×
Haliplus ruficollis	×		×		
Hydroporus palustris				×	
Hygrotus inaequalis			×		
Noterus clavicornis				×	
Diptera					
Anopheles larvae		×	×	×	
Ceratopogonidae larvae				×	
Chaeborus sp.	×	×	×	×	×
Chironomidae larvae	×	×	×	×	×
Total no. of taxa	24	22	22	27	14

TABLE 3. Calculations of Jaccard's Coefficient for Isle of Wight Pond and Western Hollow Pond.

$$\text{Jaccard's Coefficient of Similarity} = \frac{\text{Number of taxa common to both sites}}{(\text{number of taxa at site A} + \text{number of taxa at site B}) - (\text{number of taxa common to both sites})}$$

$$= \frac{25}{(43 + 50) - (25)} = 0.368$$

Results and discussion

Water chemistry

The water in the Western Hollow Pond (pH 8.3) was more alkaline than the water in the Isle of Wight Pond (pH 7.0). Water conductivity was similar in both ponds, being 340 μS/cm in Isle of Wight Pond and 380 μS/cm in Western Hollow Pond. The water of the Isle of Wight Pond was noticeably more turbid than that of Western Hollow due to suspended clay particles as reported by Ashby (1991).

Aquatic and bankside vegetation

At the time of sampling, a large proportion of the Isle of Wight Pond margin was overhung by common sallow *Salix cinerea*. Other portions were edged, and in places overhung, by a variety of other deciduous trees including oak *Quercus* spp. and birch

Betula spp. Small stands of emergents were present on and adjacent to the littoralmargins, mainly yellow flag iris *Iris pseudacorus* and soft rush *Juncus effusus.* The pond was almost devoid of macrophytes, although there was a large area of sallow carr at the eastern end and an area of diverse wetland vegetation at the point at which the feeder stream enters the pond. The major species represented in this area of wetland at the time of sampling were: water plantain *Alisma plantago-aquatica,* remote sedge *Carex remota,* great willowherb *Epilobium hirsutum,* water horsetail *Equisetum fluviatile,* Yorkshire fog *Holcus lanatus, J. effusus,* purple loosestrife *Lythrum salicaria,* water mint *Mentha aquatica,* water forget-met-not *Myosotis scorpioides,* creeping buttercup *Ranunculus repens,* red-veined dock *Rumex sanguineus,* woody nightshade *Solanum dulcamara,* and bur-reed *Sparganium erectum.* A few scattered oak and sallow saplings grew amongst these plants.

Western Hollow Pond, in contrast, had prolific aquatic macrophyte growth. Most of the area of the pond had a thick growth of *Potamogeton* sp. that extended from just below the surface (with some stems projecting slightly above) to a depth of over 30 cm. Several stands of emergents including *Sparganium erectum* and *Iris pseudacorus* grew at the margin of the pond. The banks were covered in mixed herbage and much of the margin was overhung by a variety of deciduous trees. A fallen, semi-submerged tree was present at the eastern end of the pond. Most of the benthic substrate in Western Hollow Pond was composed of mud with a high organic content including semi-decomposed leaf litter, in contrast to the sand and gravel substrate of the Isle of Wight Pond.

Macro-invertebrate communities

The Isle of Wight Pond sample contained a total of 43 taxa (Table 1). The Western Hollow Pond sample contained a total of 50 taxa (Table 2). Initially, these values do not appear to indicate a significant difference in taxonomic diversity. However, if the numbers of taxa found in each habitat zone are examined, it can be seen that the swamp sub-sample from the Isle of Wight Pond contained a disproportionate number of the total found in the whole sample. Nearly 60 per cent (25 out of 43) of the taxa found in the Isle of Wight Pond were found in the swamp, whereas the next most diverse habitat, the *Salix,* contained only 17 taxa (less than 40 per cent). A mean of 13.5 taxa/habitat zone (variance = 49.9) was found in the Isle of Wight Pond, whereas a mean of 21.8 taxa/habitat zone (variance = 23.2) was found in the Western Hollow Pond. The high variance shown by the Isle of Wight data illustrates the lack of homogeneity of the number of taxa/habitat. The lower variance of the Western Hollow data mean reflects a greater similarity of taxa/habitat in this pond.

A Jaccard's Coefficient of Similarity calculation (Table 3) based on the number of different taxa that they have in common in relation to the number discovered overall, shows a similarity of 0.368. This analysis indicates that the faunas of the two ponds are not dissimilar. However, it is considered rare for two adjacent ponds to have more than 50 per cent of their fauna in common (Friday 1987). In fact, the calculation of similarity may not reflect the true comparative index, as it must be noted that 48 per cent of the taxa present in the swamp habitat sub-sample from the Isle of Wight Pond are also found in the Western Hollow Pond. The swamp receives water from a small stream connecting the two ponds and forms a refuge for macro-invertebrates from fish predation prevalent in the rest of the pond. As a consequence, the faunal components of the swamp habitat may be influenced by immigration from Western Hollow Pond.

The taxon which varies most between the two ponds is the Coleoptera since the ponds had no adult beetle species in common. Waterbeetles are amphibious (Friday 1988) and are thus able to demonstrate their environmental preferences more easily than more-sedentary species. Perhaps the difference in the coleopteran fauna of the two ponds gives a true idea of the different environmental conditions present in each water body.

The survey shows that, in spite of its larger size, the Isle of Wight Pond had a more depauperate macro-invertebrate fauna than Western Hollow Pond. There are several

factors which may account for this. The Isle of Wight Pond has a substantial fish population. The population density is high enough to cause stunting (Beven and Radcliffe 1978, Beven 1979) as a response to competition for resources in the waterbody. Under these conditions of high population density and competitive stress, the chances of macrophyte re-establishment in the pond are low. The cyprinid species within the pond are facultative herbivores (Prejs 1984) capable of eating submerged macrophytes (Lammens and Hoogenboezem 1991, Lodge 1991). The carp, crucian carp and bream, especially, are grubbers in the benthic substrate and will uproot or dislodge any macrophytes (Welcomme 1984). In addition, the turbidity of the water in the Isle of Wight Pond, possibly the result of fish-grubbing activity, will tend to discourage the development of any submerged photosynthetic organism. Invertebrate diversity and abundance within a waterbody are usually correlated very strongly with the abundance of submerged macrophytes present (Dvorak and Best 1982). The absence of macrophytes within the Isle of Wight Pond means that there is little in the way of the cover, feeding substrate or attachment sites necessary for many species of macro-invertebrates to thrive. The dense fish population ensures that the predation pressure on the macro-invertebrate population is very high, limiting the potential for both colonization and persistence of prey species.

Conclusions

Surveys and comparisons of the macro-invertebrate faunas of ponds may be used to give a general idea of how similar they are in habitat. In this study two adjacent ponds with similar water and geology were surveyed and found to support dissimilar macro-invertebrate faunas. It is possible that the differences in macro-invertebrate diversity between the two ponds are due to the differential macrophyte cover within each. This may be a consequence of the present high fish population in the Isle of Wight Pond.

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