Biological Survey of Swan Pool, Priory Park, Malvern

Will Watson and Giles King-Salter

01. Swan Pool (lower pool) looking north towards southern island. Will Watson.

Introduction

In March 2021 Malvern Hills District Council appointed Will Watson, Ecological Consultants, to provide an ecological report which focused on the condition of Swan Pool and its wildlife. This work took place prior to its restoration in March 2022 which involved desilting, biomanipulation of fish stocks as well as aquatic macrophyte planting. The pool was visited five times in 2021 with visits in spring through to late summer.

Site Description

Swan Pool (01) is located in Priory Park, Great Malvern (at SO 7780 4575). It lies 160 metres to the east of Great Malvern Priory on the lower slopes of the Malvern Hills and is thought to have originated as the priory's fish pool. The pool is a prominent feature of the park and actually consists of two pools, with the lower, main pool located at an elevation of 110 m Ordnance Datum (OD) and the much smaller, upper pool located at 111 m OD. The lower pool is linear in shape and follows the natural contour (01). It has two small round islands which were constructed when the site was landscaped as a public park in the 19th century, and its base was found to be composed of solid clay. The strip of land to the west, six metres wide, on the upper banks of the pool has been planted with specimen trees including Hop Hornbeam *Ostrya carpinifolia*, Silver Birch *Betula pendula* and Copper Beech *Fagus sylvatica purpurea*, it also includes some naturally regenerating species such as Ash *Fraxinus excelsior*, Goat Willow *Salix caprea* and Holly *Ilex aquifolium*. The land here slopes moderately towards the pool, where there is a low stone revetment composed of Malvern Stone, which has collapsed in several places. The eastern revetment is of concrete and stone construction and is vertical-sided apparently in a good state of repair. The steep stone margins allow little opportunity for native aquatic species of plant to grow.

The upper feeder pool is located to the north-west and is concrete lined. The base of the pool has been colonised by the variegated form of Common Reed *Phragmites australis* and there is extensive open water beneath scattered shoots of the reed. The pool was heavily silted up at the time of the survey and the water depth as a consequence was only about five cm. The eastern end has abundant Bulrush *Typha latifolia* and Lesser Bulrush *Typha angustifolia* (02). A large Corkscrew Willow *Salix matudana 'Tortuosa'* has been planted on the southern bank and this shades the central region of the pool. The west bank is steep and has been landscaped with natural stones. Large *Rhododendron* bushes now occupy most of the west bank, and a *Gunnera* sp grows close to the water's edge.

02. The upper pool in summer displaying Bulrush Swamp. Will Watson.

Hydrology

There are two apparent water sources in Priory Park. One of them supplies Swan Pool at its northern end and was probably installed by the monks (Payne, 2021). This outlet is supplied from springs on the Malvern Hills so is irrelevant to the hydrology of the Park. The second water source feeds the small stream known as the Chalybeate Stream at the south end of the park. In the 19th century, this spring supplied the Chalybeate Spa where Spa Cottage is now located. Chalybeate waters, also known as ferruginous waters, are mineral spring waters containing iron salts, being visible as rust-coloured slimy deposits in the open section of the stream as it run through the

park. The Chalybeate spring whose location, now buried, is thought to be close to Malvern Priory was known as "Dog Well" in the 18th century (Malvern Spa Association). The Hay Well stream, close to Warwick House, may link to the Chalybeate Stream or possibly may be a synonym. In addition to the stream source, this area of the park occasionally exhibits damp patches and probably receives hill water by way of a natural underground channel. There is a substantial influx of water thought to be the result of several springs from the higher part of the town being piped into Swan Pool.

Management Issues

According to the Friends of the Park there was a "stagnant odour in summer". Organic residue in the pool was observed during our biological surveying. An ecotoxicology survey was carried out by Worcestershire Regulatory Service on behalf of ALS Environmental Services Ltd on three separate occasions in 2021. This found slightly elevated levels of phosphorus and nitrates. The pool had become heavily silted, with silt depths measured at 0.6 m in the lower pool and 0.75 m in the upper pool. A major contributing factor to the silt deposition are the mature trees located around the margins. Other problems are caused by the large numbers of ducks, mostly domesticated Mallards *Anas platyrhynchos* which are present on a permanent basis, with regular feeding by the public responsible for their artificially high numbers. The waterfowl droppings result in increased nutrient loading which can also cause toxic algal blooms and lower oxygen levels in summer. The high duck numbers prevent aquatic plants from establishing and they also constantly stir up the bottom sediment when feeding which releases the suspended silt and nutrients into the water column.

The Biological Survey

Amphibians

No amphibians were recorded in either of the pools but one Common Frog *Rana temporaria* was recorded by torchlight beside the Chalybeate Stream to the west on 10th March 2021 (03) at SO 7773 4575. One of the Friends of the Park recalled that "in the 1970's hundreds of frogs migrated down Orchard Road and laid prolific clumps of frogspawn in the Swan Pool and the spring pools". However, by the 1980's frogspawn was absent.

03. Female Common Frog on path recorded on 10th March 2021. Will Watson.

Mammals

Three Brown Rats *Rattus norvegicus* were recorded on and around the upper feeder pool on 10th March 2021 and two Brown Rats were recorded on the west bank of the lower pool, where there were extensive rat burrows. Rats were encouraged by the constant feeding of bread and grain to the water fowl by the public. Grey Squirrel *Sciurus carolinensis* was present on trees adjacent to pool on 22nd March 2021.

Birds

Five Moorhen *Gallinula chloropus* were noted on both the upper and lower pools on 22nd March 2021. This species nests in both pools but has greater nesting success in the upper pool where there is less disturbance. Somewhere around 50 Mallard were present on 19th July 2021, including several broods of ducklings. During all five visits large numbers of Mallard were noted. Most appear to domesticated Mallard as they are larger than the average wild bird and habituated to the presence of people. Other birds noted in and around the pool on 22nd March were Dunnock *Prunella modularis* x2, Wood Pigeon *Columba palumbus* x8, Feral Pigeon *Columba livia domestica* x8, Blue Tit *Cyanistes caeruleus* x1, Nuthatch *Sitta europaea* x1, Magpie *Pica pica* x1, Jackdaw *Corvus monedula* x17, Robin *Erithacus rubecula* x1, Blackbird *Turdus merula* x2 and Black-headed Gull *Chroicocephalus ridibundus* x1. Two Herring Gull *Larus argentatus* were recorded on 19th July 2021and were seen on other visits. Herring Gulls (04) are UK Red listed; red is the highest conservation priority identifying species in need of urgent action. The list has been drawn up by the UK's leading bird organisations. The UK Herring Gull population has declined by at least 50% in the last 25 years. According to Friends of the Park, the Herring Gulls help to control duck numbers as they predate the young ducklings. One Grey Heron *Ardea cinerea* was present on the island on 19th July 2021, and are more likely to feed on the larger fish. Kingfishers *Alcedo atthis* have returned in the last three years, visiting in autumn and winter only after the breeding season (Friends of the Park pers. comm.)

04. Two Herring Gulls temporarily residing on the pool. Will Watson.

Fish

Three-spined Stickleback *Gasterosteus aculeatus* were netted from both the lower pool and the upper pool on three separate occasions during the course of the sampling surveys. Large numbers were present in both pools, and they were the only fish species present in the upper pool. On 16th September, over 50% of the sticklebacks in the lower pool were infected with the microsporidian parasite *Glugea anomala* which forms characteristic large white cysts on the body of the fish (05).

05. A stickleback from the lower pool infected with the microsporidian parasite *Glugea anomala*. Will Watson.

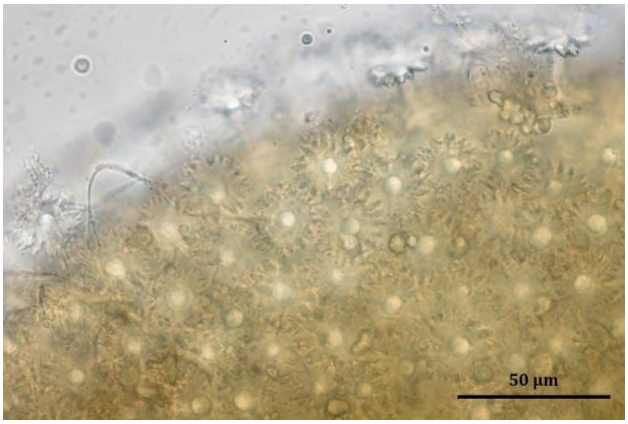
Fish other than sticklebacks were known to be present as fish were seen topping on 27th March 2021. A fish health check was carried out by Edward Brown of Furnace Mill Fisheries Ltd in March 2022 prior to desilting, and he was able to confirm the presence of Roach *Rutilus rutilus*. Approximately 30,000 fish were removed from the two pools of different sizes ranging from 1cm to 25cm. Unfortunately the fish were in poor condition and failed the health check because of the type and levels of parasites.

Invertebrates and their status

A total of 23 species of aquatic invertebrates were identified from the lower and upper pools during the surveys. 15 species were found in the lower pool (Table 1) and 13 species were found in the upper pool (Table 2). The major groups of species found were dragonflies and damselflies (five species), leeches (four species), molluscs (four species) and water bugs (three species). Adults of three species of dragonfly and two species of damselfly were recorded during the surveys: Brown Hawker *Aeshna grandis*, Emperor Dragonfly *Anax imperator*, Common Darter *Sympetrum striolatum*, Azure Damselfly *Coenagrion puella* and Large Red Damselfly *Pyrrhosoma nymphula*. These are all common and widespread species that breed in ponds and disperse widely as adults. Any of these could potentially breed at Swan Pool, but no larvae were recorded on any of the survey dates. Breeding in either the lower pool or the upper pool currently seems unlikely due to the combination of the high numbers of fish (especially Stickleback) and limited aquatic vegetation to provide protection from predation. Three additional dragonfly and damselfly species were reported from Swan Pool by Peter Dawson. These were Broad-bodied Chaser *Libellula depressa*, Common Club-tail *Gomphus vulgatissimus* and Banded Demoiselle *Calopteryx splendens*. The latter two species breed in rivers so would certainly have come from elsewhere, whereas Broad-bodied Chaser is a common pond-species but breeding at Swan Pool seems unlikely for the reasons stated above.

The freshwater sponge *Ephydatia fluviatilis* was present on a submerged tree root plate beside the outflow of the Chalybeate Stream (06).

06. Freshwater Sponge *Ephydatia fluviatilis* focus stacked image taken on site showing spicules and gemmules. Will Watson.



07. Photomicrograph of *Ephydatia fluviatilis* gemmule, showing birotulate gemmocleres. Giles King-Salter.

It was identified to species by examining the spicules (megascleres and gemmoscleres) under an Olympus BH2 compound microscope at up to 400x magnification. Photo 07 above shows a section of gemmule showing the gemmoscleres which are birotulate (shaped like an axle with a wheel at each end). Photo 08 below shows a few of the megascleres (microscleres were absent). The size and shape of the gemmoscleres are a very close match for the drawings and description of *E. fluviatilis* in Fitter & Manuel (1986). The status of *E. fluviatilis* in Worcestershire is unknown. Nationally, this is one of the commoner freshwater sponge species.

08. Photomicrograph of *Ephydatia fluviatilis* megascleres. Giles King-Salter.

A reed beetle *Donacia vulgaris* (09) was present and is a species of local interest. There are eight records on the National Biodiversity Network Atlas covering Worcestershire. Adults of this species feed on the aerial foliage of emergent plants including bur-reeds (*Scirpus* spp.), bulrushes (*Typha* spp.) and sedges (*Carex* spp.); larvae feed on the submerged rhizomes of the same plant species (Cox, 2007). Potentially this species could be breeding on the two bulrush species present in the Upper Pool.

09. Reed beetle *Donacia vulgaris* found in the upper pool. Will Watson.

Nine species of terrestrial and wetland invertebrates were recorded around the upper pool. Four of these were adult hoverflies belonging to species with aquatic larvae; these may have bred in one of the ponds or they may have arrived from elsewhere. Overall, the abundance and diversity of aquatic invertebrates was very limited. No water beetles were recorded except for a very small number of *Helophorus brevipalpis*, an extremely common and ubiquitous species of grooved water scavenger beetle. The three species of aquatic bugs recorded are all species which live on and around the water surface; none of the submerged aquatic bug species which would typically occur in a pond of this size were recorded. A few small nymphs of the Pond Olive mayfly *Cloeon dipterum* were found in the lower pool, but high levels of fish predation are likely to restrict breeding of this species in the ponds.

The major factors likely to be limiting aquatic invertebrates in the ponds are the presence of fish, the limited abundance of aquatic plants, and the hard vertical banks of both ponds. The consequence of the latter is that there is a complete absence of shallow marginal areas with a gradual transition between terrestrial and aquatic vegetation; such areas are where the majority of aquatic invertebrates are usually found.

Fish prey heavily on aquatic invertebrates, and in Swan Pool their negative effect is magnified by the hard banks and lack of submerged vegetation to provide cover, meaning that invertebrates have few places to seek refuge. Consequently, the invertebrate community was mainly made up of the most tolerant species capable of avoiding fish predation, such as leeches, flatworms and molluscs which are able to hide under rocks, plus fly larvae which can breed in the silt.

Plant communities and botanical status

A total of 66 plant species were recorded from in and around Swan Pool. This included 26 species of trees (Table 4) and 40 species of aquatic, herbaceous and climbing plants (Table 5). Of these, there were only ten species classified as aquatic and wetland species by the National Pond Survey. All 10 of these were in the upper pool; the only aquatic plant recorded from the lower pool was Yellow Flag *Iris pseudacorus*. The pond is of low value for aquatic plants on account of the number of species present.

The 10 aquatic species recorded are all emergent species with predominantly aerial foliage; there were no species of submerged, floating-leaved or free-floating aquatic plants. Species in these groups are of particular importance in providing high quality habitat for breeding amphibians and aquatic invertebrates, so their absence is a reflection of the generally poor quality of Swan Pool for amphibians and invertebrates.

Restoration of Swan Pool

Following the de-silting of Swan Pool in 2022 a range of native aquatic plants have been planted beneath gabion baskets around the pool's margin (10), and native White Water-lily which was present last century has been planted in the middle of the pool. The lower pool will be restocked with a mixture of Roach, Rudd *Scardinius erythrophthalmus* and Perch *Perca fluviatilis* at numbers well below the carrying capacity for a pool of that size, to enable a gradual recovery. The upper pool will be left fish-free in the hope it may be colonised by amphibians. The water during summer 2022 took on a milky appearance. This may be due to a proliferation of bacteria following desilting which in turn maybe a consequence of the disturbance of bottom sediments during the desilting. However, over the last few months the water has cleared (Yasmina Ashcroft *pers.comm.*) and it is expected that the water quality will continue to improve.

10. The lower pool in July 2022 with gabions protecting aquatic plants and the water milky in colour. Will Watson.

Acknowledgements

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Thanks also to the Friends of the Park for keeping us informed of wildlife happenings.

Tables of flora and fauna identified during the biological survey of Swan Pool, Priory Park, Malvern.

1.

Group	Family	Species	Common Name	Date
Bugs	Hydrometridae	*Hydrometra stagnorum*	Water Measurer	16/09/2021
Crustaceans	Asellidae	*Asellus aquaticus*	Water-slater	27/03/2021
Crustaceans	Gammaridae	*Gammarus pulex*	Freshwater Shrimp	27/03/2021
Dragonflies	Aeshnidae	*Aeshna grandis*	Brown Hawker	19/07/2021
Dragonflies	Aeshnidae	*Anax imperator*	Emperor Dragonfly	19/07/2021
Dragonflies	Libellulidae	*Sympetrum striolatum*	Common Darter	16/09/2021
Flies	Chironomidae	*Chironomidae sp.*	a non-biting midge	27/03/2021
Leeches	Erpobdellidae	*Erpobdella octoculata*	a leech	27/03/2021
Leeches	Glossiphoniidae	*Helobdella stagnalis*	a leech	27/03/2021
Leeches	Glossiphoniidae	*Theromyzon tessulatum*	Duck Leech	16/09/2021
Mayflies	Baetidae	*Cloeon dipterum*	Pond Olive	16/09/2021
Molluscs	Planorbidae	*Gyraulus albus*	White Ramshorn	27/03/2021
Molluscs	Tateidae	*Potamopyrgus antipodarum*	Jenkin's Spire Shell	27/03/2021
Platyhelminth Worms	Dugesiidae	*Dugesia ?polychroa*	a flatworm	27/03/2021
Sponges	Spongillidae	*Ephydatia fluviatilis*	a sponge	16/06/2021

Table 1. Aquatic invertebrates from the lower pool.

2.

Group	Family	Species	Common Name	Date
Beetles	Hydrophilidae	*Helophorus brevipalpis*	a grooved water scavenger beetle	16/06/2021
Bugs	Gerridae	*Gerris sp.*	a pondskater	16/06/2021
Bugs	Veliidae	*Velia caprai*	Water Cricket	16/06/2021
Crustaceans	Gammaridae	*Gammarus pulex*	Freshwater Shrimp	16/09/2021
Damselflies	Coenagrionidae	*Coenagrion puella*	Azure Damselfly	16/06/2021
Damselflies	Coenagrionidae	*Pyrrhosoma nymphula*	Large Red Damselfly	16/06/2021
Dragonflies	Libellulidae	*Sympetrum striolatum*	Common Darter	16/09/2021
Leeches	Erpobdellidae	*Erpobdella testacea*	a leech	23/03/2021
Leeches	Glossiphoniidae	*Helobdella stagnalis*	a leech	16/09/2021
Leeches	Glossiphoniidae	*Theromyzon tessulatum*	Duck Leech	16/09/2021
Molluscs	Physidae	*Physella acuta*	a non-native bladder snail	23/03/2021
Molluscs	Planorbidae	*Ancylus fluviatilis*	River Limpet	16/09/2021
Molluscs	Tateidae	*Potamopyrgus antipodarum*	Jenkin's Spire Shell	16/09/2021

Table 2. Aquatic invertebrates from the upper pool.

3.

Group	Family	Species	Common Name	Date
Bees	Apidae	*Bombus pratorum*	Early Bumblebee	16/06/2021
Flies	Anthomyiidae	*Anthomyiidae sp.*	a root-maggot fly	16/06/2021
Flies	Calliphoridae	*Pollenia sp.*	a clusterfly	16/06/2021
Flies	Syrphidae	*Episyrphus balteatus*	Marmalade Hoverfly	16/06/2021
Beetles	Chrysomelidae	*Donacia vulgaris*	a reed beetle	19/07/2021
Flies	Syrphidae	*Eristalis tenax*	Drone Fly	16/09/2021
Flies	Syrphidae	*Helophilus pendulus*	a hoverfly	16/09/2021
Flies	Syrphidae	*Melanogaster hirtella*	a hoverfly	16/06/2021
Flies	Syrphidae	*Myathropa florea*	a hoverfly	16/09/2021

Table 3. Terrestrial invertebrates from the upper pool.

4.

Family	Species	Common Name	Main Pool	Upper Pool
Aceraceae	*Acer pseudoplatanus*	Sycamore	1	1
Aquifoliaceae	*Ilex aquifolium*	Holly	1	
Betulaceae	*Alnus glutinosa*	Common Alder	1	1
Betulaceae	*Alnus incana*	Grey Alder	1	1
Betulaceae	*Betula pendula*	Silver Birch	1	
Betulaceae	*Ostrya carpinifolia*	Hop Hornbeam	1	
Cornaceae	*Cornus sp.*	Dogwood	1	
Cupressaceae	*Cupressus sp.*	Cypress	1	
Cupressaceae	*Sequoia sempervirens*	Coast Redwood	1	
Ericaceae	*Rhododendron sp.*	Rhododendron	1	1
Fabaceae	*Laburnum anagyroides*	Common Laburnum	1	
Fagaceae	*Fagus sylvatica purpurea*	Copper Beech	1	
Fagaceae	*Quercus cerris*	Turkey Oak	1	
Fagaceae	*Quercus robur*	Pedunculate Oak	1	
Fagaceae	*Quercus rubra*	Red Oak	1	
Garryaceae	*Aucuba japonica 'Crotonifolia'*	Spotted Laurel	1	
Malvaceae	*Tilia americana*	American Lime	1	
Malvaceae	*Tilia x europaea*	Common Lime	1	
Oleaceae	*Fraxinus excelsior*	Ash	1	1
Pinaceae	*Cedrus atlantica*	Atlas Cedar	1	
Rosaceae	*Prunus laurocerasus*	Cherry Laurel	1	
Rosaceae	*Prunus lusitanica*	Portuguese Laurel	1	
Salicaceae	*Salix caprea*	Goat Willow	1	1
Salicaceae	*Salix matsudana 'Tortuosa'*	Corkscrew Willow		1
Salicaceae	*Salix x sepulcralis Agg.*	Weeping Willow	1	
Taxaceae	*Taxus baccata*	Yew	1	

Table 4. Trees and shrubs recorded from around Swan Pool, Priory Park.

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Images

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