

BBOWT Wild Oxford Project

Raleigh Park Nature Reserve

Report on the Second and Third Year

January 2018 to July 2019



*Raleigh Park, view towards Oxford with dandelions and celandines
flowering in mown area in April 2018*

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All photographs in the following report are my own, except where otherwise indicated.

AIMS OF THE WILD OXFORD PROJECT AND GENERAL INTRODUCTION

The Wild Oxford Project is a collaborative initiative of BBOWT and Oxford City Council (OCC). It has already been running for five years on three other sites owned by OCC in the Oxford area (Lye Valley Nature Reserve, Chilswell Valley and Rivermead Nature Park) under the leadership of Andy Gunn. 2019 is the third year that the work has extended to Raleigh Park Nature Reserve. The project is grant funded by a local charitable trust.

The Project Aims are to:

- Introduce local people to the wildlife on their doorstep
- Enable local people to take an active role in enhancing and protecting the sites
- Deliver improvements to the wetlands (fen and stream) and other key habitats.

Introduction and background to Raleigh Park

Raleigh Park Nature Reserve (27 acres, 9.6 ha between North Hinksey and Botley) was given in trust to Oxford City Council (OCC) in 1935. Once part of the estates owned by the Harcourt family, it was sold to Raymond Ffennel in 1924 and later donated to the City of Oxford as a park to be kept as open space forever. Raleigh Park is named in honour of Sir Walter Alexander Raleigh (1861-1922), an English scholar, poet and author, who was Professor of English Literature at the University of Oxford and the founder of Oxford Preservation Trust.

The land is maintained as public open space and a nature park, managed by OCC and The Friends of Raleigh Park.

The park is on sloping land facing north-east and has small areas of a variety of habitats that make it a pleasant site for a walk and wildlife observation. It is on the slope of the Boars Hill escarpment and offers attractive views over the Thames floodplain and the city of Oxford from its highest part.

The geology is mainly Jurassic Corallian limestone and sandy clay. Habitats include relic dry limestone grassland (rather rank and species-poor due to lack of grazing), copses of trees and scrub, with the most important habitat being the wetlands – small areas of spring-fed, calcareous, alkaline, tufa-forming fen on peat and a tufa-forming stream with a constructed pond.

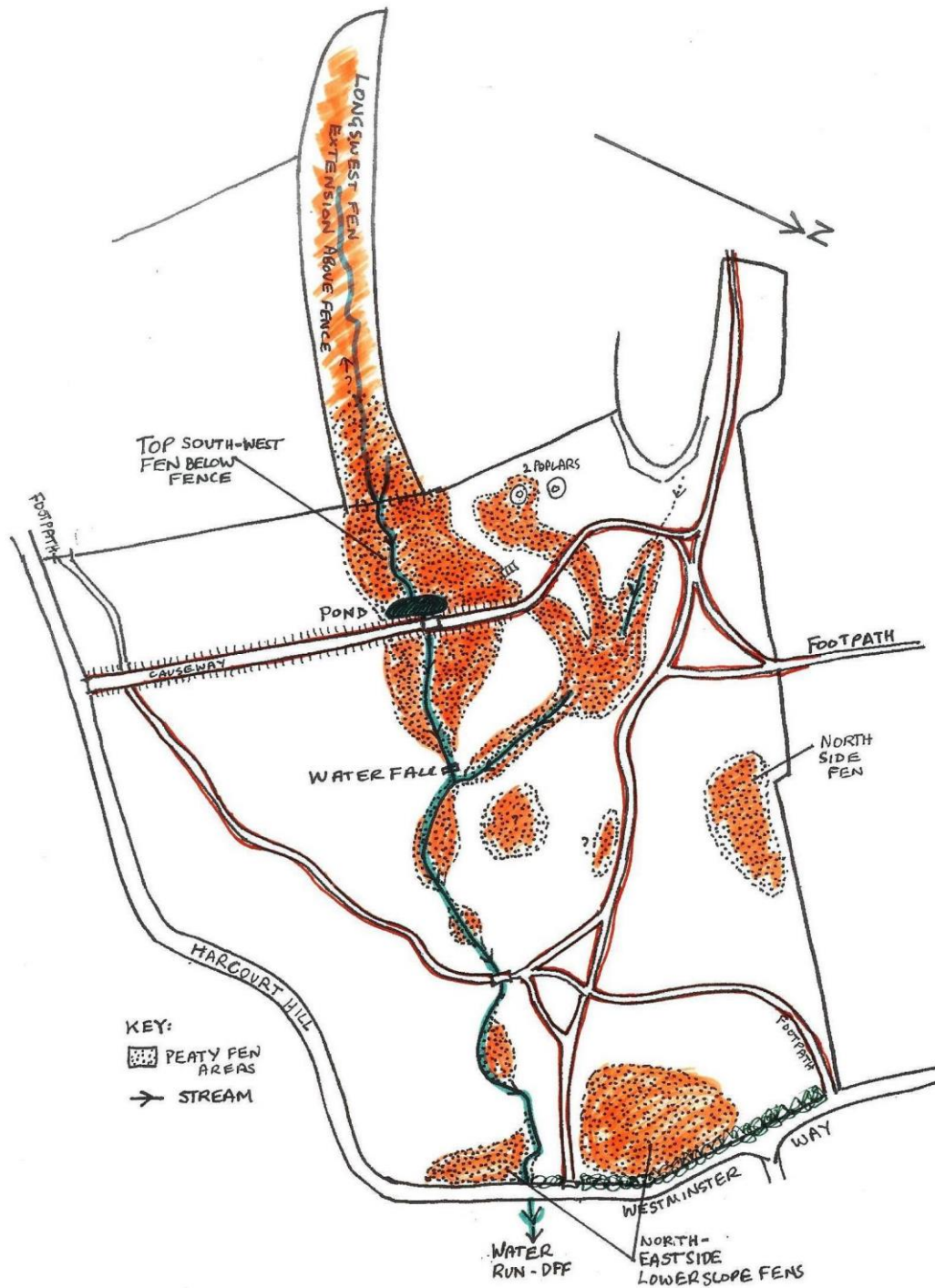
In 2014 the whole publically-accessible part of the park was designated a Local Wildlife Site (LWS) referred to as **Site 40X03** by Thames Valley Environmental Records Centre ([TVERC](#)) in recognition of its county importance for wildlife. The LWS centre's Ordnance Survey grid reference is SP492052. Access is only on foot from Raleigh Park Road, Westminster Way or Harcourt Hill. The long south-west extension of the park, which encloses the course of the small stream above the barbed wire fence, remains provisional LWS, awaiting further biodiversity information.

A local group, [Friends of Raleigh Park](#), set up in 2011, were active prior to the start of this project, carrying out scrub control and working on the pond and stream, as well as reducing the alien invasive plant known as Himalayan Balsam. The objectives of the Friends of Raleigh Park are to protect, conserve and enhance the Park for the benefit of the community.

Raleigh Park was added to the suite of sites within the Wild Oxford project in 2016 and work on site started with a volunteer taster scrub work session on 12th November 2016.

For extensive further background on the site, its habitats and the progress made in the first year of work, please see my first report for this project, 2016-2017, available from the BBOWT website at <https://www.bbowl.org.uk/wildlife/living-landscapes/wild-oxford> or from the Friends of Raleigh Park website at: <http://www.raleighpark.org.uk/resources.html>

Figure 1: Coloured sketch map of Raleigh Park showing only the stream, drainage channels, footpaths (outlined in red) and wetland fen areas identified by the extent of peat deposits (orange, provisional). Note the direction of north. The map is orientated so that the higher ground of the Boar's Hill escarpment is at the top and the lower ground adjacent to the Oxford by-pass is at the bottom.



- **Friends of Raleigh Park butterfly records** for 2018 are presented in Appendix I
- A full table of **records of species found at Raleigh Park in my surveys** from 2017 to 2019 is presented in Appendix II
- For further background information on the site and its history, see the Friends of Raleigh Park website <http://www.raleighpark.org.uk/>

FOCUS OF WORK IN THE SECOND AND THIRD YEAR OF THE BBOWT WILD OXFORD PROJECT AT RALEIGH PARK

In the first year of the project, the focus of the work was the top south-west fen area and the margins of the pond within the fen area – please see my first report on this. In the second and third years, work continued in these areas but also extended to the overgrown old fen areas below the raised causeway and down the stream corridor.

Alkaline fen restoration:

At the start of the project, relic patches of a rare, valuable, calcareous, alkaline fen habitat were identified in Raleigh Park. These have been overshadowed by uncontrolled growth of giant horsetail and scrub due to insufficient grazing and no specific cutting management.

Removal of this scrub was therefore seen as a priority to prevent species loss and encourage the return of plant species from the seed bank.

The project has provided assistance with scrub removal and regular rush and horsetail cutting and raking to return the site to the wetland vegetation type typical of when the land underwent rough, extensive, grazing by horses. In the absence of grazing, the restored fen areas will need at least an annual cut and rake.

Pond Restoration

At the start of this project in 2016 deep shading of the pond by tall crack and grey willows made it unsuitable for the breeding of invertebrates like dragonflies and damselflies, which prefer open, sunny, warmer ponds. It was identified that the Wild Oxford Project could make a big difference to this pond by tree and scrub removal, which would also improve the breeding success of amphibians.

For the results from the first year of work please see my previous report.

RESULTS OF SECOND AND THIRD YEAR OF BBOWT WILD OXFORD PROJECT WORK AT RALEIGH PARK, 2017-2019

Volunteer input and general comments

Volunteers under the leadership of Andy Gunn contributed to remedial work on several of the patches of fen at the south-western higher-slope areas of the park during full work days, which averaged 7 days per year (mainly Saturdays but occasionally Fridays instead). Occasional additional evening work sessions from 6 to 8 pm on weekdays were instituted in 2018, enabling working people to volunteer at times other than the weekend sessions. Each full-day Wild Oxford work session lasts approximately 5 hours and an evening session 2 hours. Numbers of volunteers per session have been variable, but the site attracts big groups, so habitat restoration progress has been fast.

Whilst the wetland fen and pond areas were seen as a conservation restoration priority, work in the dry-land areas of the park was also undertaken to improve the general condition of the park to the benefit of wildlife and people enjoying it for recreation.

Examples of this are the creation of glades in scrub at the site centre and the start of laying of old mature blackthorn scrub to rejuvenate it and produce young suckering growth for brown hairstreak butterflies. The tall outgrown hedge adjacent to Westminster Way was laid in 2018 – work started by Oxford City Council staff and continued by volunteers. This preserves landscape views to and from the park and provides a denser hedge with more nesting opportunity for birds.



Oxford City council staff and volunteers start work on laying the marginal hedge to Westminster Way, March 2018

Oxford City Council Parks and Open Spaces staff contributed time in extra mowing of rank grass and bramble-dominated areas to increase the open, short, grassy habitat in drier areas. This is beneficial to plant species diversity in these areas, enabling smaller plants like white clover (a good nectar source for bees) to flower abundantly. Without this mowing to stimulate the growth of white clover and self-heal there would be minimal flowers suitable for bees on this site.



White clover flowers abundantly in mown areas, benefitting bees, June 2019

OCC staff also took down larger trees near the pond. Volunteers could then clear these away into piles.

My ecological monitoring of species occurrence and mapping of habitat change happened either during the work sessions or on separate visits. This recording is assisted by occasional data collected by volunteers, especially the Friends of Raleigh Park.

Monitoring vegetation change with on-going wetland restoration is an important part of any recording in order to judge the effectiveness of the volunteer work. Whilst qualitative observations are useful, a more quantitative recording method was used as well, specifically for the biggest fen area being restored at the top south-west side of the site.

Grazing with cows happened in summer 2017, and there was a little grazing in 2018 but since then no cow grazing has been possible. As a result, rank grassy conditions are now widespread in the drier areas that are not undergoing fen restoration cutting and raking or regular mowing by machinery. Rank grass growth is successfully suppressing wildflowers, and nectar sources for insects are now poor in these areas.

Alkaline Fen Restoration

After the removal of dense willow scrub and trees, the focus here has been regular volunteer scything and raking-off of horsetail- and rush-dominated vegetation, as the site became more open and sunny.

Whilst 0.19 hectares of one fen area were opened up in the first year of the project, after three years the work has extended to 5 fen areas. The total area restored to open short fen has doubled, now covering an estimated total of 0.38 hectares, as indicated in the sketch map of progress – **Figure 2** below.

As more and more areas are returned to short fen, the amount of work involved in scything and raking to keep the areas open and prevent a return to the previous overgrown state increases with every year. If grazing by cows or horses could be re-instated, the human labour of keeping the areas open would be minimal and all human volunteer effort could be directed at restoring fen areas not yet touched.

It is interesting to compare before and after photographs for the top south-western fen area, which was the first target area at the very start of the project.



Top south-west fen in 2016 at beginning of work, early stage of restoration – grey willows to be removed



Same area of top south-western fen on 20.06.2019 after willow tree removal and 3 years of restoration cutting and raking. Marsh thistle and ragged robin in flower.

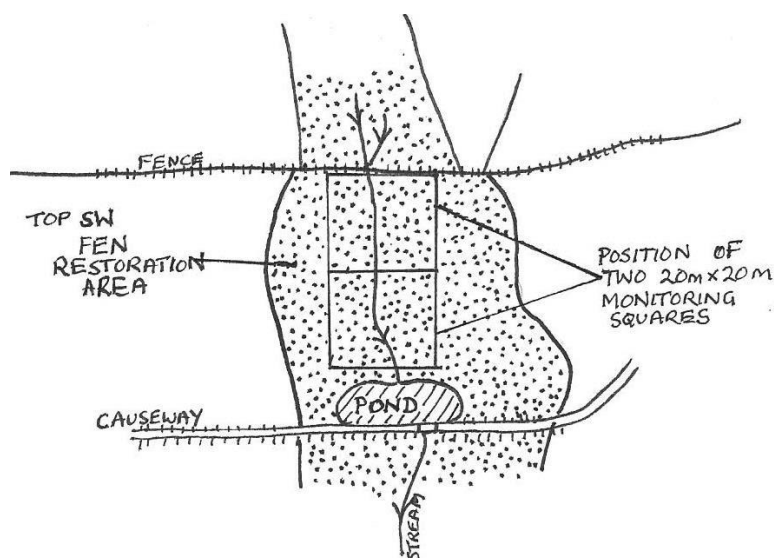
Botanical monitoring of fen restoration progress

For wildlife recording there is now better access to the bigger top south-western fen (inaccessible initially due to dense willow scrub). The results of a second year of more detailed study of this area using a botanical quadrat (set up in 2017) are presented; these clearly chart the return and increase of plant species diversity.

In order to obtain a frequency value for each species, two 20m x 20m square sections of the cleared top west fen were marked out and vegetation within each square was assessed by recording the presence or absence of species in 40 random 28cm quadrats (actually circular 'roundrats'). This recording method has been proved useful recently by Snowdon in Cothill Fen SAC (2017).

These two 20m x 20m squares can be re-located fairly accurately in the future for re-recording. The two squares are contiguous. The upper square is immediately below the fence line, the lower square immediately above the pond (see sketch map, **Figure 3**).

Figure 3: Sketch map of location of plant-monitoring squares in the top west fen



In 2018 only data for the topmost of these two squares was re-recorded due to time constraints. The lower of these two squares is very similar in plant composition to the upper one. So, considering only the topmost square, how do the results for the two years compare?

Table 1: Percentage frequency of plant species in 40 random samples in the upper 20 x20m square of the restored top south-west fen. Results for 2017 compared with those for 2018.

<i>Shading indicates notable/conservation-worthy species</i>		<i>Plant frequency in 40 quadrats in a 20m x 20m square</i>	
* <i>Date of sampling</i>		06.08.2017*	09.08.2018*
Scientific name	Common name	% freq	% freq
<i>Acer pseudoplatanus</i>	sycamore		2.5
<i>Agrostis stolonifera</i>	creeping bent	52.5	22.5
<i>Alnus glutinosa (seedling)</i>	alder		7.5
<i>Apium nodiflorum</i>	fool's watercress	10	5
<i>Arum maculatum</i>	cuckoo pint	2.5	
<i>Betula sp seedling</i>	birch		2.5
<i>Brachypodium sylvaticum</i>	wood false brome	2.5	
<i>Brachythecium rutabulum</i>	rough-stalked feather-moss		2.5

<i>Shading indicates notable/conservation-worthy species</i>		<i>Plant frequency in 40 quadrats in a 20m x 20m square</i>	
<i>* Date of sampling</i>		06.08.2017*	09.08.2018*
<i>Bryum cf. pseudotriquetrum</i>	marsh bryum		5
<i>Calliergonella cuspidata</i>	common spear moss	40	52.5
<i>Cardamine pratensis</i>	cuckoo flower	12.5	17.5
<i>Carex hirta</i>	hairy sedge	10	2.5
<i>Carex sp.</i>	sedge		10
<i>Cirsium palustre</i>	marsh thistle	12.5	12.5
<i>Conocephalum conicum</i>	lemon scented liverwort	12.5	10
<i>Cratoneuron filicinum</i>	fern-leaved hook moss	42.5	45
<i>Dactylorhiza fuchsii</i>	common spotted orchid	5	2.5
<i>Eleocharis uniglumis</i>	slender spike-rush		5
<i>Epilobium hirsutum</i>	great willow herb	7.5	12.5
<i>Epilobium parviflorum</i>	hoary willow herb	42.5	27.5
<i>Epilobium sp.</i>	willow herbs		2.5
<i>Epilobium tetragonum</i>	square-stalked willow herb		2.5
<i>Equisetum arvense</i>	field horsetail	10	27.5
<i>Equisetum palustre</i>	marsh horsetail	5	
<i>Equisetum telmateia</i>	giant horsetail	57.5	65
<i>Eupatorium cannabinum</i>	hemp agrimony	12.5	22.5
<i>Festuca gigantea</i>	giant fescue	10	5
<i>Fraxinus excelsior (seedling)</i>	ash	17.5	12.5
<i>Geum urbanum</i>	wood avens	2.5	
<i>Glyceria sp.</i>	sweet grasses	42.5	47.5
<i>Hedera helix</i>	ivy	2.5	
<i>Holcus lanatus</i>	yorkshire fog	15	25
<i>Hypericum tetrapterum</i>	square stalked St John's wort	10	10
<i>Iris pseudacorus</i>	yellow flag iris	5	7.5
<i>Isolepis setacea</i>	bristle club rush	5	
<i>Juncus articulatus</i>	jointed rush	22.5	35
<i>Juncus bufonius</i>	toad rush	15	
<i>Juncus inflexus</i>	hard rush	7.5	25
<i>Lotus pedunculatus</i>	greater bird's foot trefoil		2.5
<i>Lysimachia nummularia</i>	creeping jenny	30	20
<i>Mentha aquatica</i>	water mint	5	15
<i>Myosotis scorpioides</i>	water forget-me-not	12.5	2.5
<i>Myosoton aquaticum</i>	water chickweed	2.5	
<i>Pellia endiviifolia</i>	endive pellia liverwort	5	10
<i>Physcomitrium pyriforme</i>	common bladder moss		2.5
<i>Plagiomnium undulatum</i>	hart's tongue thyme moss	27.5	2.5
<i>Poa trivialis</i>	rough meadow grass	5	2.5
<i>Prunella vulgaris</i>	self heal		2.5
<i>Pulicaria dysenterica</i>	fleabane		2.5
<i>Ranunculus repens</i>	creeping buttercup	15	30
<i>Ranunculus acris</i>	meadow buttercup	5	
<i>Rubus fruticosus</i>	bramble	5	2.5
<i>Rumex sp</i>	docks	2.5	5
<i>Salix cinerea</i>	grey willow	20	10

<i>Shading indicates notable/conservation-worthy species</i>		<i>Plant frequency in 40 quadrats in a 20m x 20m square</i>	
<i>* Date of sampling</i>		06.08.2017*	09.08.2018*
<i>Salix seedling</i>	willow		37.5
<i>Scrophularia auriculata</i>	water figwort	2.5	17.5
<i>Silene flos cuculi</i>	ragged robin		5
<i>Taraxacum sp</i>	dandelions	2.5	2.5
<i>Trifolium repens</i>	white clover	10	2.5
<i>Typha latifolia</i>	greater reed-mace	12.5	27.5
<i>Veronica beccabunga</i>	brooklime	25	60

Description and interpretation of results

Two years of scrub removal, cutting and raking and grazing will have produced higher light levels with more open, shorter, sward conditions, which will favour some species and not favour others. Small changes in frequency from one year to another may be just chance effects of the random sampling method, but big changes are likely to be real effects of the restoration management.

Also the frequency of particular plant species has changed – some have increased and others have decreased as a response to the increased light reaching the soil with the removal of the willows and the cutting and raking. In addition to grazing, cutting and raking would always have been part of fen management in the past, as the fen hay arisings were useful as bedding for stock, if they were not of a quality for stock consumption. Of course, before the advent of grazing by domestic stock, fens would have been grazed and kept short by wild native large herbivores like wild cow (aurochs), wild horse, European elk and red deer.

Total plant species diversity

The total plant species diversity within the topmost south-western fen restoration area was **45** species in 2017 and recording shows this has increased to **52** species by 2019. An increase is expected with restoration management as competition is reduced, allowing room for more species. Trampling brings seed up from the seed bank, allowing germination of new species. Seed or spores may drift onto the site on the wind, bringing new species in. The frequency of some species stayed the same, for example, the giant horsetail. This is a deep-rooted species, which is impossible to eliminate completely. However the plants have noticeably decreased in height with the cutting and raking of the last three years. The species no longer dominates and shades the fen surface, as it has been weakened by the regular removal of its shoots.

New plant species found

Newly recorded are two mosses (one important species, **marsh bryum** *Bryum cf. pseudotriquetrum*, sycamore and birch seedlings, an unknown sedge (fruits needed for identification), greater bird's foot trefoil, self-heal, fleabane, ragged robin, slender spike rush and seedlings of alder and willow.

Of these, the most exciting is the **slender spike rush** *Eleocharis uniglumis*, rare in a county context - a species on the register of plants now rare in the county (Rare Plants Register) published as *Oxfordshire's Threatened Plants* (Erskine et al, 2017). This is an unspectacular grass-like plant that lacks showy petals, due to being wind pollinated, like grasses, but has green cylindrical leaves. It spreads sideways by underground rhizomes. From the extent of the colony it is likely this plant was present before, when the fen was shaded, but unable to flower and thus to be identified. It is now free to increase, flower and make seed. Remarkably, research shows there is a previous record of this species from this area – listed as at 'Ferry Hinksey' in 1893, by botanist G. C. Druce ' (in Druce's *Flora of Berkshire*, 1897, repeated in Bowen, 1968). Ferry Hinksey is the old name for today's North Hinksey. **A 'lost' species re-found after 126 years revealed by restoration management.**



Flowers of slender spike-rush, which flowered for the first time in the top south-western fen in 2018. Stigmas and anthers are visible. Spike rushes are wind pollinated and have no petals for attracting insects.

Plant species unrecorded this year

Cuckoo pint, marsh horsetail, toad rush, wood avens, water chickweed, meadow buttercup, bristle club rush, and wood false brome grass. These may just have been missed or they may actually be declining as not suited to the cutting and latterly no grazing, management.

Plant species remaining, but which have declined in frequency

Creeping bent grass, white clover, fool's water cress, hoary willow herb, hairy sedge, giant fescue, creeping jenny, bramble, water forget-me not, hart's tongue thyme moss have all declined in frequency, presumably less favoured by the higher light and repeated cutting and raking.

Plant species with increased in frequency

Hemp agrimony, Yorkshire fog grass, sweet grasses, jointed rush, hard rush, endive pellia liverwort, creeping buttercup, brooklime, greater reed-mace and water figwort have all increased in frequency, presumably benefitting from higher light levels. The sweet grasses, brooklime, water figwort and rushes will all have returned from long-lived dormant seed already present in the peat, waiting for light and disturbance.



Brooklime Veronica beccabunga has increased with the fen restoration work

Visually, the fen appears more colourful to the casual passer-by. Despite the decrease in frequency of common spotted orchids in the monitored square, in the rest of the fen they flowered more abundantly. Also, the clear improvement in flowering of ragged robin reflected an increase in frequency of this very attractive species. Dormant seed brought to the peat surface with all the trampling and tree removal has been stimulated to germinate by the higher light.



There was markedly increased flowering of common spotted orchids in the fen restoration areas, including one pure white version, seen on the right above.



Ragged robin showing increased flowering in the fen restoration areas.

Some issues in the restored top south-western fen area

1. Greater reedmace invasion

A continuing issue of concern is the colonisation of opened-up fen areas by seedlings of greater reedmace *Typha latifolia*, which has much increased in frequency (spread as seed on the wind from nearby uncleared areas of the south-western long extension and reedmace in the pond). Greater reedmace is a wind-pollinated, tall, dominant perennial and will make progress to a more flowery biodiverse short-turf fen difficult.



A swarm of young greater reedmace (resembling young leeks) germinated in the cleared fen from windblown seed, and had become quite large plants by May 2018. Those shown in the photo were removed by hand-pulling at this young stage.

Despite frequent pulling of the young greater reedmace plants by volunteers (easy whilst they are still young), a good many still remain. This plant can become tall and dominant, suppressing smaller plants. Progress to short-turf biodiverse fen will be slowed if it is allowed to become firmly established in restoration areas, and an intensive effort to reduce the numbers whilst the plants are still small and not well established is recommended. The next year could see this fen issue resolved by a concerted effort to remove the regular seed source by taking out all the parent greater reedmace plants from the pond, as well as from the long south-western extension of the fen and stream corridor on the other side of the barbed wire fence. This should start with scything of all the plants or pulling them out, if possible. Safe access to this long south-west extension through the barbed wire fence will be necessary.

If all cannot be removed in one year, I recommend that all the seed heads be cut off and removed by summer (in July) before seed dispersal. This should prevent any more seed colonising the restored fen area. Scything of the parent reedmace plants will weaken them, reducing their vigour and preventing flowering. Ultimately the weakened plants must be dug out for complete eradication. This large aggressive plant is not appropriate for such a small pond (more appropriate for very large pond or lake margins). If kept, it is definitely going to need the hard work of annual reduction.



Dead remains of mature greater reedmace plants in the long south-west extension, one source of seed to the restored fen downslope, 19.04.2018

2. Willow invasion

A second developing issue for the restored top south-western fen is germination of many seedlings of grey and crack willow in the new high light conditions. Female grey willows surround the fen and contribute large numbers of seed to the whole area, especially those willows on the pond margin and the island. These seedlings need removal by pulling before they develop into a dense sward of willow scrub, which would not help the restoration of a flower-rich herbaceous short-turf fen.

Two female grey willow trees remain on the island and the margin of the pond. Of course, only female willow trees produce seed that looks like white fluff and travels on the wind. It is recommended that the female willows are coppiced regularly to reduce pond shading and seed production. Willows are excellent wildlife trees and if both of these trees were male, they could stay with much benefit to wildlife, needing perhaps only slight size reduction.

Male grey willow catkins are an especially important pollen and nectar source in the spring (for bees, for example). If any willows near the pond are to be retained, it is recommended that the females be replaced by rooted cuttings of male grey willows. Restricting the size of any willows here will help retain more water in the fen during dry summers because a big willow will suck out a very large volume of water from the fen peat.

3. Hard rush control

Regular scything of hard rush *Juncus inflexus* in restored fen areas has been very successful in reducing the potential dominance of this tussock-forming plant. It has very tough, wiry, cylindrical leaves, which are not eaten by stock, so had become quite prominent in some fen areas that were previously well grazed. It has a very long-lived seed bank, so may spring up from buried seed in any area newly-cleared of scrub and where the peat is disturbed. In future, control may be achieved by digging out the tussocks, which will have been weakened by regular cutting.

Survey results from the long south-west fen/stream extension at the top of the park

This is a 'tongue' of land that runs from the top south-western fen area along the tiny stream corridor towards the top of the hill and the spring source of the stream. It is an overgrown area and access was difficult but a full survey in May 2018 revealed some important wildlife discoveries. A depth of wet peat is present and, further up the valley, there are extensive deposits of tufa in the mostly-shaded stream area. Iron deposition becomes more prominent the further up the valley one progresses.



Tufa-forming shaded small stream in the long south-west extension area, 19.04.2018

The first important discovery was a population of the opposite-leaved golden saxifrage *Chrysosplenium oppositifolium* on the stream margins, mostly in the upper reaches. This scarce plant has just slightly too many sites to be on the Rare Plants Register (*Oxfordshire's Threatened Plants*), but it is still an uncommon and very Local plant of old seepage wetlands.



Opposite-leaved golden saxifrage plants growing in the stream in the upper reaches of the long south-west extension area, April 2018



Opposite-leaved golden saxifrage has tiny, insignificant, flowers in springtime – on the long south-western extension up the hill, April 2018

Sweep-netting for flying invertebrates in this long, wet, tufa-rich and iron-rich corridor produced several interesting and important invertebrates on June 21st 2018. The dark-winged soldierfly *Oxycera analis* is particularly important, being nationally rare (Status 'Vulnerable', recent status review by Drake, 2017). One male was found by sweeping over the tufa-depositing stream. This species is restricted to the specialised habitat of shaded calcareous springs, fen and fen carr, where the aquatic larvae live in shallow water films. It is found only in southern counties in England.



The dark-winged soldierfly Oxycera analis

Several large predatory white larvae found under a waterlogged rotting log in the wet tufa area were those of a large spectacular and uncommon crane fly *Pedicia rivosa*, which has wings with a 'tuning fork' pattern. This is a very Local species with specific habitat requirements for the aquatic larvae, which hunt for prey living in the thin water film of such gently-running shallow water.



Pedicia rivosa, the 'tuning fork' winged crane fly

Rotting waterlogged wood lying half submerged in the stream was removed and set up to rear any interesting invertebrates using this habitat to breed. A good number of the local crane fly known as the common yellow splinter *Lipsothrix remota* emerged a couple of weeks after collection of the wood.



A common yellow splinter crane fly, Lipsothrix remota, newly emerged from the waterlogged wood it rests on, May 2018

Other species found included the brown tree ant *Lasius brunneus* (Notable). This breeds in hollow trees.

The species mentioned here are just indicators of the importance of this long south-west extension area. Many more invertebrate species are likely to be found and targeted surveys are necessary in future to get a clear idea of the invertebrate fauna and their management needs.

On the basis of those species found already, what is important is a continuation of gentle water flow with high calcium, vital for tufa formation, and this must not significantly dry out in summer. A degree of semi-shade is helpful, but more light could be let in, with the benefit of more water remaining in the stream if some willow scrub is removed (willows will suck up very large quantities of water). Shade could then be provided by other marginal trees. Management of the reedmace (and Himalayan balsam) in the wet peaty area just above the fence is the first priority, with the aim of eliminating the balsam and slowly getting rid of the reedmace. Disturbance of the seed bank here will bring back a number of more desirable fen species.

The accurate delimitation of OCC land on the north-western margin (currently unfenced or marked in any way) is urgently needed so that in future volunteers can be sure of working only on land belonging to the park and not on private land abutting the park.

Extension of restoration to dry fen below the causeway and bridge to stream

Much volunteer effort has been expended on clearing dense bramble and other scrub either side of the stream just below the causeway. This was started in winter 2017-2018, and in 2018-2019 work has focussed on cutting and raking the cleared area several times.

Personal experience has shown that restoration of old, dried-out, fen peat areas such as this is a big challenge. What returns initially is a poor quality 'weed' species community with very few original fen species. Nettles can predominate due to the encouragement of nutrient enrichment (drying of peat causes mineralisation and release of plant nutrients such as phosphate and nitrate, which favours nettles) and what seed bank does remain may produce a flush of growth and dominance of common rushes and sedges, which then become problem species as they suppress more desirable returning fen species.

Below the causeway, bramble scrub had climbed almost to the top of a hawthorn tree before work was done and the area was deeply shaded. After this scrub removal a remarkable mixture of plants arose from the bare peat. The community featured mainly great willow herb, bramble, nettle and thistles, but remarkably by summer 2019 common spotted orchids were visible in the strange mix of plants that had grown up in this area. The early stages of work and the re-growth response of the vegetation are shown below:



Looking downstream from the causeway – new area visible after clearing dense bramble scrub, March 2018



Looking upstream to the causeway March 2018 – new fen area cleared of bramble



First scything of the re-growth (mostly horsetail) below the causeway in May 2018



Scything and raking the first regrowth of the newly-cleared area below the causeway in May 2018



Regrowth of the cleared fen area below the causeway by June 2019. Abundant flush of marsh thistles – view looking downstream from the causeway, stream (invisible) to the right.

By July 2019 the area featured a great variety of plant species. Desirable ones recurring from the seed bank include: water figwort, square-stalked St John's wort, brooklime and ragged robin. Marsh thistles have arrived via wind-blown seed. There is still some bramble re-growth and it will need repeated scything and raking to finally eradicate these plants and reduce the vigour of the giant horsetail.

This vegetation response is encouraging, but the old fen peat uncovered is still too dry, as the stream channel passing through this area is incised (? historic drainage). The next stage in the process of helping fen restoration is the installation of small log dams every few metres through the restoration, to impede water flow and re-wet sideways.



This wetting work has already started with the installation of the first few log dams, but more will be needed. Fortunately, logs are readily available from previous tree work.

*One of the first small log dams in the stream below the causeway
14.05.2019*

Pond restoration

The creation of open sunny conditions in and around the pond has progressed very fast. From an almost completely shaded state at the beginning of 2016, the majority of the tall shading willows have now gone and the pond now benefits from a good deal more light. As a result, there has been abundant flowering of pond vegetation, such as yellow flag iris, a very attractive plant and a good nectar source, attracting many bees.



Before south-side work – the pond is invisible behind the bramble scrub and tall crack willows, Feb 2017



Pond now open to light on south side due to felling and removal of large willows and bramble 15.03.2018



The tall crack willows were converted to a useful log and brash habitat pile, which will provide winter refuge areas for amphibians and food for all dead-wood invertebrates. 19.06.2018



Yellow flag iris flowering abundantly in the high light round the open pond edges in May 2018

However, with more light, the mats of sweet grass, branched bur reed and greater spearwort have grown greatly, spreading over the pond surface and threatening to eliminate open water. A degree of removal of this floating vegetation is recommended annually to retain central open water and keep the pond attractive to dragonflies and damselflies.

This partial vegetation mat removal action happened first in 2019 with the work of a corporate volunteer group organised by Carl Whitehead.



Pond in June 2019, open water restored, female willows suggested for coppicing on the right margin

Ponds are naturally transitional habitats and if they are left untended vegetation succession ultimately progresses to filling in with vegetation and sediment, with loss of water. This happens faster if stock are not available to graze-down the sweet grass (*Glyceria*) marginal mats and create poached (trampled) marginal areas favoured by some pond invertebrates.

Good numbers of frog spawn clumps occurred in the pond in spring 2018 and 2019. Smooth newt adults were also observed. A juvenile toad was found in summer 2017 near the pond but as yet no toad spawn has been recorded here.

Pond water quality

It was noted in spring 2018 and 2019 that the northern side of the pond was exhibiting a growth of dark-green filamentous algae, which past experience has shown is indicative of a degree of nitrate enrichment of the spring/seepage iron-rich water which emerges here. The source of this enrichment could be the housing within the catchment to the north and west of Raleigh Park. Leakage from sewers, septic tanks or even water mains can result in groundwater pollution with nitrate in sufficient concentration to negatively affect a dependent pond or wetland. *See section on the calculation of the hydrological catchment below.*



North side of pond – dark-green filamentous algae present in March 2018, indicative of nutrient enrichment

Effect of the summer drought in 2018 on Raleigh Park

Lack of rainfall and hot conditions during last summer resulted in a lack of water supply from the catchment beyond the park. The top south-western fen retained some water, so the peat was damp, but the pond dried down to damp mud only. If stock had been present, they would have had nothing to drink. The stream corridor below the causeway and through the newly-cleared fen area dried out completely.



Dry pond on 09.08.2018



The stream below the causeway was completely dry by mid-August 2018

Calculation of the rainwater catchment of the Raleigh Park fen and stream

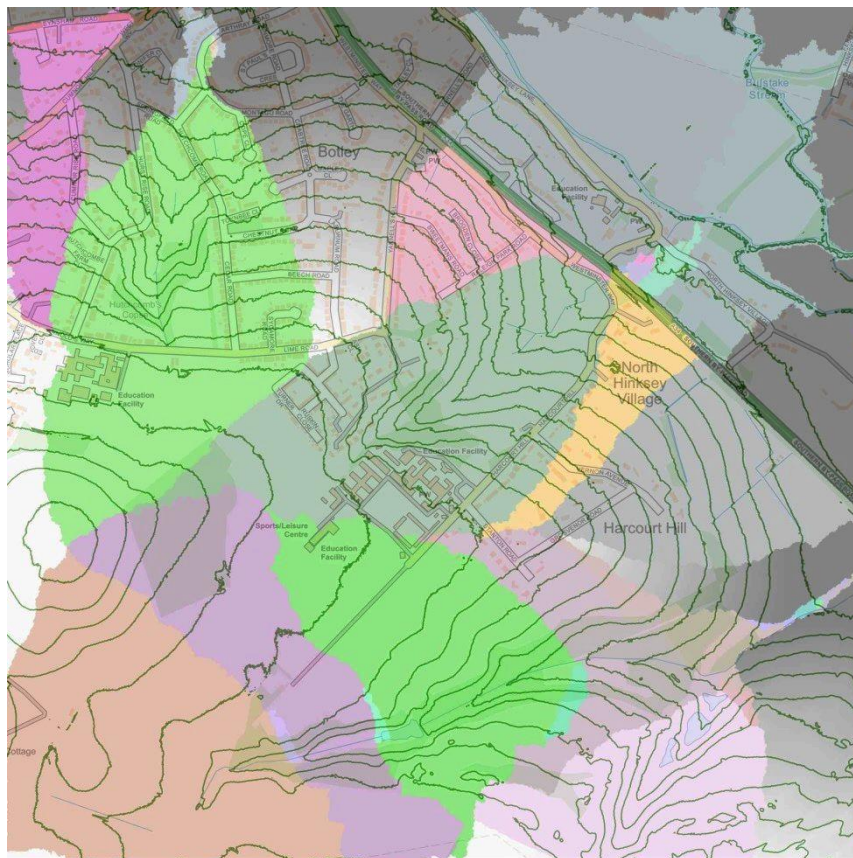
Wetlands live or die by their water supply. Raleigh Park wetlands are fed by ground water – originally rain water, which fell on a specific area of land above the park (catchment area), percolated into the ground and seeped into porous underground rocks (the aquifer). Moving downslope, and changing its chemistry (picking up lime), this water eventually emerges in seepage zones in the park, ensuring continual supply to the wetland fen areas. There needs to be sufficient water volume and good water quality (chemistry) for the health of the receptor wetlands.

The water supply should be sufficient to ensure all-year-round water at the surface and for these alkaline fens the water needs to be high in lime and of good quality (unpolluted) in terms of dissolved nitrate and phosphate. Levels of these latter chemicals need to be very low; an increase in either from agriculture or urban development (due to sewage or mains tap water leaks) will lead to unhealthily high nitrate in the groundwater, stimulating aggressive plants at the expense of rare fen flora. For a good spring water supply there needs to be plenty of natural green vegetated areas in the catchment upslope and the catchment must not be covered by a lot of hard surfacing, which prevents rainwater entering the ground. **Green fields and gardens enable rainwater to freely penetrate the ground and to replenish the limestone aquifer underground, from whence it later emerges downslope in spring and seepage zones.**

Dr David Brown of the Friends Group has used QGIS software to calculate the approximate limits of the area of ground beyond the park that forms this crucial rainwater catchment for the wetland areas of the Raleigh Park Fen using the free Ordnance Survey maps (data © Crown copyright and database right 2019) and Lidar maps (data © Environment Agency copyright).

The vertical accuracy of the Lidar data is 15cm and the horizontal resolution is 1m

<https://environment.data.gov.uk/dataset/aace5ed3-2580-4c2e-bdd8-69b3d473d99d>.



*Calculation of the approximate rainwater catchment of Raleigh Park wetlands.
Diagram by permission of David Brown, 2019.*

The map shows a central grey-green area as the catchment area of the Raleigh Park wetland fens. Note the high ground of Boar's Hill escarpment is to bottom left and the western Oxford bypass runs across the map in the north-eastern, top right-hand, corner; beyond this is the Thames floodplain.

Despite the limitations of this method of catchment calculation, looking at the central grey-green area it is immediately apparent that a substantial part of the Oxford Brookes University site and the developments to the south of Lime Road lie upon the rainwater catchment for all wetland areas in the park.

Further urban development in the remaining unbuilt catchment is extremely undesirable due to restriction of water infiltration to the ground, especially in the light of the bad effects on the park of the summer drought in 2018, when the wetland areas dried out, with damage to very sensitive wildlife the likely consequence.

The first to suffer when a wetland dries may be the soft-bodied larval stages of fen invertebrates. Sustainable urban drainage systems (SUDS) are suggested as mitigation for developments. In these, roof and hard surfacing water is collected and put into the ground via soakaways or permeable paving to re-supply groundwater. **However the functioning of such SUDS declines over time, especially with no management to de-silt them when they become clogged with dust (management cannot be enforced in private developments).**

Decline in SUDS functioning over time means that the only safe surface for the catchment of the Raleigh Park wetlands is a green sward of uncompacted grass or other growing crop. In such a green catchment, earthworm and root action continually produce new soil drainage channels which allow rainwater to easily penetrate soil with no decline in function over time.

Glade creation in central drier areas of the park

Much of the centre of the park had become inaccessible due to the development of large, dense, bramble patches and tall horsetail. Opening up and maintaining warm sunny grassy/flowery glades here was seen to benefit biodiversity. Additionally, when grazing returns, these short-turf glades will attract grazing stock away from the main, short-turf, footpath areas, thus reducing interaction of park users and grazing stock on footpaths.



The first clearance of a central glade on slightly drier soil in the park centre

ACHIEVEMENTS

- Four fen areas (0.38 hectares in total) have now been completely cleared of bramble and young willow scrub, plus vegetation re-growth scythed and raked off. Some large crack willow tree felling has been carried out by Oxford City Council; a few remain to be felled this winter and some grey willows also need to be winched out of the pond.
- Species diversity in the restored fen areas has increased and an important species thought lost has been re-found.
- Invertebrate surveys of the long south-western extension have shown the importance of this area for the total plant and invertebrate biodiversity of the whole park.
- A glade has been opened up and cleared of bramble and scrub in the site centre.
- Blackthorn management (annual laying of a section of each scrub patch) has started. This is in order to favour the breeding needs of brown hairstreak butterflies.
- Oxford City Council has continued to assist by clearing bramble with machinery and carrying out a cut-and-collect, removing hay from grassy areas on the marginal drier ground and widening rides throughout the site.
- The hedge to the north-eastern margin has been laid by a combination of work by OCC and volunteers.
- An increasing number of people have been introduced to the site via volunteering in the Wild Oxford work sessions, and the conservation work of the Friends group has been given a boost and a clearer focus.
- The attraction of the site to the general walker has been much increased by restoring some of the open landscape views that used to be a site feature.

SUMMARY AND CONCLUSIONS

- The BBOWT Wild Oxford Project continues to make good positive changes to the habitats in Raleigh Park in the second and third year, with the target fen and pond areas showing a return to short turf, a more biodiverse fen and a more open-margined pond. Clearance of dense scrub has proceeded much further down the stream corridor, and old dry fen areas are now ready for re-wetting to occur to mitigate the damaging effects of on-going climate change to hotter and drier conditions in future.
- Surveys have shown the ecological importance of the long south-west site extension forming a tongue of land along the streamlet up the hill towards the source spring. These surveys have also shown the need for conservation management in this area to improve its condition.

RECOMMENDATIONS FOR FUTURE CONSERVATION AND MANAGEMENT WORK AT RALEIGH PARK

1. **Now that a survey has demonstrated the wildlife importance of the south-western upslope long extension (tongue of land) with tufa-forming stream and source spring, conservation management should start.** The strip is unfenced on the north-western margin and the definition of the limit of OCC land and beginning of adjacent private property is unclear. Important management work on scrub and invasive wetland plants is needed on parts of this area in OCC ownership. This necessary work cannot happen without land ownership clarity; **volunteers must be sure of working on only OCC property**. It is suggested that a grant application for this vital fencing be made so that it can be installed and conservation management can occur.

2. **Identification of the approximate limits of the rainwater catchment upslope to the west of the park's fen areas will serve to reinforce arguments against further loss of green space** to hard-surfacing (ie development), which would cause a reduction in spring water flow and hence damage to those fen areas.
3. **Removal of scrub and trees from all the fen peaty wetland areas should continue.** Any re-growth of herbaceous vegetation should undergo scything and raking-up of arisings at least once annually to reduce the suppressing influence of inedible dominant plants like giant horsetail and hard rush. This will benefit species and habitat diversity overall on site, with the added benefit of making landscape views across the park much more attractive.
4. **Specifically target particular dominant tussock plants, such as hard rush and pendulous sedge, in fen areas** by scything and raking off several times a year. This will control but not eliminate them, so, when weakened, the perennial tussocks of these plants may need digging out to ensure smaller plants can thrive.
5. **Seedlings of greater reedmace and willow will need to be regularly pulled** from the fen restoration areas. In addition to limiting seed input to the fen from female willows, the seed heads need to be cut off this summer from mature reedmace in the long south-west extension and plants dug out whenever labour is available. Female willows near the fen areas will be the source of seed. Control seed production by coppicing these trees or remove them completely and re-plant with male willows (as willow is such a good wildlife tree). Male willows, of course, will not generate seed but will have catkins with abundant nectar and pollen for insects.
6. **Grazing needs to return and increase to promote the return of species diversity in the grassland** not receiving any mowing. Suitable stock could be either cows or horses. Without this the grasslands will get ranker and ranker; consequently flowery species will continue to be lost from the drier grasslands with reduction of insects, such as butterflies and bees, due to lack of nectar-source flowers.
7. **Hogweed is the best summer nectar source for all invertebrates**, from butterflies to flies to bees and beetles. Obtain some seed and introduce this to the drier margins of the wetland areas where it can provide nectar and pollen specifically for fen invertebrates.
8. **Continue the further removal of a proportion of the dense bramble-scrub patches** on drier ground to open up/widen rides for stock access. This will make the interaction between stock and the public easier by giving walkers and stock more visibility to each other.
9. **Continue the annual laying of a proportion of the blackthorn scrub** to produce the young suckers needed by brown hairstreak butterflies for egg-laying.
10. **Consider purchasing some Dutch Elm Disease-resistant elm saplings** to replace the grove of dying English elms in the north-west site corner. It may be possible to attract white-letter hairstreak butterflies to breed on this elm.
11. **Creeping thistle needs control in some grassland areas** by topping combined with removal of arisings before it flowers in summer.
12. **Further surveys to get a better view of site biodiversity** would be useful and could cover species groups not yet investigated, including small mammals, with bat surveys (contact Oxford Mammal Group?), moth-trapping, glow-worm walk, constructing reptile hibernacula and refuges to detect any present. What about involving local primary children in these activities?
13. **Ponds should be managed with a light touch in future, when shading willows are all removed.** Now the pond near the causeway has had some large willow trees removed, sun and warmth are stimulating floating mat vegetation to grow fast and this could eliminate open water if not controlled.

This growth is encouraged by the water enrichment discovered. Annual work is necessary to allow the pond centre to remain open water, or this will disappear as natural succession occurs. In this situation a proportion of the vegetation mat would need to be removed carefully by raking out with a crome* or digging out annually in the autumn. Sweet grass should occupy not more than a third of the pond on the south side. Eradicate greater reedmace by pulling or digging out. Control the branched bur-reed and greater spearwort by pulling/digging out, so they occupy not more than a third of the pond. This should maintain central open water but leave a good thick marginal vegetation fringe in untouched areas, ideal for amphibian and invertebrate breeding. **The pond should not be further deepened.** Shallow margins with lots of vegetation are best for aquatic species diversity. With climate change to hotter and drier conditions, the pond will naturally dry out each summer, but all aquatic animal species present will survive this.

*A pond-raking tool resembling a long-handled fork, with 4 tines bent at 90° (Wikipedia).

14. **Once they are clear of scrub, continue re-wetting some of the dry, peaty, fen areas in the centre of the site** by using small woody-debris dams at regular intervals across the stream. These will slow water flow off the whole site and spread some sideways to re-wet dry areas. This water retention will help to reduce the likelihood of flooding downslope. To help this process, historic deepening of the stream corridor should be reversed by shallowing the stream bed between woody dams. This will enable even greater retention of spring water on site to the benefit of restored wetlands.
15. **Install a Hampshire gate to allow controlled and safe access to the south-west tongue** for volunteers to control the greater reed mace and Himalyan balsam.

ACKNOWLEDGEMENTS

I am grateful to Carl Whitehead of Oxford City Council for discussions and for access to documents regarding the site held in the City Council's archives and to Andy Gunn of BBOWT for discussions as the work progressed. I am grateful to the Friends of Raleigh Park for their butterfly records from 2018. Thanks to David Brown for his preliminary hydrological catchment calculation. My thanks also go to TVERC for supplying historic species lists. Marilyn Cox gave invaluable editorial help with this report.

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APPENDIX I: Results of butterfly surveys by the Friends of Raleigh Park in 2018, collated by Barbara Witkowski and presented at the Group's AGM, Sept 2018

Barbara's report:

Nick Bowles from the Upper Thames Branch of Butterfly Conservation arranged with the Friends of Raleigh Park and Andy Gunn, BBOWT, to undertake a site visit and do an initial survey of butterflies in Raleigh Park on 8th May 2018. The intention was that a self-organising group would form and carry out three further surveys in June, July and August.

I heard about the event via an email from Nick to local members of Butterfly Conservation, and Leon and I joined with about 8 other people in the Park on a sunny afternoon and spent two hours walking through a variety of habitats, spotting butterflies and learning a lot from Nick, such as:

- White butterflies on the wing in early May could be one of five different species, most are difficult to tell without close observance
- Blue butterflies here are likely to be either Holly or Common Blues, identifiable to some extent alliteratively by their flight pattern:
 - Holly Blues fly at head height
 - Common Blues crawl at lower levels

On that first survey, we saw 18 individuals of 7 different species including a few typical spring butterflies: fresh new Orange Tips and Holly Blues and a couple of dusty Peacocks that had overwintered. We decided to arrange our next survey for three weeks later and followed this pattern throughout the summer: we have completed 7 surveys and may hold another one if the warm weather holds until the end of September.

Our surveying group has ranged between 5 and 12 people, with a mode of 7, and a different mix of people every time. Nobody claims to be a butterfly expert, but everyone brings knowledge, sharp eyes and enthusiasm – the survey walks are really enjoyable.

We walk the same route each time, taking about an hour and recording every butterfly we see whilst we are in transit. This method is unlike the methodology of a static survey such as the Big Garden Birdwatch; we don't record the highest number of a species seen at one time. Leon uses an app. from Butterfly Conservation that identifies and records a sighting electronically, so that the figures can be saved and added to a spreadsheet with ease. I use a pen and paper, luckily it didn't rain on any survey!

What have we seen? Please see attached table for full data, here's a summary:

18 species in total over the 5 month period, from the typical spring species mentioned above, through the summer flushes of Skippers, Meadow Browns, Gatekeepers and Ringlets to the late summer emergence of Small Coppers.

The lowest count was on 21 May when only 7 individuals were seen, which I believe ties in with the phenomenon of an early 'June Gap' when the first generation of spring butterflies have died out and later generations and species are yet to hatch.

The highest count was in early July with 162 individuals counted, although we quite possibly missed as many. The air was full of Ringlets and Meadow Browns, so all being well there will be a great number of eggs to bring about a healthy population next year.

The most exciting butterfly of the year was not spotted during a survey, but the day after, when David saw a female Brown Hairstreak on the blackthorn stand at the east end of the Park.

What might be helpful for next year:

If it's agreed that butterfly surveying continues, it would be good to start the surveying season in April if the weather is warm enough (i.e. above the 12 degrees centigrade required by butterflies to fly).

Perhaps next year we may be able to invite butterfly and moth experts to join us on our surveys to help us see what we're missing and expand our knowledge, especially regarding larvae and egg identification.

There's much to be celebrated about the way that the landscape and plant array is being managed in the Park to provide for the variety of butterflies that currently use it. For example: the open area around the pond has been rich in Lady's Smock / Cuckoo Flower (*Cardamine pratensis*) in the spring and was busy with Orange Tips, in late summer it's full of Common Fleabane (*Pulicaria dysenterica*) and is a rich site for Common Blues. It's great that a Brown Hairstreak found her way to the blackthorn and exciting to think of being able to encourage more species in by specific planting.

Barbara Witkowski September 2018

		08-05-2018	21-05-2018	12-06-2018	02-07-2018	23-07-2018	13-08-2018	03-09-2018	Total of species seen
Comma	<i>Polygonia c-album</i>				1	1	1		3
Common Blue	<i>Polyommatus icarus</i>			1		6	18	7	32
Gatekeeper	<i>Pyronia tithonus</i>					10	1		11
Green-veined White	<i>Artogeia napi</i>	1			4		1		6
Holly Blue	<i>Celastrina argiolus</i>	3		2	1				6
Large Skipper	<i>Ochlodes sylvanus</i>				1				1
Large White	<i>Pieris brassicae</i>	2		2	11	28	9	4	56
Marbled White	<i>Melanargia galathea</i>			1	1				2
Meadow Brown	<i>Maniola jurtina</i>				61	10	6		77
Orange Tip	<i>Anthocharis cardamines</i>	2	4	3					9
Peacock	<i>Aglais io</i>	2	1	2					5
Red Admiral	<i>Vanessa atalanta</i>				1				1
Ringlet	<i>Aphantopus hyperantus</i>				52	4	1		57
Small Copper	<i>Lycaena phlaeas</i>					1		4	5
Small Skipper	<i>Thymelicus sylvestris</i>				7				7
Small White	<i>Artogeia rapae</i>			1	15	17	11	7	51
Small Tortoiseshell	<i>Aglais urticae</i>	1							1
Speckled Wood	<i>Pararge aegeria</i>	7	2	7	8	12	16	4	56
Unspecified Fritillary						1			1
Unspecified White								2	
Total seen that day		18	7	18	162	83	45	21	

See separate document – Appendix II – for full species record, data from Jan 2018 to end March 2019