

Spring Covert pond survey



A report for the Freshwater Habitats Trust

May 2017



1. Introduction

Spring Covert forms part of Didlington Forest, within the Forestry Commission's wider Thetford Forest estate. It is located at an elevation of around 14 metres AOD, 15 km north-west of Thetford, within the Breckland National Character Area.

Spring Covert is one of several Forestry Commission holdings in Breckland which contain natural ponds known as pingos or, more accurately, palsa-scars. These were formed by the freezing and thawing of upwelling ground-water under tundra-like conditions at the end of the last glaciation. As well as being of considerable geomorphological interest, undegraded pingos are often characterised by rich communities of plants and invertebrates including 'relict' species which are restricted to ancient wetlands.

This survey was undertaken to assess the biodiversity value of eight ponds at Spring Covert, in order to guide future management of the pingos and their surrounds. It was commissioned by the Freshwater Habitats Trust as part of the Flagship Ponds project. Fieldwork was undertaken by Jonathan Graham (botanical survey) and Martin Hammond (invertebrates) on 18th May 2017.

2. Survey methods

Permanent or semi-permanent ponds were surveyed using PSYM (**P**redictive **S**ystem for **M**ultimetrics), the standard methodology for evaluating the ecological quality of ponds and small lakes (Environment Agency, 2002). The PSYM survey involves:

- Obtaining environmental data such as pond area, altitude, grid reference, substrate composition, cover of emergent vegetation, degree of shade, accessibility to livestock and water pH
- Collecting a sample of aquatic macro-invertebrates using a standard protocol (three minutes' netting divided equally between each 'meso-habitat' within the pond basin, plus one minute searching the water surface and submerged debris)
- Recording wetland plants

PSYM generates six 'metrics' (measurements) representing important indicators of ecological quality. The three botanical metrics are:

- diversity of emergent and submerged plant species
- the number of uncommon plant species
- Trophic Ranking Score (TRS, an estimation of nutrient status based on plant indicators)

The three invertebrate metrics are:

- Average Score Per Taxon (ASPT, an estimation of biological water quality based on the sensitivity of different invertebrate families to organic enrichment)
- diversity of dragonfly, damselfly and alderfly families¹
- diversity of water beetle families

¹ As no alderflies were recorded in the survey, this metric is referred to simply as diversity of Odonata families.

The results are analysed using software which compares the observed data with values predicted from a large reference dataset of undegraded ponds. PSYM predicts how a high quality pond with similar attributes *should* score for each metric, and compares the predictions with the survey results. The scores for each metric are combined to produce an Index of Biotic Integrity (IBI) which provides an overall indication of the ecological quality of the pond. Ponds are then categorised as Very Poor, Poor, Medium and Good.

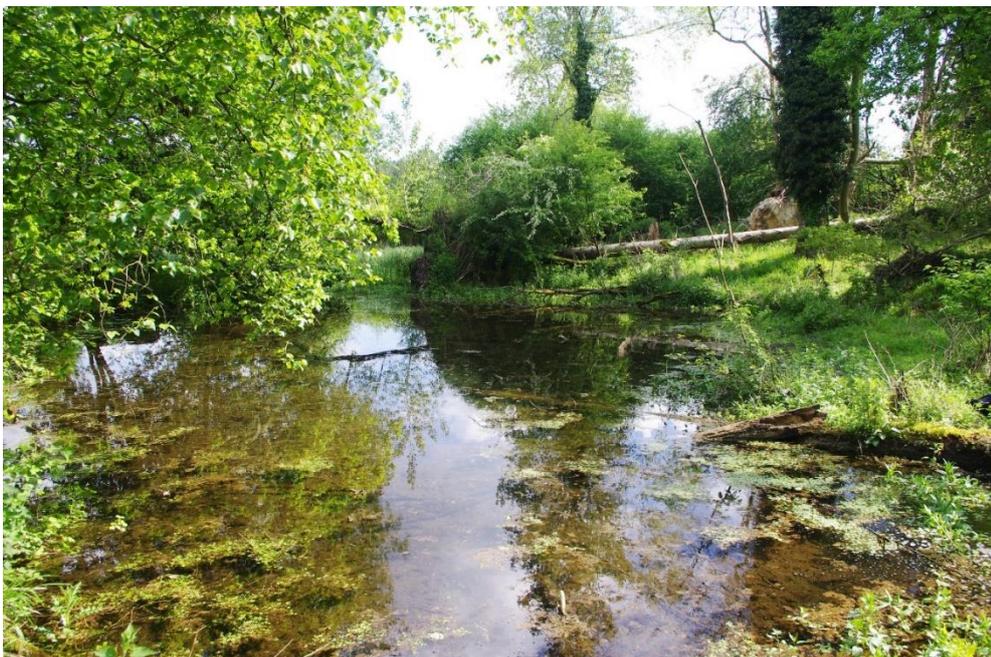
Whilst PSYM requires only family-level identification of invertebrates, material was identified to species level wherever possible. As a departure from normal procedure, the sample was sorted on the bankside to avoid the risk of removing large numbers of individuals of rare species.

The PSYM methodology cannot be used to assess seasonal ponds because these ponds are not represented in the PSYM database. In the current survey, Ponds 1, 6, 7 and 8 were assessed using PSYM although Pond 7 was considered to be of borderline suitability. Ponds 2, 3, 4 and 5 were not assessed using PSYM as they were considered to be highly seasonal. Pond 4 contained no water so only plants were recorded. General collecting of aquatic invertebrates was undertaken in Ponds 2, 3 and 5.

3. The ponds surveyed

Pond 1

Grid reference	TL 79209 96204
Size	400 m ²
pH	7.0
Conductivity ($\mu\text{S}/\text{cm}^{-1}$)	810
% shading	20
% emergent	12
Substrate	Silt
Grazing	Ungrazed (FC land)



Pond 1 is a tree-fringed, spring-fed, silty pond with Greater Pond Sedge *Carex riparia* swamp at its southern end. Submerged and emergent vegetation structure in the main water body is limited. This is unlikely to be a pingo/palsa scar.

Twenty-two wetland plant species (including bryophytes) were recorded. None of these were species of conservation concern. Thirty-seven aquatic macro-invertebrate taxa were identified from the PSYM sample. These included the Near Threatened scavenger water beetle *Enochrus nigritus* and the Nationally Scarce *Helophorus nanus*. Local species included the lesser water-boatman *Hesperocorixa moesta* and the diving beetles *Rhantus exsoletus* and *Hydroporus figuratus*.

PSYM assessment produced an Index of Biotic Integrity of 72%, placing Pond 1 in the **Moderate** category of ecological quality though just below the threshold for Good quality. It scored well for wetland plant diversity and Trophic Ranking Score (a proxy indicator of eutrophication) but poorly for representation of uncommon plant species. It scored highly for ASPT (biological water quality), moderately for diversity of water beetle families and poorly for diversity of Odonata families.

Pond 2

Grid reference	TL 79227 96239
Size	30 m ²
pH	7.0
Conductivity ($\mu\text{S}/\text{cm}^{-1}$)	270
% shading	5
% emergent	85
Substrate	Silt
Grazing	Ungrazed (FC land)



This is a small, shallow pingo which was almost dry at the time of the survey. It is too seasonal to assess using PSYM. It supports frequent Blunt-flowered Rush *Juncus subnodulosus* with a few large tussocks of Tufted Sedge *Carex elata*.

Thirteen wetland plant species were recorded, Tufted Sedge being categorised as Near Threatened in England (Stroh *et al*, 2014). Only 18 aquatic macro-invertebrate taxa were recorded, all but one of these being water beetles. Two Near Threatened species were recorded (the diving beetle *Agabus uliginosus* and the scavenger water beetle *Hydrochus brevis*) along with the Nationally Scarce *Helophorus nanus* and *H. strigifrons*.

Pond 3

Grid reference	TL 79331 96189
Size	60 m ²
pH	7.4
Conductivity ($\mu\text{S}/\text{cm}^{-1}$)	760
% shading	0
% emergent	80
Substrate	Silt
Grazing	Ungrazed (FC land)



This shallow, unshaded pingo is dominated by tussocks of Tufted Sedge. It contained only a small amount of standing water at the time of the survey and is too seasonal to assess using PSYM.

Only nine wetland plant species were recorded, Tufted Sedge being categorised as Near Threatened in England. Eleven aquatic macro-invertebrate taxa were collected including two Nationally Scarce scavenger water beetles: *Helophorus strigifrons* and *Cercyon granarius*.

Pond 4

Grid reference	TL 79362 96134
Size	540 m ²
pH	No water (drawn down)
Conductivity ($\mu\text{S}/\text{cm}^{-1}$)	No water (drawn down)
% shading	3
% emergent	90
Substrate	Silt
Grazing	Ungrazed (FC land)



This pingo contained no standing water at the time of the survey, so cannot be assessed using PSYM. No aquatic invertebrates could be collected. Eleven wetland plant species were recorded, tussocks of Tufted Sedge being the dominant vegetation.

Pond 5

Grid reference	TL 79290 96076
Size	112 m ²
pH	7.4
Conductivity ($\mu\text{S}/\text{cm}^{-1}$)	490
% shading	25
% emergent	90
Substrate	Silt
Grazing	Ungrazed (FC land)

This pingo was again dominated by Tufted Sedge although there were also small amounts of Hop Sedge *Carex pseudocyperus*, Greater Pond Sedge and Greater Reedmace *Typha latifolia*. Seventeen wetland plant species were detected.

Small pools of water allowed invertebrates to be collected but the seasonal nature of this pond makes it unsuitable for evaluation using PSYM. Twenty-one aquatic macro-invertebrate taxa were identified in the PSYM sample. These included the Nationally Scarce water beetles *Hygrotus decoratus* and *Helophorus nanus* and the Near Threatened *Hydrochus crenatus*.



Pond 6 (see cover photograph)

Grid reference	TL 79262 96067
Size	1440 m ²
pH	7.6
Conductivity ($\mu\text{S}/\text{cm}^{-1}$)	860
% shading	25
% emergent	90
Substrate	Silt (with surface detritus)
Grazing	Ungrazed (FC land)

This medium-sized pingo is dominated by Greater Pond Sedge with some trailing grass and tussocks of Tufted Sedge. It probably holds some water for most of the year, so is suitable for assessment using PSYM.

Fifty-five aquatic macro-invertebrate taxa were recorded. These included the Near Threatened scavenger water beetle *Hydrochus brevis* and five Nationally Scarce water beetles: *Hygrotus decoratus*, *Helophorus longitarsis*, *H. nanus*, *Enochrus quadripunctatus* and *Cercyon granarius*. Sixteen wetland plant species were recorded.

PSYM assessment produced an Index of Biotic Integrity of 78% for Pond 6, placing it in the top (**Good**) category of ecological quality. It scored moderately well for all three botanical metrics. It scored highly for ASPT (biological water quality) and diversity of water beetle families, and moderately for diversity of Odonata families.

Pond 7

Grid reference	TL 79255 96069
Size	512 m ²
pH	7.3
Conductivity (µS/cm ⁻¹)	820
% shading	30
% emergent	80
Substrate	Silt
Grazing	Ungrazed (FC land)



This shallow, convoluted pingo supported varied vegetation structure with more moss than the other ponds surveyed. Much of the vegetation resembles fen-meadow but there were several pockets of standing water at the time of the survey. This was the richest pond botanically, with 33 wetland plant species. Noteworthy species included Great Fen Sedge *Cladium mariscus*, Brown Sedge *Carex disticha*, Tufted Sedge, Blunt-flowered Rush, Water Avens *Geum rivale*, Fen Bedstraw *Galium uliginosum* and the moss *Plagiomnium elatum* – although only Tufted Sedge is categorised as a species of conservation concern.

Forty-four aquatic macroinvertebrate taxa were recorded including the Nationally Scarce diving beetle *Hygrotus decoratus*.

This pond was assessed using PSYM though it may dry up in most summers. PSYM gave an Index of Biotic Integrity of 83%, placing Pond 7 in the top (**Good**) category of ecological quality. It scored well for diversity of wetland plants and representation of uncommon plant

species, and moderately for Trophic Ranking Score. It scored highly for ASPT (biological water quality) and diversity of water beetle families, but poorly for diversity of Odonata families.



Flowering Water Avens with Wild Angelica and Brown Sedge (SE margin of Pond 7)

Pond 8

Grid reference	TL 79109 96006
Size	230 m ²
pH	7.6
Conductivity (µS/cm ⁻¹)	740
% shading	35
% emergent	15
Substrate	Silt
Grazing	Ungrazed (FC land)

This permanent pond is in partial shade on the line of a shallow drain near the edge of Spring Covert. Arable land lies around 20 metres to the south. Stands of Fine-leaved Water-dropwort *Oenanthe aquatica* and Thread-leaved Water-crowfoot *Ranunculus trichophyllus* are present in open water. Nineteen wetland plant species were recorded, including Tufted Sedge.

Twenty-three aquatic macro-invertebrate taxa were identified from the PSYM sample. These included the Near Threatened scavenger water beetle *Enochrus nigrinus* and the Nationally Scarce *Enochrus quadripunctatus*.

PSYM assessment produced an Index of Biotic Integrity of 83%, placing Pond 8 in the top (**Good**) category of ecological quality. It scored well for diversity of wetland plants and representation of uncommon plant species, and moderately for Trophic Ranking Score. It scored highly for ASPT (biological water quality) and diversity of water beetle families, but poorly for diversity of Odonata families.



4. Results

4.1 Physico-chemical status

All water samples indicated near-neutral water chemistry, with a pH range of 7.0 to 7.6 and a mean reading of 7.33. The presence of calcicole plant species such as Blunt-flowered Rush, Fen Bedstraw, Kneiff's Hook-moss *Drepanocladus aduncus*, Fern-leaved Hook-moss *Cratoneuron filicinum* and Tall Thyme-moss *Plagiomnium elatum* in some ponds suggests that conditions are generally base-rich.

Electrical conductivity (a measure of solute content) ranged from 270 to 860 $\mu\text{S}/\text{cm}^{-1}$ with a mean reading of 679. This compares with mean values of 574 μS for 41 pingos on Thompson Common and 444 μS for 16 ponds on Stow Bedon Common. Care must be taken in using electrical conductivity as a proxy indicator of trophic status but it is likely that the pingos at Spring Covert are fed by rather nutrient-enriched ground water. Given the proximity of arable farmland, this would be unsurprising.

4.2 Wetland plants

Forty-six wetland vascular plants and bryophytes were recorded (Table 1). Submerged macrophytes were absent, reflecting the seasonal or very shallow nature of the pingos surveyed.

The most frequent species (i.e. those occurring in the most ponds) were, in roughly descending order, Water Mint *Mentha aquatica*, Woody Nightshade *Solanum dulcamara*, Tufted Sedge, Marsh Thistle *Cirsium palustre*, Kneiff's Feather-moss *Leptodyctium riparium*, Gipsywort *Lycopus europaeus*, Greater Marsh Bedstraw *Galium palustre* ssp. *elongatum*, Common Duckweed *Lemna minor*, Creeping Bent *Agrostis stolonifera*, Wild Angelica

Angelica sylvestris, Kneiff's Hook-moss *Drepanocladus aduncus*, Greater Willowherb *Epilobium hirsutum*, Hemp Agrimony *Eupatorium cannabinum*, Soft Rush *Juncus effusus*, Water-cress *Nasturtium officinale* sensu lato and Reed Canary-grass *Phalaris arundinacea*.

Table 1: wetland vascular plants and bryophytes recorded from eight ponds at Spring Covert

Botanical name	English name	Botanical name	English name
<i>Agrostis stolonifera</i>	Creeping Bent	<i>Hypericum tetrapterum</i>	Square-stalked St John's Wort
<i>Angelica sylvestris</i>	Wild Angelica	<i>Iris pseudacorus</i>	Yellow Flag
<i>Berula erecta</i>	Lesser Water-parsnip	<i>Juncus articulatus</i>	Jointed Rush
<i>Brachythecium rivulare</i>	River Feather-moss	<i>Juncus effusus</i>	Soft Rush
<i>Calliergonella cuspidata</i>	Pointed Spear-moss	<i>Juncus inflexus</i>	Hard Rush
<i>Callitriche platycarpa</i>	Various-leaved Water-starwort	<i>Juncus subnodulosus</i>	Blunt-flowered Rush
<i>Cardamine pratensis</i>	Lady's Smock	<i>Lemna minor</i>	Common Duckweed
<i>Carex disticha</i>	Brown Sedge	<i>Lemna triscula</i>	Ivy-leaved Duckweed
<i>Carex elata</i>	Tufted Sedge	<i>Leptodictyum riparium</i>	Kneiff's Feather-moss
<i>Carex pseudocyperus</i>	Hop Sedge	<i>Lycopus europaeus</i>	Gipsywort
<i>Carex riparia</i>	Greater Pond Sedge	<i>Lythrum salicaria</i>	Purple Loosestrife
<i>Cirsium palustre</i>	Marsh Thistle	<i>Mentha aquatica</i>	Water Mint
<i>Cladium mariscus</i>	Great Fen Sedge	<i>Myosotis laxa</i> ssp. <i>caespitosa</i>	Tufted Forget-me-not
<i>Cratoneuron filicinum</i>	Fern-leaved Hook-moss	<i>Nasturtium officinale</i> sensu lato	Water-cress
<i>Deschampsia cespitosa</i>	Tufted Hair-grass	<i>Oenathe aquatica</i>	Fine-leaved Water-dropwort
<i>Drepanocladus aduncus</i>	Kneiff's Hook-moss	<i>Oxyrhynchium speciosum</i>	Showy Feather-moss
<i>Epilobium hirsutum</i>	Greater Willowherb	<i>Phalaris arundinacea</i>	Reed Canary-grass
<i>Equisetum palustre</i>	Marsh Horsetail	<i>Plagiomnium elatum</i>	Tall Thyme-moss
<i>Eupatorium cannabinum</i>	Hemp Agrimony	<i>Ranunculus trichophyllus</i>	Thread-leaved Water-crowfoot
<i>Filipendula ulmaria</i>	Meadowsweet	<i>Scrophularia auriculata</i>	Water Figwort
<i>Galium palustre</i> ssp. <i>elongatum</i>	Greater Marsh Bedstraw	<i>Solanum dulcamara</i>	Woody Nightshade
<i>Galium uliginosum</i>	Fen Bedstraw	<i>Typha latifolia</i>	Greater Reedmace
<i>Geum rivale</i>	Water Avens	<i>Veronica anagallis-aquatica</i>	Blue Water-speedwell

4.3 Aquatic macro-invertebrates

Ninety-three aquatic macro-invertebrate taxa were recorded. Caddis larvae were identified only to family level but there are likely to be several species of *Limnephilus* using the ponds. Odonata, molluscs requiring permanent water and water bugs were all rather poorly represented, reflecting the seasonal nature of most of the ponds. Two-thirds of the taxa recorded were water beetles, with genera characteristic of summer-dry pools such as *Helophorus* and *Cercyon* being well-represented.

Species of conservation concern were all water beetles (see section 5.2 below). There were few noteworthy species amongst other Orders although water bugs included the rather local lesser water-boatman *Hesperocorixa moesta* and the pond-skater *Gerris lateralis*. Larvae of the Black Colonel soldierfly *Odontomyia tigrina* were recorded from Pond 6. This species was formerly categorised as Nationally Scarce but will lose its national conservation

status in a forthcoming review (Drake, in prep) as it has now been recorded from over 100 hectads in Great Britain since 1990. It is, however, an uncommon species associated with high quality wetlands.

5. Species of conservation concern

5.1 Plants

***Carex elata*, Tufted Sedge**

English status (Stroh *et al*, 2014): Near Threatened

This tussock-forming sedge is associated with fluctuating water margins in base-rich fens. Its British distribution is centred on the belt of former fenland extending from East Anglia to the Vale of York with outlying centres in the Lake District, the Cheshire Plain and Anglesey. Its range (Extent of Occupancy) in England contracted by 29% during the second half of the 20th century (Stroh *et al*, 2014).

Tufted Sedge is one of the most characteristic plants of Breckland palsa-scar ponds, in both shaded and open habitats and forms an important structural component of their vegetation. It was recorded from all the ponds in this survey except for Pond 1.

5.2 Invertebrates

All the invertebrates of conservation concern recorded during this survey are water beetles. Aquatic Coleoptera are by far the most species-rich group of macro-invertebrates recorded during hand-netting surveys of seasonal/temporary ponds in Britain (Nicolet *et al*, 2004) and are particularly characteristic of the Breckland pingo/palsa scar pool systems (Foster, 1987).

Agabus uliginosus (Dytiscidae), a diving beetle

GB status (Foster, 2010): Near Threatened



Several specimens of *Agabus uliginosus*, including both sexes, were caught in Pond 2. This mid-sized diving beetle is a speciality of seasonal pools in fens, unimproved grassland and lowland heathland. It persists where woodland which has developed on such habitats provided there has been a continuity of shallow pools. Its main centres are in Breckland and the Humber river basin with very scattered populations elsewhere. *Agabus uliginosus* is categorised as Near Threatened due to the fragility of its habitats and evidence of decline in parts of its range (Foster, 2010).

Norfolk populations of *Agabus uliginosus*, including the one at Spring Covert, have females with matt wing-cases. This form is known as *A. uliginosus dispar*.

Hygrotus decoratus (Dytiscidae), a diving beetle

GB Status: Nationally Scarce

This tiny but attractively-marked diving beetle occurs very locally in fen pools and pond margins from North Yorkshire southwards. It is often found amongst mossy vegetation. *Hygrotus decoratus* was recorded from Ponds 5, 6 and 8 during this survey.

Helophorus longitarsis (Helophoridae), a scavenger water beetle

GB Status: Nationally Scarce

This pioneer species is typically recorded from recently-created ponds but can occur in fens (Foster et al., in prep). There are thinly scattered records from England and Wales north to York, though there appears to be only one previous record for the Vice-county of West Norfolk. A single male specimen was collected from Pond 6 and confirmed by microscopic examination of the genital capsule. Despite being a rarity, this record has limited conservation significance.

Helophorus nanus (Helophoridae), a scavenger water beetle

GB Status: Nationally Scarce

This small beetle is associated with seasonal pools in fens and swamps, usually in places which dry out each summer. Records are clustered around historic wetland regions such as the Somerset Levels, the grazing marshes of south-east England, Norfolk, the Fens, the Cheshire Plain and the Humber basin (Foster et al, in prep). *Helophorus nanus* has been recorded from a number of pingo systems including on Thompson Common and Frost Common. During the present survey, it was collected from Ponds 1, 2, 5 and 6 and was found in good numbers.

Helophorus strigifrons (Helophoridae), a scavenger water beetle

GB Status: Nationally Scarce

Helophorus strigifrons often occurs with *H. nanus* but is more restricted to semi-natural wetlands and is not found in isolated field ponds. It has a wide but very thinly scattered British distribution. It is likely that *H. strigifrons* is poorly dispersive. During this survey, single specimens were collected from Ponds 2 and 3.

Hydrochus brevis (Hydrochidae), a scavenger water beetle

GB status: Near Threatened

This national rarity inhabits moss or other dense vegetation in very shallow water. The distribution of *H. brevis* "must be considered truly relict" (Foster et al, in prep) and it is one of the specialities of Breckland pingo systems. The collection of specimens from Ponds 2 and 6 at Spring Covert is therefore a significant indication of the high conservation value of these water bodies.

Hydrochus brevis has its British stronghold in Norfolk, with clusters of sites in both the Brecks and the Broads. It is very scattered elsewhere, with modern records from 11 locations (map in Foster et al, in prep). However, this species has been identified much

more widely as a Holocene subfossil, so its current range is the result of habitat loss and fragmentation.

Hydrochus crenatus (Hydrochidae), a scavenger water beetle

GB status: Near Threatened

This small water beetle has a very restricted British distribution centred on East Anglia and the Fens (Foster *et al*, in prep). Within this limited range, though, it is more dispersive than *H. brevis* and can occur in habitats such as mineral pits and arable drains (e.g. Hammond, 2015). It is found in very shallow water amongst vegetation. *Hydrochus crenatus* can be frequent in pingo systems though during this survey only a single specimen was collected, from Pond 5.

Enochrus nigrinus (Hydrophilidae), a scavenger water beetle

GB Status: Near Threatened

This small hydrophilid occurs amongst fen vegetation in shallow water margins. It has a very limited distribution in East Anglia, Cambridgeshire, the New Forest, Herefordshire and a handful of sites elsewhere in southern England and Wales. "It is mainly found in relict fens but also occasionally in recently created habitats in old fen areas" (Foster *et al*, in prep). Single male specimens were recorded from Ponds 1 and 8 at Spring Covert.

Enochrus quadripunctatus (Hydrophilidae), a scavenger water beetle

GB Status: Nationally Scarce

This mid-sized water beetle has a very local distribution, mainly in the east of England. Although occurring in fens, *E. quadripunctatus* is not a pingo specialist and is often associated with more disturbed habitats where grazing or other management maintain exposed mineral substrates. In drains around the Ouse Washes, for example, it is restricted to shallow, cattle-poached ditches rather than larger, reedy channels. It was found in Ponds 6 and 8 at Spring Covert.

Cercyon granarius (Hydrophilidae), a scavenger water beetle

GB Status: Nationally Scarce

This beetle is confined to southern Britain, from Somerset to Norfolk, and has a relict distribution associated with unimpaired, semi-natural wetlands (Foster *et al*, in prep). It was recorded from Ponds 3 and 6.

6. Priority Pond assessment

Priority Ponds are a *habitat of principal importance* as defined in Section 41 of the Natural Environment and Rural Communities Act 2006. All public authorities are obliged to consider the conservation of Habitats and Species of Principal Importance during the exercise of their duties. Priority ponds are considered to represent the best 20% of UK ponds in terms of

nature conservation value. They are identified using a number of criteria². Seven of the eight ponds surveyed at Spring Covert qualify as Priority Ponds, as summarised in Table 2.

Table 2: Priority Pond assessment for ponds at Spring Covert

Qualifying criterion	Pond 1	Pond 2	Pond 3	Pond 4	Pond 5	Pond 6	Pond 7	Pond 8
Ponds with species of high conservation importance (UKBAP/Section 41 species, fully protected species, Red List species); ponds with 1 Nationally Scarce plant or 3 or more NS aquatic invertebrates ³ .		2 NT + 2 NS invertebrate species			1 NT + 2 NS invertebrate species	1 NT + 5 NS invertebrate species		
Ponds with exceptional populations or numbers of key species (>29 wetland vascular plants; >49 aquatic invertebrates)						55 aquatic invertebrate taxa		
Ponds of high ecological quality, classified as being of Good quality using PSYM.						PSYM IBI = 78%	PSYM IBI = 83%	PSYM IBI = 83%
Important pond types: these are individual ponds or groups of ponds with a limited geographic distribution recognised as important because of their age, rarity of type or landscape context e.g. pingos, duneslack ponds, machair ponds.		Pingo	Pingo	Pingo	Pingo	Pingo	Pingo	

Six of the eight ponds are presumed to have originated as pingos/palsa-scars and qualify on this basis; the origin of Pond 8 is uncertain. Ponds 2, 5 and 6 qualify based on the number of scarce invertebrates recorded, with Pond 6 additionally qualifying for its exceptionally species-rich invertebrate assemblage. Ponds 6, 7 and 8 are also Priority Ponds based on their PSYM scores. Pond 1 did not qualify on any criteria.

² See <http://freshwaterhabitats.org.uk/projects/pond-hap/priority-pond-criteria/>

³ It is assumed that since Near Threatened species have a higher conservation status than Nationally Scarce species, they also count towards this criterion.

7. Implications for conservation management

As well as being of geomorphological interest, undegraded pingo systems are often of exceptional value for biodiversity. Their most characteristic feature is the presence of 'relict fen' invertebrate assemblages, comprising species which are found largely or exclusively in ancient wetlands. Nationally rare or scarce species also tend to dominate the invertebrate fauna of undegraded pingos (e.g. Foster, 1987) while commonplace or opportunistic species tend to be less well represented.

With the exception of *Hydrochus brevis*, none of the rarest and most restricted relict-fen water beetles were recorded during this survey (e.g. *Hydroporus elongatulus*, *H. glabriusculus*, *H. scalesianus*, *Hydrochus ignicollis*, *Hydraena palustris*, *Dryops anglicanus* or *D. griseus*). The lack of permanent open water accounts for the absence of pingo specialities such as Shining Ramshorn snail *Segmentina nitida* or Variable Damselfly *Coengion pulchella*. This is also reflected in the low or moderate scores for the 'Odonata/Megaloptera' PSYM metric.

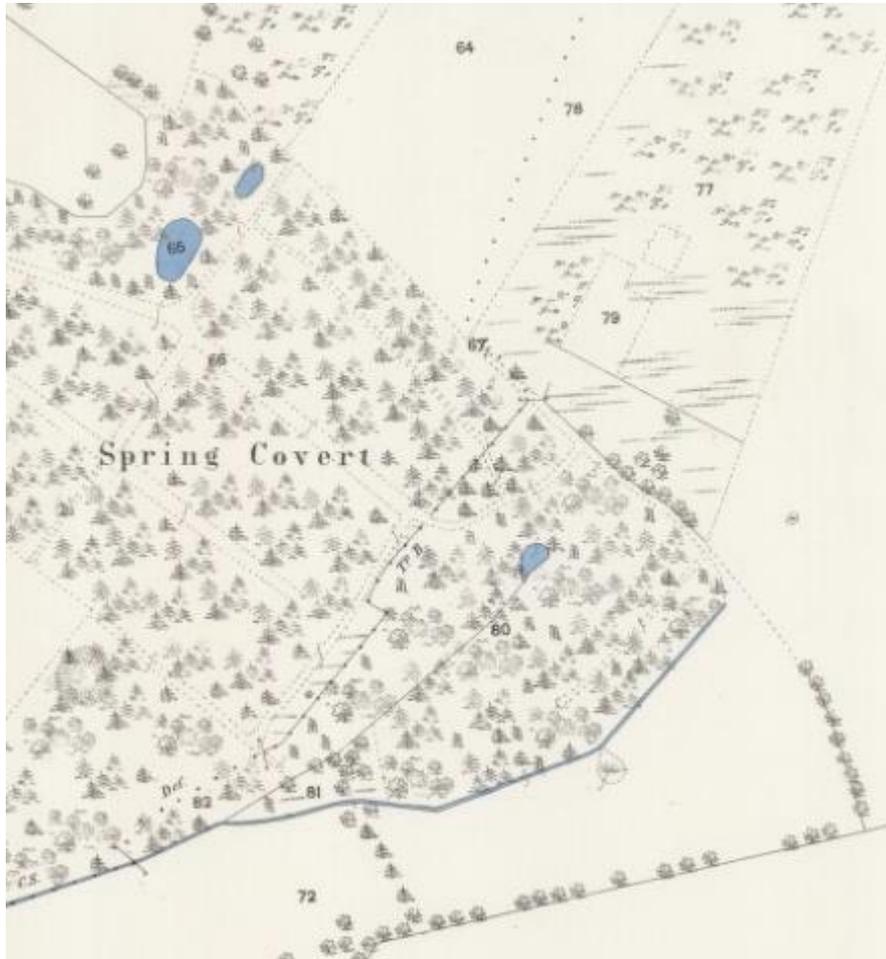
Nonetheless, this is certainly an important second-tier pingo site supporting a distinctive suite of rare or scarce water beetles associated with long-established and relatively natural fens, i.e. *Agabus uliginosus*, *Helophorus strigifrons*, *Hydrochus brevis*, *Enochrus nigrinus*, *Cercyon granarius*. The presence of other scarce but probably more mobile fenland beetles such as *Hygrotus decoratus*, *Helophorus nanus* and *Hydrochus crenatus* adds to the interest of the site as do other indicators of high quality fens such as the Black Colonel soldierfly *Odontomyia tigrina*. Botanically, these ponds are less notable but Tufted Sedge (present in seven of the eight ponds surveyed and dominant in three) and Great Fen Sedge (present in Pond 7) are characteristic pingo plants; both of these also provide valuable structure for wetland invertebrates.

Given that the cluster of pingos we surveyed is relatively small and isolated, the presence of four Near Threatened and six Nationally Scarce water beetles is remarkable. Moreover, the site has a longer history of tree cover than 'classic' pingo sites such as Thompson Common, Stow Bedon Common and Foulden Common, where extensive tree cover only developed following the cessation of grazing in the 1940s. Historically, Spring Covert was part of the Didlington Estate. It has been under woodland at least since the early 19th century, and is shown as mature plantation on the first edition OS six-inch map surveyed in 1883 (excerpt below). In addition to its afforested character, Spring Covert contains networks of drainage ditches which are likely to have affected the hydrology of nearby pingos.

Although a few shade-tolerant species are present, such as the small diving beetles *Hydroporus figuratus* and *H. memnonius*, there was no evidence of a well-developed fen carr invertebrate fauna. Analysis of data from other pingo systems indicates that shade from overhanging trees has a strong negative correlation with a range of measurements of biodiversity value. This concurs with the conclusions of the Breckland Biodiversity Audit (Dolman *et al*, 2010).

Our principal management recommendations are therefore to ensure that current levels of openness are maintained in Ponds 2 to 8 by:

- Avoiding restocking and preventing natural regeneration of trees in the vicinity of the ponds
- Removing the suckering, non-native dogweed (likely to be *Cornus sericea*) in the vicinity of Pond 7 (this will originally have been planted as Pheasant cover but could engulf the pingos if left unchecked)



Excerpt from 1883 OS 6'' map

8. References

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Appendix 1: PSYM results

<i>Site details</i>				
Site name	SPRING COVERT POND 8	SPRING COVERT POND 7	SPRING COVERT POND 6	SPRING COVERT POND 1
Survey date	18-May-17	18-May-17	18-May-17	18-May-17
Grid reference	TL791960	TL792960	TL792960	TL792962
<i>Plant metrics</i>				
No. of submerged + marginal plant species (not including floating leaved)	18	25	12	15
Number of uncommon plant species	6	6	2	1
Trophic Ranking Score (TRS)	9.4	9.255555556	9.4	9
<i>Invertebrates metrics</i>				
ASPT	4.9	4.666666667	5	4.714285714
Odonata + Megaloptera (OM) families	1	1	2	1
Coleoptera families	3	5	5	2
<i>Environmental variables</i>				
Altitude (m)	14	14	14	14
Easting	5791	5792	5792	5792
Northing	2960	2960	2960	2962
Shade (%)	35	30	25	20
Inflow (0/1)	1	0	0	1
Grazing (%)	0	0	0	0
pH	7.6	7.3	7.6	7
Emergent plant cover (%)	15	80	90	12
Base clay (1-3)	3	3	3	3
Base sand, gravel, cobbles (1-3)	1	1	1	1
Base peat (1-3)	1	1	1	1
Base rock (1-3)	1	1	1	1
Area (m ²)	230	820	1440	400
Results				
Submerged + marginal plant species				
Predicted (SM)	16.3	20.7	22.9	18.0
Actual (SM)	18	25	12	15
EQI (SM)	1.11	1.21	0.52	0.83
IBI (SM)	3	3	2	3
Uncommon plant species				
Predicted (U)	2.8	3.6	4.0	3.1
Actual (U)	6	6	2	1
EQI (U)	2.12	1.66	0.51	0.32
IBI (U)	3	3	2	1
Trophic Ranking Score (TRS)				
Predicted (TRS)	8.72	8.73	8.73	8.70
Actual (TRS)	9.40	9.26	9.40	9.00
EQI (TRS)	1.08	1.06	1.08	1.03
IBI (TRS)	2	2	2	3

ASPT				
Predicted (ASPT)	5.13	5.11	5.11	5.16
Actual (ASPT)	4.90	4.67	5.00	4.71
EQI (ASPT)	0.96	0.91	0.98	0.91
IBI (ASPT)	3	3	3	3
Odonata + Megaloptera (OM) families				
Predicted (OM)	3.38	3.42	3.38	3.33
Actual (OM)	1	1	2	1
EQI (OM)	0.30	0.29	0.59	0.30
IBI (OM)	1	1	2	1
Coleoptera families				
Predicted (CO)	3.80	3.76	3.76	3.82
Actual (CO)	3	5	5	2
EQI (CO)	0.79	1.33	1.33	0.52
IBI (CO)	3	3	3	2
Sum of Individual Metrics	15	15	14	13
Index of Biotic Integrity (%)	83%	83%	78%	72%
PSYM quality category (IBI >75%=Good, 51-75%= Moderate, 25-50%=Poor, <25%=V Poor)	Good	Good	Good	Moderate
Is this a Priority Pond? (Good quality category)	Yes	Yes	Yes	No