A strategy for clean water pond creation at the Knepp Castle Estate

Draft

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1. Introduction

1.1 Background

This short report was prepared for Lord Charles Burrell of the Knepp Castle Estate as part of the Million Ponds Project (see Box 1 below for further information). It proposes an outline 10-year strategy for restoring the freshwater landscape of the Estate by re-creating clean, unpolluted freshwater habitats using ponds as a major focus.

The strategy is based on discussions with Lord Charles Burrell and a 2-day site visit of some of the Wildland Project area by Dr Pascale Nicolet, Freshwater Ecologist at Pond Conservation, to assess the potential for pond creation to restore the freshwater habitat typical of natural landscapes (the areas visited are shown in Appendix 1).

Box 1 The Million Ponds Project

The Million Ponds project seeks to reverse a century of loss and decline in Britain's ponds, so that once again we have a million ponds in the British countryside. The primary aim of the project is to bring clean water back to many landscapes, creating vital new wildlife habitats.

The Million Ponds Project is a partnership of over 30 major UK landowner and land managers, led and coordinated by Pond Conservation. Partners include Natural England, the Environment Agency, the Forestry Commission, the Defence Infrastructure Organisation and the RSPB.

In the first four years (2008-2012), the project partners and others aim to create 5,000 clean water ponds across England and Wales. This first phase also aims to raise the profile of pond creation so that it becomes embedded in policy and in the culture of organisations involved in land management and restoration. As part of this work, the project team has developed The Pond Creation Toolkit - a range of factsheets which are available to download freely from the project's website (see Appendix 2 to see the content). The toolkit includes dossiers with technical information on how to create and manage ponds for over 50 pond-associated BAP species. These were published in partnership with specialist organisations including Plantlife, Buglife, the Aquatic Coleoptera Trust and the Bat Conservation Trust. The online BAP species map helps target pond creation for some of our most threatened species. Currently over 1000 people from both partner and non-partner organisations have been trained as part of the project.

www.pondconservation.org.uk/millionponds

1.2 Ponds in natural landscapes

Although in Britain today many ponds are manmade, there is evidence from the geological record that ponds have always been a common habitat in the landscape – forming anywhere that water collects in surface irregularities (see Box 2 for a definition of 'pond'). Studies of relatively undisturbed ancient woodland in the UK show that the past land surface was probably full seasonal and permanent ponds, and that human activity, including ploughing, has effectively smoothed the land surface so that only a fraction of these now remains (Rackham, 1985; Williams et al, 2000).

Box 2 Pond definition

Ponds are waterbodies between 1m^2 and 2 ha in surface area. They include manmade ponds and those created by natural processes. Ponds vary across a wide range of water permanence, and include temporary ponds and scrapes, as well as larger, more permanent waterbodies.

Left: A larger permanent pond, Bay Pond in Surrey. Right: A small temporary pond in the New Forest in Hampshire.

Left: a manmade marl pit in grassland in Cheshire. Right: a tree-fall pool, a natural permanent pond in the New Forest in Hampshire.

Natural ponds can be created as part of short-term processes, e.g. tree-fall pool or wild boar swale, or very long-term processes such as glaciations. On the floodplain of natural river or stream systems, which are now rare if not extinct in western Europe, ponds are created as part of the scouring effect of flood events, or from cut off meanders and channels. In the recent past, ponds were also created as part of many industrial and agricultural activities which have now ceased.

Whether ponds are manmade or created as part of natural processes seems to have little importance in terms of their biological value. It is the density and variety of waterbodies which make some of the last remaining semi-natural landscapes in Britain so rich and interesting for their plant and animal communities. Particularly good examples of pond-rich semi-natural landscapes in lowland Britain include the New Forest in Hampshire, the Lizard Peninsula in Cornwall and the Pembrokeshire Commons. In the New Forest in spring, seasonal pools density can reach 100/km^2 (Williams et al, 2000)!

Extensively grazed ponds are a natural pond type and animals are key in dispersal process, particularly for wetland plants. Animal poaching and grazing helps create bare muddy ground and short turf habitats to which many freshwater plants and animals are specially adapted. At the landscape scale, variations in the extent to which animals disturb ponds creates between-pond differences that increase pond biodiversity at regional level.

1.3 The importance of ponds in the freshwater landscape

Ponds are a critical habitat for biodiversity in the freshwater landscape. Studies in the UK and abroad have shown that, regionally, they support more species and more uncommon species than other freshwater habitat such as rivers, streams and ditches (Williams et al, 2004; Davies et al, 2008). One of the reasons for this is that individual ponds are very varied depending on soil type, age and landuse. Even ponds located next to each other can have very different physico-chemical conditions, and so support distinct plant and animal communities. Rivers and streams, in contrast, drain much larger catchments and this, combined with the mixing action of flowing water, means that they have rather similar physico-chemical conditions along their length.

Ponds are very important for rare and threatened species. In the UK, 105 BAP species live in or are associated with ponds – this represents 10% of *all* BAP species (see a list of pond-associated BAP species in Appendix 3). Survey data also shows that in semi-natural landscapes in Britain, 1 in 5 ponds support *at least* 1 Red Data Book species. Only 1 in 100 ponds in the wider countryside supports Red Data Book species (Pond Conservation unpublished data).

Bearing in mind the role ponds play as stepping stones, and that many freshwater species live both in running and standing water, creating clean water ponds can clearly help protect and enhance the whole freshwater landscape – in the short term, and at minimum cost. In essence, in the context of ecological restoration, ponds offer the maximum benefit for minimum input of resources.

1.4 The UK pond resource

There is incontrovertible evidence that most of Britain's freshwaters are significantly polluted, especially in the lowlands. Some three-quarters of rivers in England and Wales and two-third of lakes fail the minimum water quality standard set by the UK Water Framework Directive (Environment Agency, 2011). The results for ponds are similar: Countryside Survey data show that pond quality is declining, and that currently 80% of ponds in the UK are in poor or very poor condition (Williams et al, 2010; Figure 1)

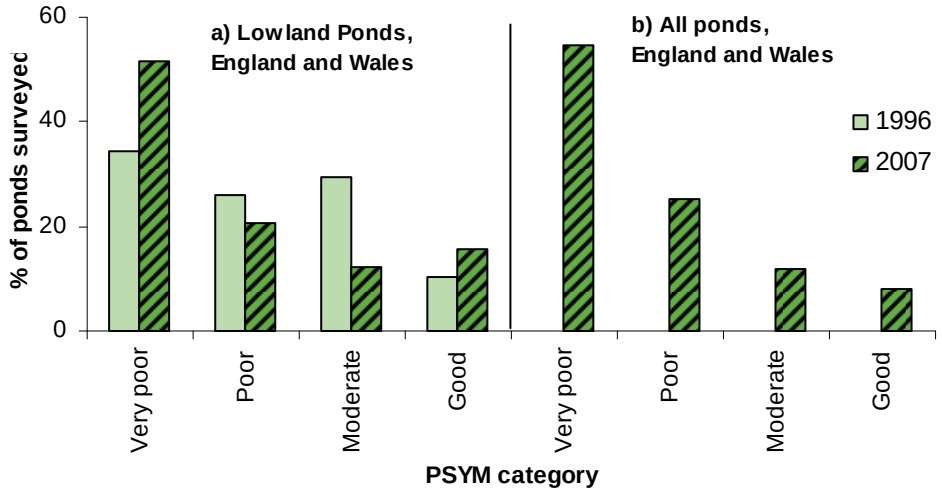

Figure 1 Percentage of ponds which fall within one of four PSYM categories in England and Wales. Left: comparison of lowland England and Wales in 1996 and 2007 showing the decline in pond quality. Right: England and Wales in 2007. (From Williams et al, 2010)

Nationally, it is clear that one of the major causes of the degradation of freshwaters is diffuse pollution from intensive agriculture, and in particular arable land. Ponds, because of their small volume, can also be affected by very small scale impacts such as fish stocking, duck feeding and road run off. Streams or ditch inflows are particularly damaging because watercourses bring high levels of pollutants draining from their catchment, as well as silt which significantly reduces the life and quality of the waterbody. In contrast, ponds without inflows can sometimes survive in the landscape for millennia – with a very long lasting phase when they become temporary (e.g. pingos), particularly when they are grazed and poached by animals.

Set against concern about declines in pond quality, there is evidence of the protective effects of freshwater networks. Ponds with a higher proportion of other wetlands in their surrounds, including both standing and running waters, are more likely to maintain their quality in terms of species richness and rarity. This shows the importance of maintaining the density of ponds and other wetlands in the landscape and of creating ponds near existing wetlands.

After major losses from the mid-19th century onwards, ponds numbers are currently increasing after reaching an all time low in 1980s (Figure 2). This is good news, but these estimates do not take into account the million of small freshwater ponds or pools which were never recorded on maps, including trackway ruts and shallow temporary depressions which are an integral part of the freshwater landscape. These

wetland features are easily lost as a result of the intensification of the countryside, particularly drainage, and very few remain except in the most natural landscapes.

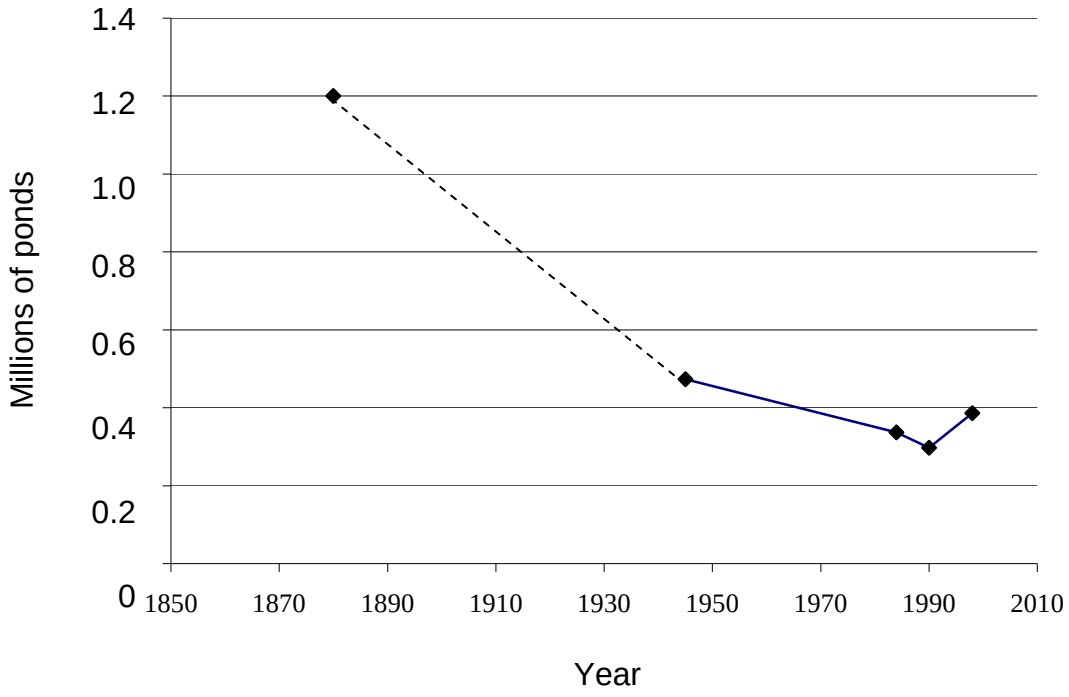

Figure 2 Estimate of pond number from the late 19th century to the late 1990s (from Biggs et al, 2005). Note that these do not include the millions of small ponds and pools which would have been present before landuse intensification.

2. A 10-year strategy for pond creation on the Knepp Estate

2.1 The strategy

> ‘The rationale of the Knepp Wildland Project is to restore most of our 3,500 acres of land to the state it enjoyed before intensive agriculture took its toll, and to allow the grazing animals to drive habitat changes by letting them roam as freely as possible with minimal human intervention.’
>
> (Knepp Estate website)

The overall aim of this pond creation strategy is to restore the Knepp Estate landscape close to a pre-industrial, semi-natural state, and to enhance its potential to sustain rich freshwater plant and animal communities.

The soils of the Estate are predominantly heavy clay, and so it is likely that in the past the area supported natural ponds in abundance. These would have included many shallow depressions fed by surface water, and floodplain ponds. Looking at national trends, manmade ponds were also probably much more abundant in the pre-industrial past created for livestock watering and many other purposes. Regardless of their origins, many ponds will have been lost in the last 100 years as a result of the modification of watercourses, drainage, the intensification of agriculture and the conversion of pastoral land to arable.

On the Knepp Estate, there is the opportunity to reverse many of these recent impacts by creating many ponds across the estate over a 10 year period. Specifically:

1. Create pond networks
2. Create clean water habitats
3. Create a range of pond types focussing on shallow and seasonal habitats
4. Maintain existing ponds
5. Allow natural succession

Overall it is recommended that around 10 ponds are excavated each year, many of them small and shallow, so that a strategic network of around 100 new ponds are created over the next decade.

1. Create pond networks
The creation of a network of clean water ponds on the Knepp Estate fits well within the rational for the Knepp Wildland Project. It will both help to restore a more natural freshwater landscape, and improve the quality of the freshwater environment for biodiversity. New ponds can be strategically located to improve freshwater connectivity and strengthen existing populations.

2. Create clean water pond
Clean, unpolluted freshwater habitats can be re-created on the Estate by ensuring that new ponds are not linked to existing watercourses, unless they are at the top of a semi-natural catchment. Of course, the creation of on-line ponds can provide ecosystem services (e.g. water and nutrient retention) and permanent ponds or scrapes fed by flood water are beneficial for species less sensitive to water quality. However it is unconnected ponds that will provide the best and most sustainable habitat for freshwater wildlife in the long term. An example of the value of an existing clean water pond for wetland plants on the Estate is Lower Barn Farm (Box 3).

3. Create a range of pond types focussing on shallow and seasonal habitat
The aim should be to create a wide range of pond types, focusing on re-creating the smaller, shallow water features typical of natural landscapes. These waterbodies, which may be as small as $1m^2$ and as shallow as 20 cm, will complement the existing large, permanent water habitat provided by the dammed ponds on the Estate and potentially will help to maintain or even enhance freshwater diversity at the landscape scale.

Box 3 A clean water pond on the Knepp Estate: Lower Barn Farm

Lower Barn Farm ponds was restored relatively recently to a mid-succession stage and is a good example of permanent pond fed only by clean, unpolluted water draining from the surrounding area. The pond has a broad range of habitat types, including bare mud created by animal poaching and shade from the surrounding mature trees, dense tall emergent plants stands where animals were not able to graze, and low growing herbaceous species where only moderate amount of poaching and grazing has taken place. Over 20 wetland plant species have been recorded at the site, including Water-violet (*Hottonia palustris*) and Fine-leaved Water-dropwort (*Oenanthe aquatica*) – both species are sensitive to water quality and have declined in the South East as a result of drainage and agricultural intensification.

4. Maintain existing ponds
Currently, many of the remaining ponds on the Estate which are unconnected to watercourses are in a late successional stage. Although often shaded and poor in plant diversity, these should ideally be left unmanaged because they are beneficial for invertebrates, particularly Diptera, and are good feeding ground for bats. The quality of this freshwater resource is best enhanced by the creation of complementary successional habitats which are unpolluted and will stay so in the long-term. Consider digging out existing ponds which have been *completely lost* rather than de-silting or deepening late succession ponds or temporary ponds.

5. Allow natural succession
Given the 10-year timeframe, there is potential for a small number of ponds to be created every year. These should be left to colonise and succeed naturally, allowing grazing animals already roaming the Estate to manage the resource at the landscape scale.

2.2 New pond location

Potential locations for new ponds are suggested in Figure 3. This is not by any means an exhaustive list and some of these locations will require further investigations of hydrology and geology depending on the type of waterbody to be created, e.g. permanent or temporary. Generally, create ponds strategically:

- **to increase the mosaic of habitats on floodplain and grassland**. Some floodplain ponds should be located towards the upper end of the floodplain to ensure that they are mostly fed by surface water, rather than floodwater likely to be rich in nutrients and other pollutants;
- **along wildlife corridors** such as woodland edge, hedge lines or field corners to enhance connectivity for groups such as amphibians and bats;
- **near existing wetland features** (e.g. ponds, ditches, wet woodland) to strengthen existing populations of freshwater plants and animals, and add pioneer habitats.

There are also opportunities to create shallow ponds and wet grassland habitats by damming or ‘ponding’ ditches, as advised in Janes et al. (2006), particularly where they drain unpolluted catchments.

Obviously, ponds should not be created where they might have an impact on existing archaeological interest, scarce species or communities, or where they might replace existing wet features.

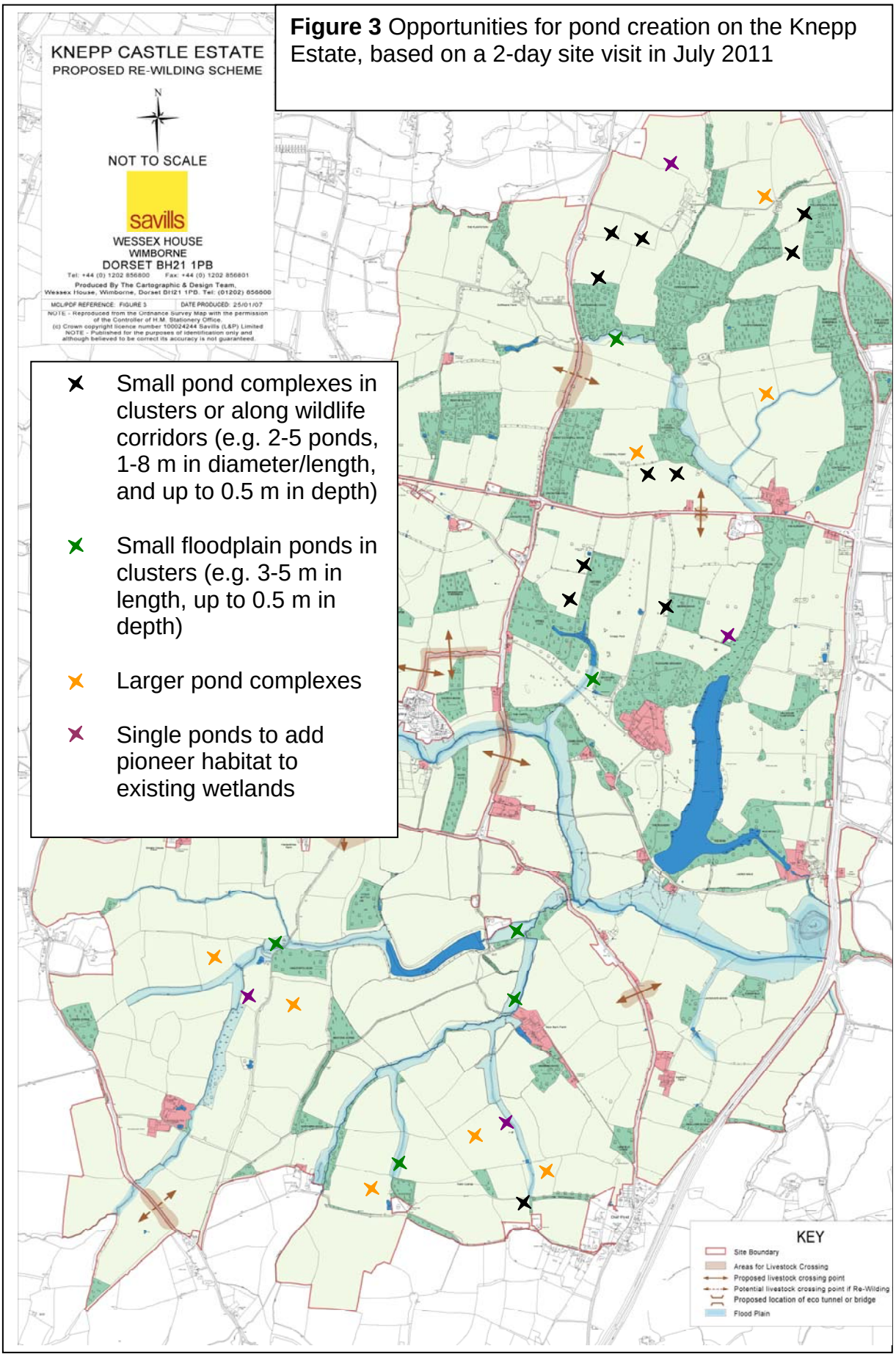

Figure 3 Opportunities for pond creation on the Knepp Estate, based on a 2-day site visit in July 2011

2.3 Pond design

At each individual location, the type of pond created will depend on the space available and local hydrological conditions, e.g. the size of the catchment area. The aim at the Knepp Estate should be to create a wide variety of ponds including gradients of depth (0.2 m to 1 m at then deepest point), surface area (1 m^2 to c. 1000 m^2) and permanence (temporary to permanent). Some suggestions have been made for the characteristics of ponds which could be created at the sites identified (see Figure 3), and these can be developed further as part of the implementation of this strategy.

Although there are no hard and fast recipe for good pond design, applying some basic principles which mimic ponds in natural landscapes can help maximise the benefits for biodiversity. These are explained in detail in the Pond Creation Toolkit (Pond Conservation, 2011) and some of the key points are summarised below.

Create pond complexes with multiple waterbodies, rather than a single pond. In semi-natural habitat, ponds often occur in clusters, rather than singly. At the Knepp Estate, there are many opportunities to create complexes of small ponds (e.g. 2-5 ponds, 1-8 m in diameters and up to c. 0.5m in depth), particularly along hedges and at the boundary between woodland and grassland. There are also opportunities for larger pond complexes, with more extensive shallow water ponds in some fields, e.g. near Lower Barn Farm (see Figure 3). Pond complexes can be created over a number of years, starting with one or two waterbodies. New ponds can be added once the local hydrology is better understood. At some locations, single ponds can be strategically located near existing wetland habitats – adding different types of wetland patches to the mix.

Create wide drawdown zones with microtopography. The drawdown zone is the area at the edge of a pond where the water fluctuates – generally annually - between the maximum and minimum water levels. It is created by annual fluctuations in water levels, which are typical of natural ponds fed by surface water, and is one of the richest areas of the pond for wildlife. The drawdown zone can be extended by create banks with very low angles. Microtopography results from leaving irregularities at the edges of the pond as it is excavated, and can help make this zone even more diverse.

Create extensive shallows. The majority of pond plant and animal species live in less than 10cm of water and so this zone should be maximised. Low bank angles can be created in larger ponds, and by designing asymmetric profiles including steeper banks in smaller ponds.

Note that because many of the proposed ponds are small and shallow, they do not require detailed technical drawings. However, on-site supervision while the excavations take place will be critical, particularly for the first ponds, which will provide examples for later years.

2.4 Post-creation monitoring

Current monitoring data on ponds not connected to watercourses at the Knepp Castle Estate focuses mainly on amphibians (Greenaway, 2005). Future work should continue to assess the suitability of the pond resource for this important group.

Ideally, the current pond resource on the Estate should be assessed for wetland plants and macroinvertebrate prior to new pond being created, and Pond Conservation would be keen to fundraise for this baseline survey for 2012. Even if funding for baseline data on existing unconnected ponds does not become available, it is important to gain more detailed information on the value of new ponds.

Standardised methods, using wetland plants and aquatic macroinvertebrates, should be used for monitoring because (i) these groups allow the overall pond quality to be assessed, and (ii) the data collected can be compared to regional and national datasets, including the Countryside Survey dataset of ponds in the wider countryside, and the National Ponds Survey dataset of minimally impaired sites.

Surveying of the new ponds should start 3 years after creation, once the initial colonisation phase has taken place. The monitoring programme should include the whole range of pond types, including small shallow features.

3. Conclusions

At the Knepp Estate, there is a great potential to help restore the freshwater landscape to its post-industrial state by re-creating the small ponds and pools which would have been abundant before drainage and land intensification. This will help maintain and enhance freshwater biodiversity across both the Estate, and the region as a whole, and will complement work already in progress to restore the River Adur and its floodplain.

The 10-year timescale for this strategy means that ponds can be created on a rotation and left to colonise and succeed naturally, without intervention other than the grazing and poaching of the livestock roaming the Estate, in keeping with the Wildland Project aims.

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