SUPPLEMENTARY HABITAT FACTSHEET

Designing wildlife ponds in woodland

MILLION PONDS PROJECT
Pond Conservation

A 50-YEAR PROJECT TO CREATE A NETWORK OF CLEAN WATER PONDS FOR FRESHWATER WILDLIFE

1. The value of woodland ponds

Woodland ponds are important for many species including dragonflies, amphibians and bats. A surprisingly large number of wetland plants are also happy growing in wet woodland and around tree-lined ponds, particularly in dappled or light shade.

Woodlands are an excellent place to create new ponds because they often have clean water - an asset which can enable them to become very high quality wildlife habitats. This factsheet explains how to design woodland ponds to maximize their wildlife potential.

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Figure 1. Woodland ponds can be very rich in wetland plants if some light is allowed to reach the water. Late succession ponds are naturally more shaded, but are very important for many mosses and invertebrates.

What's in this factsheet?

2. Design principles for woodland ponds

Trees cast shade and drop considerable amounts of leaf litter into woodland ponds. This may reduce the number of species that woodland ponds can support, especially if they are small. But by following a few simple design rules, woodland ponds can be very species rich.

- **Create a range of pond types including some larger ponds** (>20m diameter) **–** larger ponds are beneficial because some light can always get into the middle of the pond beyond the tree canopy.
- **Create very shallow edges** – so that marginal plants can grow here. Plants like rushes, reeds and some wetland plants, don't usually thrive where there is shade ***and*** where the water is more than a few cm deep.
- **Make low spits and islands –** to create shallow areas beyond the tree fringe.
- **Create submerged bars and shoals in deeper water –** wooded ponds fill in more quickly than some pond types, so this is a useful way to keep bare substrates available for longer.
- **Allow ponds to mature naturally –** creating new ponds adjacent to old ponds. This will provide the greatest range of habitat types and support the most species (Figure 1).
- **Retain tyre ruts and other tiny pools on trackways and elsewhere –** they can provide important habitats for plants and animals including water beetles, amphibians and wetland plants, including uncommon species (Figure 2).

3. Choosing pond location and finding a clean water source

Deciding where to put a pond will be the most important decision you take when creating a woodland pond. It will determine how good the pond will be for wildlife, which species the pond will support and the future management needs of the pond.

Finding a source of clean water

Woodland catchments are often low in nutrients and can provide a good source of unpolluted water. But whatever the woodland type there are some basic principles to finding clean water.

What is a pond?

Ponds are permanent or seasonal waterbodies between 1m^2 and 2 hectares in surface area (about 2.5 football pitches).

This definition includes temporary ponds that dry up during the year, as well as tiny pools and very shallow ponds like 'wader scrapes'. All pond types can be found in woodlands.

- **The best sources of water for ponds** are usually (a) groundwater or (b) rain and surface water draining off non-intensively managed areas surrounding the pond (see *Pond Creation Toolkit Factsheet 2* for more advice).
- **Avoid stream, ditch or drain inflows into ponds**. Streams and ditches will bring in silt which will rapidly fill the pond, reducing its lifespan. Even tiny trickles and seasonal ditches will do this. If the stream or ditch drains from outside the woodland it is also likely that it will bring in agricultural or other pollutants (nutrients, pesticides, sewage and the like).
- **Don't locate ponds at the bottom of drainage furrows in woodland**. Even relatively minor forestry operations can cause soil disturbance, erosion and nutrient and pesticide runoff which can result in eutrophication or other pollution damage of the pond. Do follow best practice guidelines on protecting the aquatic environment during forestry operations www.forestry.gov.uk/pdf/FCGL002.pdf/$FILE/FCGL002.pdf.
- **Consider the land use adjacent to the woodland**. Intensive areas (e.g. arable or urban land-use) outside the woodland but part of the pond catchment (the area draining water into the pond) could introduce high levels of nutrients and pollutants. Woodlands surrounded by other low intensity habitats, such as fen, marsh, heathland or low intensity grassland will have the greatest wildlife potential.
- **Don't add topsoil or leave it near the pond**. Topsoil is very high in nutrients. So, having made sure the pond water source is clean, don't then add pollutants from topsoil.
- **Don't connect ponds to one another.** There is a misconception that linked ponds will hold water better than isolated ponds. A complex of ponds with different water depths, which hold water for different lengths of time, will increase the diversity of a woodland pond complex. In addition a pollution incident affecting one isolated pond will not spread to the rest of the site.

Figure 2. Maximising pond opportunities in woodlands

Bramshill Plantation, part of the Thames Basin Heaths, was once open heathland. In the 1920's it was extensively planted with conifers and the wildlife value of the site declined. But, in the 1970's, gravel extraction and subsequent pond creation significantly increased the site's potential. It created a wetland mosaic which is now designated as a Site of Special Scientific Interest SSSI, for species such as Pillwort *Pilularia globulifera*, Marsh Clubmoss *Lycopodiella inundata* and Six-stamened Waterwort *Elatine hexandra*.

The key to the site's value is the number and variety of waterbodies which have been created. There are currently 15 distinct ponds of different sizes, shapes and depths, numerous ditches and areas of wet heathland. Even the pools along the woodland trackways are home to uncommon species such as Small Water-pepper *Persicaria minor.* The Forestry Commission has another 15 ponds here as part of the Million Ponds Project to increase the diversity of the site still further.

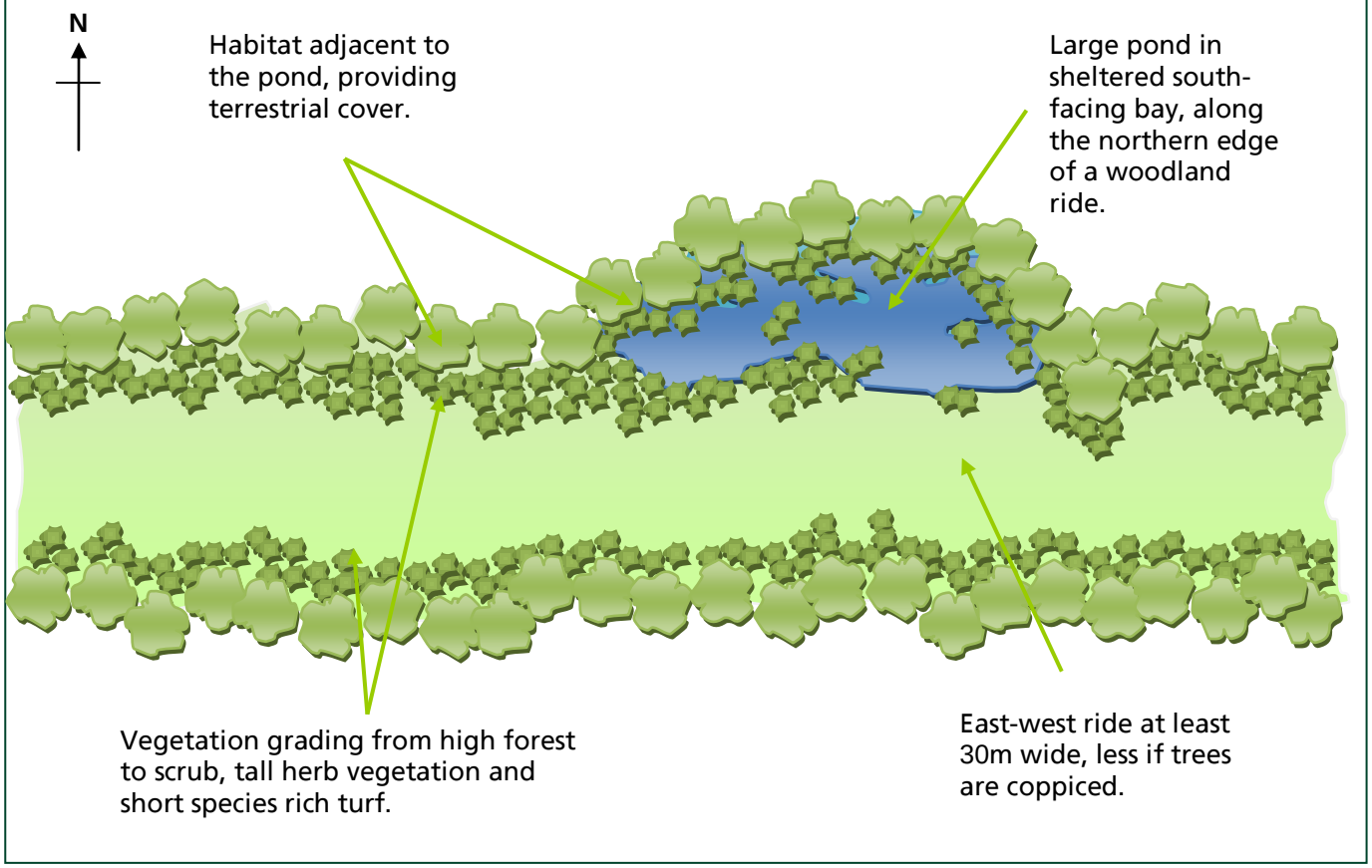
Pond aspect

High quality wildlife ponds can be created anywhere within woodlands. However, many pond plants and invertebrates thrive in sunny sheltered areas. Glades, rides and woodland edges provide clearings where the creation of a pond can attract wildlife and also act as corridors for dispersal through the woodland (Figure 3). These clearings often also support tall herb and scrub communities which are important terrestrial habitats for groups such as dragonflies and amphibians.

Some invertebrate species prefer shaded or dappled light conditions, so consider pond creation in a number of different locations within the woodland. Pond complexes will also support more species by providing different habitat conditions. That said, it can be useful to ensure that some ponds are located in areas particularly likely to benefit a wide range of species (Figure 4). These include:

- East-west rides, which will generally be more floristically rich than north-south rides, as they provide a south-facing sunny edge.
- Broad rides (>30m) will be less shaded than narrow rides, allowing for the angle of the sun over the trees. Sunny ponds can be created where the rides are at least one and a half times wider than the height of the trees on the south side to maximise the amount of light reaching open water.
- Bays or scallops along woodland rides are good locations for ponds and they have the potential to prevent wind funnelling. Clearings should be large enough to provide sunlight for most of the day, but not too large or shelter will be compromised.

Figure 3. Choosing pond location and pond aspect to maximise the amount of available sunlight



Avoiding sensitive areas

If you are considering creating a pond in your woodland for the first time or adding ponds to an existing pond network, you will be excavating soil and you may need to do some tree clearance. Before work begins consider the following.

- New ponds should be designed to enhance not replace existing habitats. Ensure the work will not damage areas of woodland with existing high biodiversity value. For example, areas with rare woodland plants, mosses and lichens, mature or veteran trees, dead wood habitats, habitats supporting woodland butterflies and damp shady pools supporting rare invertebrate communities (Figure 4).
- Consider the bat populations that the woodland may support. Woodland ponds can be very beneficial for bats, providing an insect food source and fresh drinking water. However, bats and their roosts are strictly protected. Therefore, important habitat features, such as potential tree roosts – trees with splits, cavities or woodpecker holes; and trees and scrub surrounding potential tree roosts must be retained.
- Bat foraging areas aren't strictly protected, unless they are part of the designation of a bat Special Area of Conservation (SAC), however it is important to consider potential feeding areas in pond design plans, to increase their value for bats. For more information contact the Bat Conservation Trust, www.bats.org.uk.
- Woodlands can be rich in archaeological interest. Ensure that pond creation will not damage sites of interest. Check with a county archaeologist before work begins.

Figure 4. The Meres in Shropshire (left) formed in natural depressions in glacial deposits following the last ice age 15,000 years ago. They illustrate the natural development of ponds over many thousands of years from open water through to alder carr woodland. This is a rare habitat type in the UK but examples can still be found in the less disturbed landscapes of Eastern Europe (right).

4. Woodland pond designs

When designing ponds in areas where extensive tree shade is eventually likely to develop, the main aims are to ensure that, at least in some ponds:

a) some light will get to the pond (Figure 5)– even when the edges are completely tree-lined.

b) the bottom of the pond isn't going to become completely covered with leaves too quickly – this is because inorganic (sand, clay, gravel) bottom substrates will support submerged plants for longer.

c) you take advantage of opportunities to create ponds in different areas of the woodland, adapting pond designs to create a range of different habitat types.

Pond substrate

Woodland ponds have traditionally formed through a combination of the underlying geology and, in many cases, human design. To satisfy their end use, some of these ponds were lined or dammed to ensure that they held water year round. For wildlife, the best woodland pond designs are often large with an undulating bottom and a complex shallow edge design, which can make artificial lining difficult and expensive.

The best schemes will use the local hydrology and geology to create a pond without the need for an artificial liner. Ponds can be dug into just about any substrate: clay, sand, gravel, peat or rock. The trick is to choose locations where water is naturally retained in these substrates.

- Groundwater-fed ponds can be created on any type of geology by digging into the substrate to reach the water table. This is only really feasible where the groundwater level is close to the surface, although some overburden can be removed to reach the groundwater level before constructing the pond (see *Pond Creation Toolkit Factsheet 4* for more information).
- On impermeable substrates (i.e. clay) pond creation is often easy, because ponds will fill from surface water and direct rainfall.
- Wherever possible, don't remove small ponds that appear 'naturally', often as a result of forestry activities. For example, in poorly drained clay woodlands, deep wheel-rut pools often form where heavy vehicles track through wet ground and on many substrates, pools can be created simply by compaction.
- Similarly, even more freely draining substrates, such as gravels or sands, usually contain some fine clays. These clays can accumulate in ponds in, or alongside trackways and by gateways, impeding drainage and leaving small shallow pools which are very valuable for specialised plants and animals.

Figure 5. Good designs for woodland ponds

This pond is located within ancient wood-pasture in the north of the New Forest overlaying clay geology. There are a number of features which make this an exceptionally rich pond for biodiversity.

- It is a large pond (25m x 30m) which extends well beyond the tree line into a woodland clearing.
- The open section of the pond is south facing, supporting abundant submerged and emergent wetland plants, whilst the shaded portion of the pond is carpeted by mosses.
- The whole pond is shallow, less than 40cm at its deepest point, and with broad (5m) shallow margins (<10cm).
- The pond dries up annually. A temporary pond, such as this, will be very long-lived. Organic sediments are oxidized when the pond dries up, preventing the build-up of material in the pond basin.
- Grazing by commoner's livestock and deer across the dry pond reduces the dominance of tall emergent plants like bulrush, slowing down the rate of pond succession still further. In addition, poaching along the pond margin creates an important bare ground habitat for wildlife.
- This pond is part of a complex of ponds of varying size and depth, some of which are fully shaded whilst others are open.

Pond size

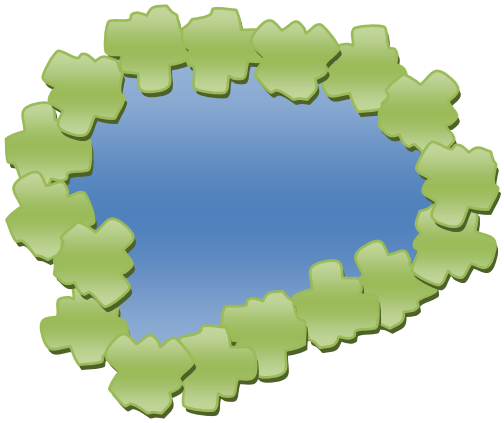
In woodlands, creating several large ponds (>20m diameter) is better than just creating small shaded ponds (Figure 6). Mature trees can have a canopy extending 8m from the bank, so shallow open water will need to extend well beyond the tree line. In woodland glades, consider creating a large pond adjacent to the tree line, with a number of smaller ponds in the centre of the clearing.

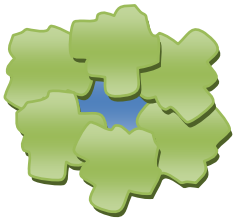
Figure 6. Create large woodland ponds to maximise the amount of light reaching the water

GOOD

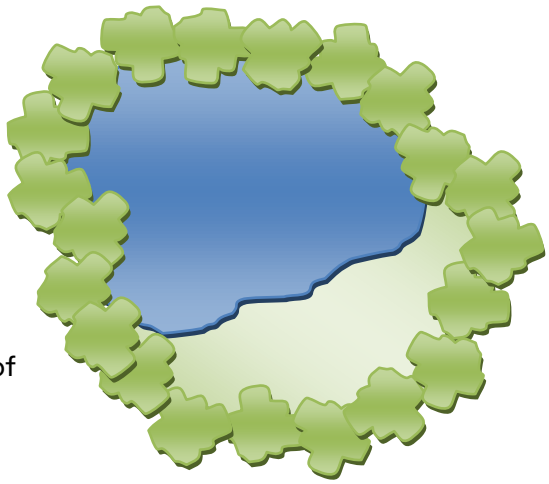
Small pools can quickly become completely shaded.

This can be an interesting habitat type and beneficial if these ponds are created as part of a complex of ponds.





Big ponds (>20m) allow light to reach the pond banks and the central open water areas even in tree lined ponds.



Locating big ponds (>20m) on the edge of rides and glades, will allow even more light to reach the water.

The clearing can be kept open by the grazing action of animals in pasture woodland and by deer.

In un-grazed woodlands the glade will eventually be colonised by trees, but this is not a problem, as the maturing pond habitat will support a different suite of species as it closes over.

Ideally new open ponds will be created to replace the habitats which are being lost.

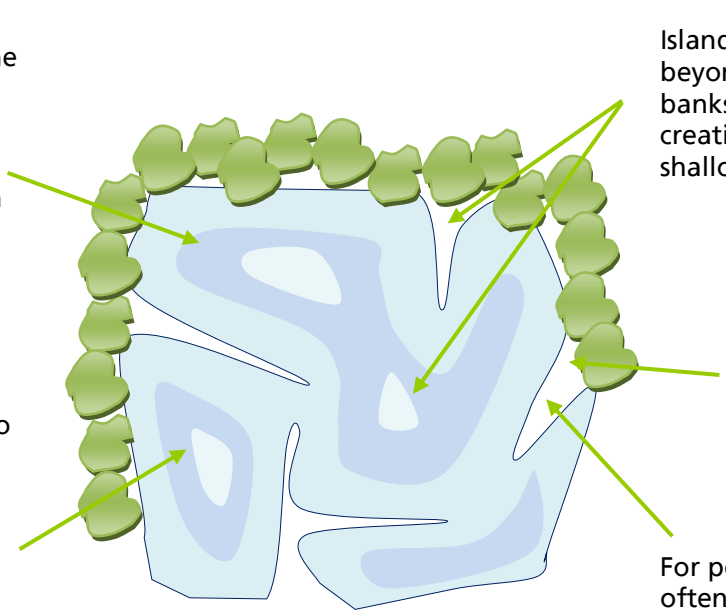
BETTER

Drawdown zone and shallow margins

Big ponds do not have to be deep. Marginal plants in dappled shade cannot grow where the water is more than a few centimetres deep. So it is important to maximise the drawdown zone, as this will be one of the richest part of the pond. In woodland pond design it can be useful to include the following.

- A very shallow margin, 1:20 (3°) or less, extending well beyond the tree line. Even a slope as gentle as 1:20 will only have a water depth of less than 10cm for the first 2m. To improve the value of shallow areas over a wide margin it's worth creating them with a gently undulating bottom.
- Where space is limited, dig down steeply to reach the top of the drawdown zone (the highest standing winter water level), then flatten off and create extensive spring and summer shallows (Figure 8a).
- Low spits extending from the margins into the deeper regions of the pond and submerged islands will create shallow areas beyond the tree line and extend the area available for aquatic plants (Figure 7). Spits and islands will need to be submerged for part of the year or trees will become established casting even more shade over the pond surface (see *Pond Creation Toolkit Factsheet 4* for further information).

Figure 7. Pond shape to maximise shallow water in areas of heavy shade



Deeper water

Because woodland pools often have clean water they can be excellent places for some of the deeper water aquatic plants. However, because deeper water areas will quickly fill with organic sediments (leaf litter) some submerged plants do not persist for longer than 15-20 years as they need bare inorganic sediments (such as sand and clay).

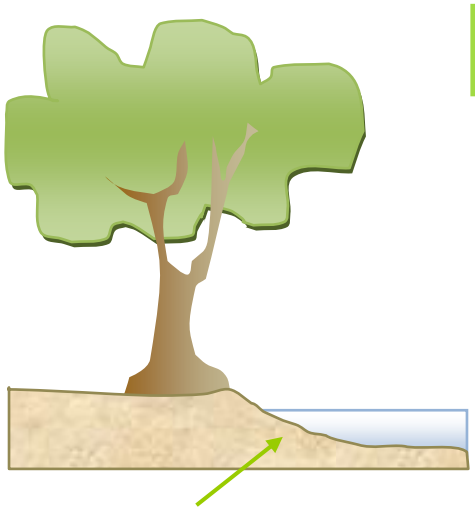
A solution to this problem is to create underwater bars and shoals which remain free of organic sediment for longer (Figure 8b). They work because leaf material slips off the underwater bars, leaving bare inorganic clays or sand which species such as stoneworts can colonise. Expert opinion suggests that bars of 1-5+m width are valuable. Some allowance should also be made for subsidence and erosion, particularly in shallow water where bars and shoals need stability against wave wash.

Figure 8. Designing woodland pond profiles

a. Create extended, very shallow margins

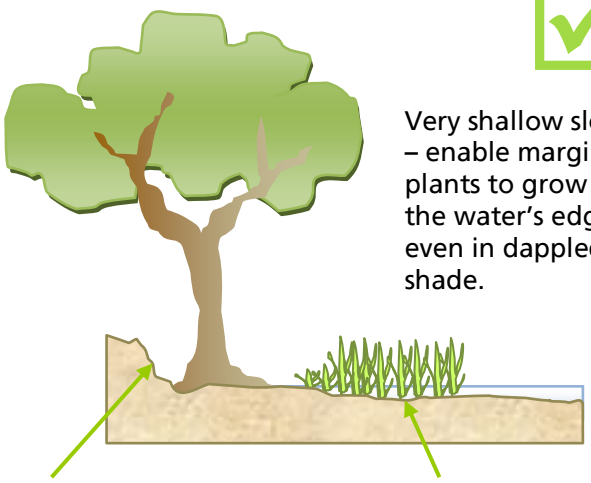
Most broadleaved trees - Oak, Ash, Beech, etc. and coniferous trees have leaves that don't degrade well in water.

Organic sediment will build up quickly in ponds under these trees, especially where they overhang the water.



This bank looks quite gentle – but is still too steep to allow marginal plants to grow under shade.

Willow and Alder naturally grow close to water. Their leaves degrade well, so sediment doesn't build up so quickly.

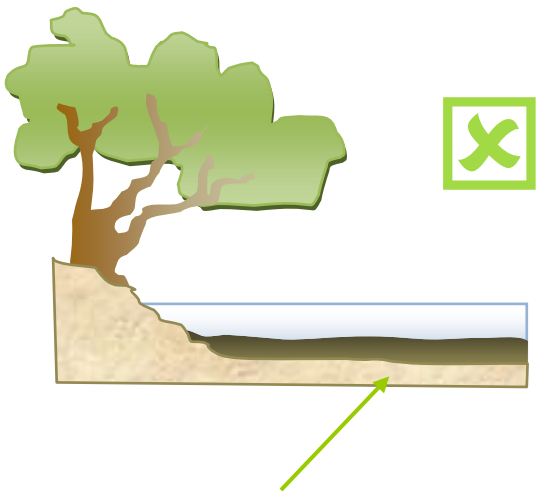


Very shallow slopes – enable marginal plants to grow at the water's edge, even in dappled shade.

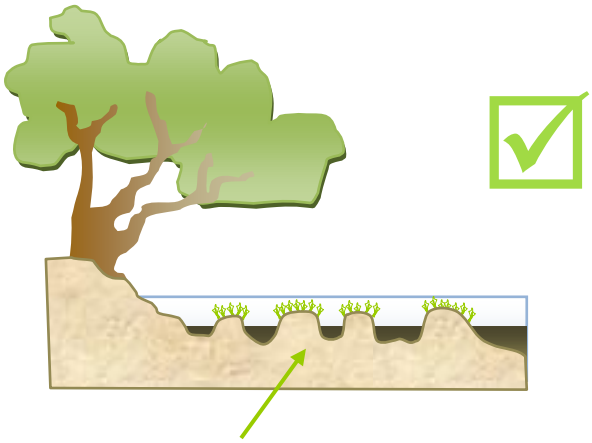
Height lost rapidly near the top of the high water zone.

Very shallow water extending beyond the tree overhang zone allows marginal habitat to develop.

b. Create underwater bars and shoals



Tree lined ponds can fill up quickly with organic silt.



Organic silt slips off the top of underwater bars – leaving them bare = good for a wide range of submerged plants.

5. Designing woodland ponds for rare and threatened species

There are at least 30 Biodiversity Action Plan (BAP) pond species and many Red Data Book and Nationally Scarce species which occur in woodland ponds (e.g. Figure 9). These species take advantage of the warm sheltered conditions and often require the high quality terrestrial habitat found in woodlands.

Specialist species often have specific habitat requirements. The *BAP Species Map* gives a summary of the requirements and distribution of BAP pond species. *Species Dossiers* are also available in the *Pond Creation Toolkit*, giving detailed pond habitat designs for key Priority Species.

Plants

Many scarce plants, like Yellow Centaury *Cicendia filiformis*, the Hedgehog Stonewort *Chara aculeolata* and Violet Crystalwort *Riccia huebeneriana* (a liverwort) are poor competitors. The ponds in which they occur do not have to be large or deep but they must be free from shade and have some form of regular disturbance to uncover bare mineral substrates which are free from organic sediments.

Grazing in pasture woodlands and wave wash in ponds along woodland rides can help to maintain early successional habitats. In large ponds, submerged bars will also help to reveal inorganic sediments. Small ponds can be created along paths and trackways where animal and vehicle traffic will keep the habitat open.

Invertebrates

Shaded, leaf filled woodland ponds support many specialist invertebrate species including beetles, flies and specialist species such as the Mud Snail *Omphiscola glabra*. Some are adapted to periodic drought which will eliminate competitors and fish preditors. Other invertebrates, such as the Downy Emerald Dragonfly *Cordulia aenea* require warm sheltered conditions, with patches of emergent vegetation (Figure 10).

To cater for the different needs of woodland pond species it is important to build variety into pond complexes. Ideally, ponds should be allowed to develop naturally, creating new ponds to provide a continuity of habitat.

Vertebrates

Amphibians, bats and woodland birds all use woodland ponds. These ponds provide a good source of invertebrate food and fresh drinking water. For amphibians such as the Great Crested Newt *Triturus cristatus*, encouraging growth of tall herbs and scrub adjacent to the pond is useful. Large shallow ponds will also allow submerged plants to grow beyond the tree line which are then used as egg laying sites. Amphibians also benefit from a complex of ponds or landscape-scale networks of ponds.

Bats such as Natterer's Bat *Myotis nattereri* fly in extreme clutter within woodlands and do not like breaking cover to find food and water. They benefit from ponds within or directly adjacent to their foraging habitat. In contrast, many woodland birds like Hawfinch *Coccothraustes coccothraustes* prefer open sight lines to and from the pond with adjacent canopy cover. This highlights the need for variety in pond type within the woodland.

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Figure 9. Woodland ponds are important for many species including (top to bottom) Mud Snail, Hawfinch and Natterer's Bat.

Figure 10. Case study: Bentley Woods, Wiltshire

Tytherley Woods and the Mottisfont Estate on the Hampshire/Wiltshire border are part of an ancient woodland landscape, of exceptional quality for terrestrial, aquatic and semi-aquatic species. The woodlands around Mottisfont have been designated as an SAC for the significant breeding population of Barbastelle Bats *Barbastella barbastellus* found there, whilst Tytherley Woods and the surrounding farmland support a significant population of Great Crested Newt *Triturus cristatus*.

In the middle of this woodland complex lies Bentley Wood SSSI which is undergoing restoration following broadleaved and conifer plantation, as part of Butterfly Conservation's South East Woodlands Project. A pond in this woodland supports the Nationally Scarce Downy Emerald Dragonfly, and has many features that make it a very good example of how to design a woodland pond.

The Downy Emerald Dragonfly
Cordulia aenea

Dense understory provides cover for amphibians and bats.

Scalloped bays increase the area of shallow margin (<10cm) which support stands of emergent vegetation.

Large pond (~25x15m) allows sun to reach the surface beyond the tree line.

Clean water supporting emergent, floating-leaved and submerged plants.

- Pond is part of a complex of other ponds in the woodland/ farmland landscape.
- Potential to create new ponds as part of the woodland restoration scheme.

6. Woodland pond management

A well designed woodland pond will need little management (see *Pond Creation Toolkit Factsheet 4* for further information). The ponds will develop naturally over time, and the communities of plants and animals will change. Large woodland ponds will take many centuries to reach the end of their life and then will normally develop into temporary marshy pools or wet woodland – both valuable habitats in their own right. With this in mind, there are a few things which can help to prolong the life of a woodland pond.

- **Don't plant up the pond** - The bare substrates of new ponds are colonised by an important group of species (e.g. stoneworts and bryophytes) which will only be present in the first few years of the ponds life. Value these early years: rushing the pond to maturity by adding species will shorten its life still further.
- **The early years** - Monitor which plants colonise the pond. Invasive alien plants can be controlled if they are caught early enough. You may also want to remove Bulrush (*Typha latifolia*) as this can rapidly take over new ponds and prevent other species from becoming established.

  Bramble and bracken have a tendency to flourish in recently cleared glades. These will not impair the pond and can add valuable terrestrial cover close to the water's edge. If management is embarked upon, care should be taken in the choice of control to ensure that there are no negative long-lasting effects on pond life.
- **Mature ponds** - Creating large woodland ponds will mean that they retain open water for a long time without the need for any management. Ponds in coppiced woodlands can be included within the rotational management of the site and should require no additional management.

  Where tree clearance work is taking place, ensure that excessive brash does not fall into the pond. Some deadwood is beneficial to pond biodiversity but avoid using the pond as a pit for felled trees.

  If the pond supports a Priority Species, you may want to maintain the pond at a particular successional stage for this species. But, when undertaking management think about pond density: as the number of ponds increases, the need for micro-management of individual ponds can often be reduced as the inherent variety of the ponds provides landscape-scale protection. Rather than halting succession by managing individual ponds it is better to create a landscape of ponds of different ages.
- **People and ponds** - Any pond located near to a path or in clear view and with easy public access is likely to be impacted by people. The main problems are addition of invasive species, fish (particularly carp), feeding ducks and regular swimming by dogs. If people and their dogs do use the woodland it may be useful to fence the pond or create a ditch barrier, at least on the side exposed to woodland paths (see *Supplementary Advice Factsheet: Designing ponds in areas of public access* for more information).

  The creation of large woodland ponds with underwater bars and shoals are excellent for wildlife but also pose a potential safety issue for those people who may be tempted to wade into the pond. Interpretation to highlight potential threats also provides the opportunity to raise public awareness about the value of ponds for biodiversity.

7. Further reading

Blakesley, D. and Buckley, P. (2010) *Managing your woodland for wildlife*. Pisces Publications, Newbury.

Calder, IR., Harrison, J., Nisbet, TR. and Smithers, RJ. (2008) *Woodland actions for biodiversity and their role in water management*. The Woodland Trust, www.woodlandtrust.org.uk.

The Forestry Commission www.forestry.gov.uk/

For further information about the Million Ponds Project and to consult other factsheets in the Pond Creation Toolkit, please visit *www.pondconservation.org.uk/millionponds* or email enquiries to *info@pondconservation.org.uk*

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