SUPPLEMENTARY HABITAT FACTSHEET

Designing wildlife ponds in heathland

MILLION PONDS PROJECT
Pond Conservation

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

1. The value of heathland ponds

Heathland ponds are biodiversity hotspots. They are highly variable and often experience extreme conditions such as low nutrients, low pH and annual drought. As a result they support a special suite of plants and animals, many of which are restricted to this habitat type (Figure 1). Some receive protection at the National and European level because of the rarity of the species they support.

Heathland ponds appear wherever there is restricted drainage, e.g. in wheel-ruts on trackways, around trampled gateways, or in valley basins where groundwater reaches the surface. They were also historically created to provide drinking water for stock and as a result of small scale peat digging. The decline of pastoral economies and the small scale of many heathland pools means that they are often overlooked, neglected or destroyed. This factsheet explains how to design and create heathland ponds to reverse the decline of this critical habitat type (Figure 2).

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Figure 1. Large or small? These heathland ponds ***both*** contain important pond species - Hampshire Purslane *Ludwigia palustris* (left) and Coral Necklace *Illecebrum verticillatum* (right).

What's in this factsheet?

2. Design principles for heathland ponds

Heathlands form on nutrient poor, freely draining sands and gravels or more rarely on serpentine or limestone outcrops. Because of the hydrology there is a perception that it is difficult to create ponds on heathland. But by following a few simple design rules, creating heathland ponds can be very successful and will help to support a great number of rare species.

- **Create a complex of ponds.** Species can disappear and reappear across the complex as conditions become suitable in different ponds.
- **Create small shallow ponds.** Successful heathland ponds can be as small as 0.5m across and less than 10cm deep. These can be combined with larger shallow and deeper ponds as part of a pond complex.
- **It doesn't matter if the pond dries out during the summer months.** Seasonal pools are common in heathlands and are easy to create. They can be particularly valuable because many uncommon pond species of heathland are poor competitors and need bare ground and seasonal drought.
- **Maintain the habitat by extensive grazing with cattle or ponies.** Traditionally, heathland habitats were maintained by free roaming stock which controlled scrub and halted succession. Their activity around ponds also creates disturbance which maintains areas of bare ground.

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 heathland 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

Heathland catchments are naturally very low in nutrients and are a very good source of unpolluted water (see *Pond Creation Toolkit Factsheet 2* for further information). However, these small water bodies are highly sensitive to pollution therefore particular attention should be paid to the water source (i.e. avoid creating ponds near to any sources of pollution, such as roads, car parks etc.). Heathlands are often located on free draining soils, so you will need to think about how the pond will fill and how long the pond will hold water (Figure 3).

In the planning stage it is helpful to bear the following in mind.

- Are there ponds already present on the site? These will act as a guide to future pond creation. If there are no ponds, consider digging a number of test holes to determine the water holding capacity of the soil.
- Maintain flexibility in approach. Heathland ponds can be very simple to create, so the best advice is to create many different types of ponds in different locations. Each one may hold water in a different way but this will add diversity to the site and benefit a great number of different pond species.
- Temporary ponds are a valuable habitat type in heathlands, they need only hold water long enough to reduce the cover of terrestrial plant species, allowing poor competitors to flourish.
- Even if some ponds never hold water, areas of bare soil will provide important habitats for many plants, invertebrates, amphibians and reptiles and increase the micro-topography of the site.

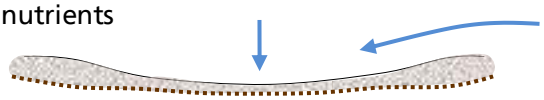
Figure 2. Clean water ponds have been created in many heathland around England and Wales – clockwise from top right – The Lizard Peninsula, Cornwall; Dowrog Common, Pembrokeshire and Nordon Heath, Dorset.

Figure 3. How to make heathland ponds hold water?

1. Ponds on impermeable soil horizon

Very low in nutrients

Direct precipitation and surface inflow

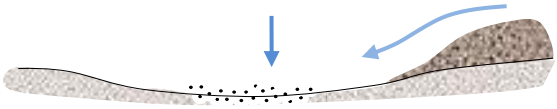


Impermeable soil horizon underlying freely draining soils, e.g. Iron pans or clay lenses

2. Self-sealing

Impeded drainage, creates temporary pool

Spoil (not topsoil) piled next to the pond

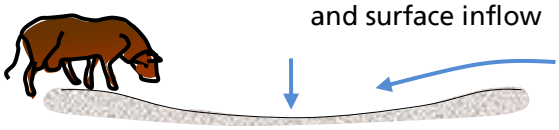


Sediments washing into pond become trapped, consolidate and form a slowly permeable membrane (see also Figure 6)

3. Compaction

Inputs of animal dung and trampling can provide nutrient input into the system

Direct precipitation and surface inflow



On trackways and at pinch points such as gateways, trampling will compact the soil leading to standing surface water

4. Groundwater fed ponds

Rich in organic matter, low in nutrients and low in oxygen, leading to formation of peat

Small square pools are evidence of old peat cutting

Predominantly groundwater fed

Can also be fed by seepage springs on valley slopes and high groundwater levels in valleys and basins

Surface water (1-3 above) will collect in any depression, but in free draining heathland soils an impermeable layer is needed to hold the water back.

1. **Impermeable soil.** Water seeping down through the soil can drag minerals such as iron into a single impermeable iron-pan horizon. These soils are usually ash grey in colour, and often have patches of standing water in the winter. **During pond creation take care not to dig through the iron-pan, dig a test hole first to work out the depth of the impermeable layer.**

   Soils are rarely uniform and in many heathlands patchy clay deposits will form impermeable layers. It can be difficult to know where these deposits begin and end, but it doesn't matter. **Create many small ponds, some will hold water, others won't, but *BOTH* have value. In heathlands the most exciting areas for wildlife are the wet areas and the bare sandy areas.**

2. **Self-sealing.** Ponds on free-draining soils can be self-sealing. Fine sediments washed into the pond can fill in cracks, reducing drainage rates. This process is more effective in sparsely vegetated areas because larger roots will break through the impermeable layer. **After digging a pond, pile the sub-soil (not the nutrient-rich topsoil) next to the pond to allow silt to wash in and plug the gaps.**

3. **Compaction.** Grazing and human traffic causing compaction will also limit drainage and create ponds. Where there are clay particles in the soil, the poaching action of stock trampling will consolidate the clay to form an impermeable layer. **Choose some creation sites next to pinch points in gateways and where paths cross. This will encourage compaction by grazing animals and vehicles.**

4. **Groundwater.** Groundwater can also act as a water source for heathland ponds. In valley basins with high groundwater levels and on valley slopes where springs mark the junction between different bedrocks, bogs will develop. These conditions often result in the creation of peat, because they are permanently waterlogged and lack oxygen. This is a very important habitat type, supporting many rare and specialised plants and animals. This habitat type is also very threatened and declining rapidly because of drainage and eutrophication. **It is easy to create new micro-pools in less diverse areas of these habitats, e.g. uniform stands of grasses, e.g. Purple Moor-grass. These ponds develop quickly and are hugely important for many rare pond plants and invertebrates.**

Locating new ponds

Heathland ponds show great variability in the species they support depending on the underlying geology, water depth, source of water (surface water or groundwater fed) and the length of the wet phase. The pond community will also be influenced by pond location and the surrounding habitat type.

- **Dispersal of target species.** If the pond is being created to extend or enhance the population of a particular species it should ideally be created adjacent to an existing population. Many heathland pond specialists have poor powers of dispersal and will need new habitat within a short distance (<100m), or the same grazing unit, unless translocation is being considered (Figure 4).
- **Grazing.** Many heathland pond specialists are intolerant of competition and need a large proportion of the pond to be bare ground. Extensive grazing by free roaming stock is an essential management technique, but to increase the level of disturbance on a particular pond complex, consider locating ponds in areas with high animal or human traffic, e.g. trackways, pinch points at gateways or areas in which animals congregate.
- **Creating patchiness.** Heathlands are a complex mosaic of different habitat types - wet, dry and humid heath, acid grassland, bog, lichen heaths and Purple Moor-grass dominated swards. Ponds in each of these habitat types will support a different suite of species and greatly increase the number of species the heathland will support (see *Case Study* below).
- **Heathland restoration.** Many heathlands have suffered from a lack of management resulting in scrub encroachment, whilst others have been planted with extensive stands of conifers. Restoration plans often include plans to remove the scrub or conifer and restore heathland habitats. This will provide opportunities for pond creation as large machines are already on-site to undertake the clearance work.

Avoiding sensitive areas

If you are creating new ponds in heathland or adding ponds to an existing pond network, you will be excavating soil. Before work begins you should consider the following.

- Will the work damage areas of heathland with existing high biodiversity value? It is especially important not to deepen or fill areas which currently hold surface water for part of the year.
- New ponds should enhance not replace existing wetland or bare ground habitats. Look for large areas of single species such as Heather *Calluna vulgaris* or Purple Moor-grass *Molinia caerulea.* These will be enhanced by pond creation, because ponds will add to the mosaic of habitats.
- Very small heathland ponds can have very high biodiversity value and can be incorporated into habitats such as bogs, acid grasslands and wet heathland without damaging their existing biodiversity value.
- Heathlands can be rich in archaeology. Ensure that pond creation will not damage sites of interest. Check with a county archaeologist before work begins (for more information go to *Pond Creation Toolkit Factsheet 6*).

Figure 4. This large, shallow, grazed, temporary pond in the New Forest is one of many heathland pools in the National Park supporting rare plants such as Coral Necklace, *Illecebrum verticillatum*. Coral Necklace is able to disperse between adjacent ponds and the pools in rutted trackways because of the free movement of grazing livestock across the heathland. Within the pond complex this temporary pond specialist will germinate in different ponds in different years wherever conditions are suitable.

4. Case study: Heathland ponds come in all shapes and sizes

Heathland pools can be very different, even within the same site, due to differences in area, depth, whether the pond is groundwater or surface water fed and the amount of grazing pressure.

As this example shows you don't need to stick to one design. The greater the variety of pond types the more species the site will support.

1. Permanent ring pond around a tumulus in wet heath, home to a rare heathland diving beetle *Graptodytes flavipes.*
2. Complex of temporary ponds in wet heath (below) used by nesting Lapwing *Vanellus vanellus*.

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3. Temporary pond on edge of bare sandy track covered by Coral Necklace *Illecebrum verticillatum* during the dry summer months.
4. Numerous micro-pools (<1m^2) at pinch points around underpass created by grazing animals and human traffic (below), home to Pillwort *Pilularia globulifera.*

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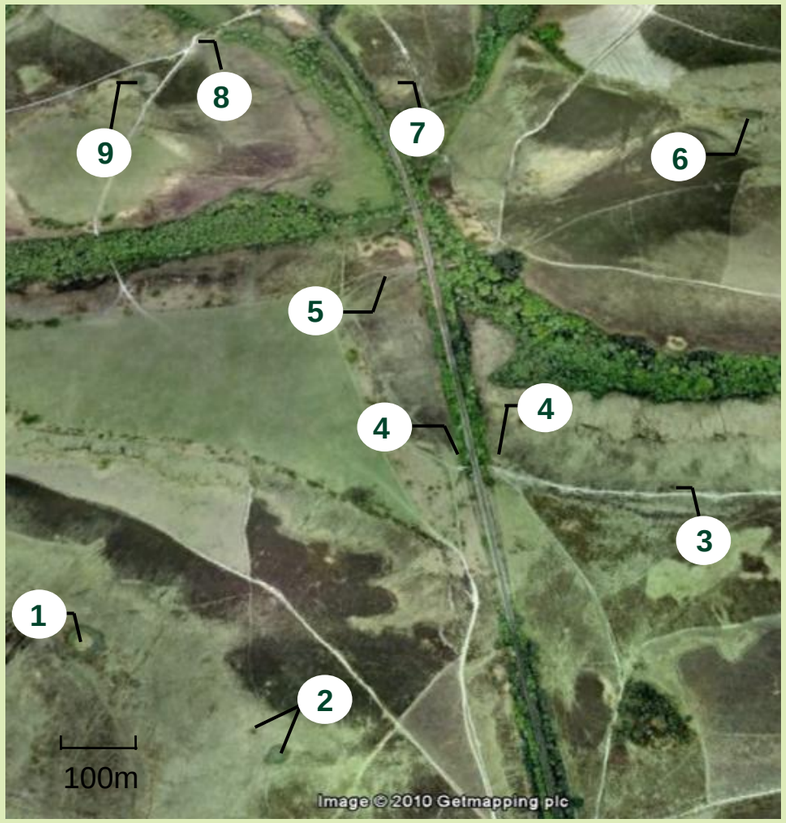

Map of a small area of the New Forest and the huge variety of pond types within walking distance of one another

5. Series of well vegetated ephemeral ponds created by bomb damage during World War II (below).

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6. Large permanent bog pond uncovered following conifer removal and mire restoration (above).
7. Complex of shallow ponds connected to ditch during periods of high water – another Coral Necklace site.

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8. Many (>20) permanent micro-ponds in peat (above) all of which dry out in summer but which are connected by a thin film of water in the winter. Marsh Clubmoss *Lycopodiella inundata* grows here - responding to the trampling pressure of grazing animals leaving the track.
9. Large permanent pond where stock congregate to drink.

5. Heathland pond designs

There are very few design rules in creating heathland ponds. It is very easy and cheap to create complexes of small, shallow temporary ponds. When space, opportunity and geology allows consider creating larger bodies of water as part of the pond landscape which may be either temporary or permanent.

- **Small shallow micro-pools** (<1m^2) can be very rich in wildlife and support some of the UK's rarest heathland species. They have a simple profile but should be created as part of a complex of many micro-pools. The smallest pool that can easily be dug with a digger bucket is about 0.5m in diameter. If the spoil is then piled next to the pond clay particles will wash into the pond basin sealing the pond (Figure 5).
- **Broad undulating drawdown zones** can be created in larger ponds. These will be flooded by the spring high water level but exposed during the summer months. These shallow zones will often be the most wildlife-rich part of the pond. As the pond dries they will form a complex of shallow pools (Figure 6). In mire systems ponds fed by groundwater will show little fluctuation in water levels. The shallow pond margin will become dominated by mosses and sundews.
- **Maintain a flexible approach**, as it can be difficult to determine what the water levels will be in advance of pond creation. Begin by creating shallow profiles which can be deepened at a later date if necessary, or create many ponds to provide as much variety as possible.
- **Deeper water ponds** (>30cm) are valuable, particularly in a pond complex, because the clean water quality in heathlands will allow submerged plants, such as stoneworts, to flourish (see *Species Dossiers* for more information).
- **Use wave-wash** in larger ponds (>20m in diameter) in open heathland landscapes to maintain bare sediments. In contrast, creating underwater bars and bays on the wave washed margins of very large ponds (>50m) will create wildlife rich backwaters (see *Pond Creation Toolkit Factsheet 4* for more information).

Figure 5. A self-sealing bucket pond which was colonised by Fairy Shrimp *Chirocephalus diaphanus* within a year of being created. The pond to the left is a very shallow existing Fairy Shrimp pond – which is just a few metres from the new pond - it is assumed that eggs have been moved on the feet of grazing animals to the new pond.

Figure 6. Heathland ponds design examples

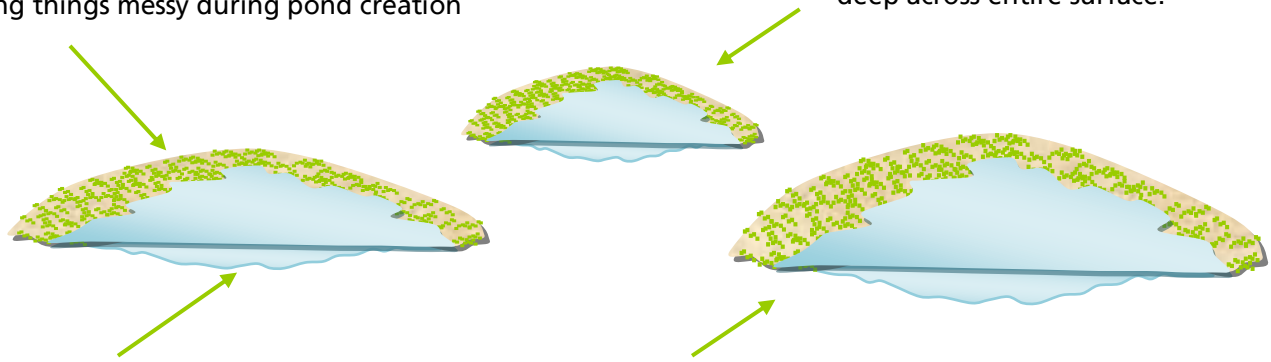
Heathland pond designs can include a huge variety or shapes and sizes, from 0.5m wide to over 1ha in surface area.

- Increase variety by creating as many different pond types as possible within the complex.
- Keep small ponds shallow.
- Include broad shallow margins on large ponds.

Pond width <10m

Don't overdesign heathland ponds, convoluted margins can be produced by keeping things messy during pond creation

Keep wide shallow margins, <10cm for at least 1m. In some ponds keep the depth <10cm deep across entire surface.



Shallow basin, maximum depth <40cm

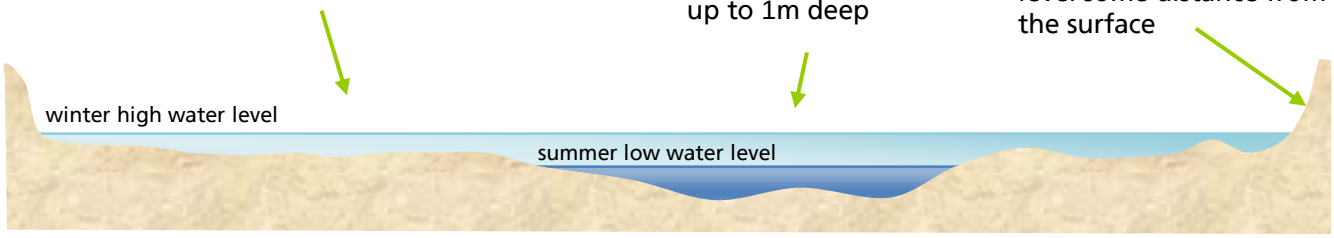
Aim to create a complex of small ponds of different depths and surface areas to increase the area of habitat available for heathland pond plants and invertebrates.

Pond width 10m – 100m

Shallow undulating margin, <10cm deep, very gentle slope <1 in 20 (3°)

Deeper water, up to 1m deep

A rapid drop at top of the drawdown zone can be useful to reach a water level some distance from the surface



- Large heathland ponds may be temporary or permanent.
- An undulating profile increases the width of the drawdown zone.
- The undulations are not created by design but result from digger movements and leaving the pond margin 'unfinished'.

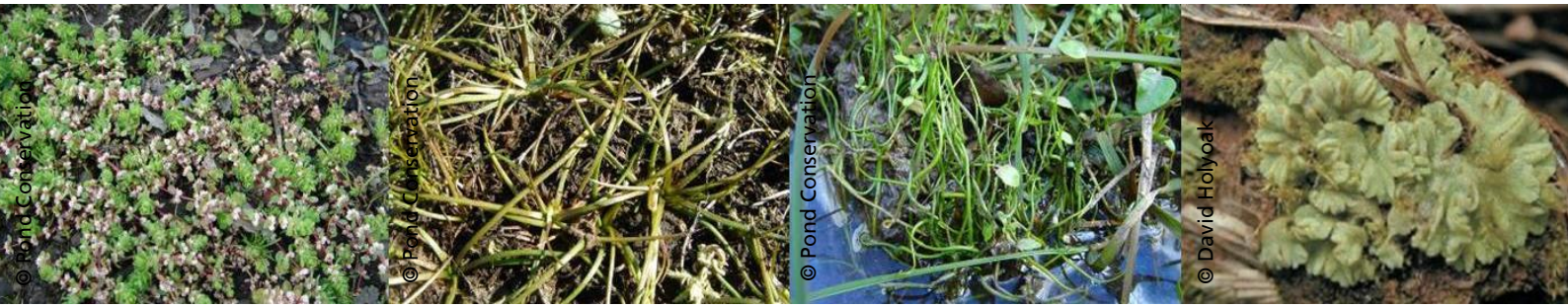


Figure 7. Rare plants associated with the shallow grazed margin of temporary ponds: Coral Necklace *Illecebrum verticillatum*, Shoreweed *Littorella uniflora*, Pillwort *Pilularia globulifera*, Lizard Crystalwort *Riccia bifurca.*

6. Rare species associated with heathland ponds

The extreme conditions associated with heathland pools, i.e. low nutrients and periodic drought, have led to the evolution of a specialist flora and fauna. Almost one third of the Biodiversity Action Plan (BAP) species can be found in this habitat type and many are found no-where else.

In general plant and animal species which live in temporary heathland pools all have a short life cycle. They produce vast numbers of offspring but have poor powers of dispersal, remaining dormant until favourable conditions occur. Many depend on the wet season but many others are restricted to the dry phase of the pond's yearly wet/dry cycle.

- Many temporary pond plants such as Coral Necklace *Illecebrum verticillatum*, Shoreweed *Littorella uniflora*, Pillwort *Pilularia globulifera*, Lizard Crystalwort *Riccia bifurca* (Figure 7) are poor competitors. They need fluctuating water levels and grazing to maintain areas of bare ground for growth and germination.
- Rare heathland species typically require very low nutrient environments and are sensitive to pollution from agricultural and road run-off. Therefore, ponds should be located in areas buffered from nutrient runoff.
- Specialist invertebrate species (Figure 8) in heathland ponds are also poor competitors (e.g. the Tadpole Shrimp *Triops cancriformis,* Fairy Shrimp *Chirocephalus diaphanus* and Mud Snail *Omphiscola glabra*). The temporary nature of the ponds they inhabit reduces the number of invertebrate predators.
- Other invertebrate species such as the Small Red Damselfly *Ceriagrion tenellum* are associated with specific micro-habitats in the pond. In the case of the Small Red Damselfly a carpet of *Sphagnum* mosses are required for egg laying.
- Amphibians and reptiles also inhabit heathland ponds. The Natterjack Toad *Epidalea calamita* is a temporary pond specialist, which uses shallow, warm, neutral ponds for breeding and open, sandy terrestrial habitats for foraging, dispersal and hibernation.

Species Dossiers have been produced for many heathland plant and invertebrate species, to provide detailed guidance of how to design, create and manage ponds to benefit these threatened populations (see the *Pond Creation Toolkit* for more information).

Figure 8. Rare invertebrates associated with heathland ponds: Spangled Water Beetle *Graphoderus zonatus*, Mud Snail *Omphiscola glabra*, Fairy Shrimp *Chirocephalus diaphanus* and Small Red Damselfly *Ceriagrion tenellum*.

7. Heathland pond management

Grazed heathland ponds will require little additional management (see *Pond Creation Toolkit Factsheet 8* for further information). Ponds will develop naturally over time, but ephemeral temporary ponds are remarkably long lived, taking thousands of years to reach the end of their lives. However, there are a few management tweaks in the first few years which can be helpful and a few pitfalls to avoid.

- **Don't plant up the pond** - The bare substrates of heathland ponds are essential for many temporary pond species. Rare species will colonise new ponds if they are adjacent to existing populations and within the same grazing unit.
- **The early years** – Keep an eye on which plants colonise the pond. Heathland ponds are particularly vulnerable to invasive non-native plant species, because of the amount of bare ground and the intolerance of heathland plants to competition. If caught early enough they can be easily removed.

  In waterlogged sites Purple Moor-grass *Molinia caerulea* may show a tendency to colonise shallow ponds, but if grazing levels are correct, this should not be a problem.
- **Mature ponds** – Heathland ponds will be maintained in good condition by grazing (ponies and cattle) and will require no additional management. This traditional form of management has been part of the worked heathland landscape for thousands of years and should be supported in order to conserve these vulnerable habitats.

  In the past, new ponds were continually being created, from wheel ruts in trackways and small scale abstraction of minerals and peat. This high density of ponds of different age allowed many species to move across the landscape as pond conditions changes.. To continue this history of pond creation today, new pond creation should become part of the long term management plan for heathland sites.
- **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. People in themselves are fine, but in heathlands their pets can severely impact clean water ponds. Fish added to heathland ponds may have short term effects, but will often be controlled naturally because of the temporary nature of many heathland ponds.

  Dogs can stir up bottom sediment making the water permanently cloudy and may add damaging levels of nutrients to these fragile ecosystems. Fencing will exclude dogs but will also exclude beneficial grazing animals, and is not advisable on heathland sites. A better method will be to create ponds away from heavy dog walking traffic and to consider creation of a dog swimming pond close to car parks. This will channel pressure away from sensitive sites.

  Peatlands are particularly vulnerable to damage from excessive trampling by walkers. The fragile communities are easily damaged and because they are very slow growing; they take many years to recover. Boardwalks around part of the site can be a useful tool to allow public access without damaging the habitat.

  The delicate balance between surface flows and groundwater in heathland ponds means that they are particularly vulnerable to the negative effects of water abstraction. It may be useful to monitor groundwater levels to identify problems before they begin to have a negative effect on heathland habitats. Work with adjacent landowners in the wider landscape to resolve issues.

8. Further reading

Gimingham, CH (1992) *The Lowland Heath Management Handbook*. English Nature, Peterborough.

Williams, P., Biggs, J. Fox, G., Nicolet, P. and Whitfield, M. (2001) *History, origins and importance of temporary ponds.* Freshwater Forum, 17, pp. 7-15.

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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