

## **DANGERS AND OPPORTUNITIES IN MANAGING TEMPORARY PONDS**

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### **Introduction**

Although there is a growing awareness of the value of temporary ponds in Europe (Bratton 1990; Collinson et al. 1993; Griffiths 1997; Grillas & Roche 1997; Williams et al. 2001a), there is still remarkably little information available to help guide their conservation and management. In the UK, for example, detailed advice on the management of temporary ponds is largely based on the requirements of a handful of rare temporary pond species, including natterjack toads, plants such as tassel stonewort *Tolypella intricata* and a small number of Red Data Book water beetles (Beebee & Denton 1996; Foster 2000; Williams et al. 2001b). More general principles which can be used to guide the management of temporary ponds as a whole have yet to be established. The aim of this article, therefore, is to give a broader overview of the main principles of temporary pond conservation, particularly by building on a number of general principles for managing ponds previously described by Biggs et al. (1994) and Williams et al. (2000). Special attention is paid to the potentially powerful management technique of habitat creation, based on examples drawn from our own experience of ponds in England.

### **Managing temporary ponds**

One of the most important initial considerations in the management of temporary ponds is to decide on the purpose of that management. If the principle aim is nature conservation, site managers should first consider whether the management is really necessary. As noted previously in this volume, well established temporary ponds located in semi-natural landscapes often can be very stable systems that are largely self sustaining (Williams et al. 2001a). In such situations, 'benign neglect' may well be the best management option.

### **The need for survey data**

Where benign neglect is not appropriate, and invasive management (like dredging or tree clearance) is being considered, then wherever possible the management should be based on good survey data. This is particularly important



FIG. 1. (a) (above): Fringford Road Pond, Oxfordshire, supports populations of the fen relict water beetles *Agabus uliginosus*, *Dryops similaris* and the RDB 1 species *Haliplus furcatus*. It is largely surrounded by arable land but is partly protected by a thick belt of scrub, (b) (below): Temporary ponds created accidentally at Greenham Common during removal of the concrete runways.

because temporary ponds are exceptionally easy to underestimate - although they often look dull, they frequently support rare species. Temporary ponds in areas of semi-natural vegetation (e.g. ancient woodland, old grassland, moorland) are particularly likely to be at risk of damage from mismanagement because of the number of sensitive, uncommon species they support. In recent survey work undertaken by Pascale Nicolet (Nicolet 2001), Red Data Book plant and animal species were recorded in a quarter of temporary ponds in a stratified random sample of ponds in semi-natural landscapes.

Caution about management also needs to be exercised even in more intensively managed locations because rarities regularly occur in these areas as well. For example, at Fringford in Oxfordshire, a temporary pond in arable farmland (Fig. 1a) was found to support several species of water beetle that are indicative of relict wetlands, including a population of one of Britain's rarest water beetles, the RDB1 species *Haliphus furcatus*: a species which is otherwise known only from an ancient pingo site in East Anglia (Collinson et al. 1993; Foster 2000).

The Fringford pond does not look particularly exceptional (Fig. 1a). It was discovered purely by chance in a survey of ponds in Oxfordshire and is not in any existing area of known conservation interest. In many ways it is astonishing that this site has maintained its interest at all, because with the exception of a buffering belt of scrub, the pond is completely surrounded by conventional, intensive arable farmland.

### **Survey timing**

With temporary ponds, it is particularly important that surveys are undertaken at the right time of year. For plants and aquatic invertebrates this usually means in the spring when the ponds are wet, or a little later when they are drying down and still damp. Semi-terrestrial invertebrates may need to be surveyed later in the year, but for most species the worst time to survey temporary ponds is in late summer when many of the uncommon wetland species will often have disappeared without trace. For example, the Biodiversity Action Plan species tassel stonewort grows in temporary ponds and pools from about November through to April, with late March usually the optimal growth period. Once the water has dried up the plants rapidly break down and become completely undetectable except as spores in the soil.

### **Using survey data to determine the management strategy**

Once biological data are available from a pond it is clearly important to use these data to focus the management strategy. This normally means that management strategies for temporary ponds need to be designed on a site-by-site basis. It is particularly important to avoid the application of standard prescriptions such as

"clear out half of the pond at a time" or "maintain one-third vegetated, two-thirds open water". Such prescriptions take no account of the structure of the site or the distribution and habitats of species within the pond and so increase risk of damage.

For example, the management needed to maintain a temporary pond for natterjack toads is quite different from that needed to maintain populations of bare-ground, non-competitive, annual temporary plants such as tassel stonewort (Beebee & Denton 1996; Williams et al. 2001b). Natterjack management is typically focused on reducing predator density to allow tadpoles to recruit in reasonable numbers. In the case of rare annual plants the main objective is commonly to prevent excess growth of competing, perennial plants by employing disturbance mechanisms such as grazing by livestock.

### **The main principles of temporary pond management**

Inevitably, one of the most important objectives of temporary pond management is to maintain the appropriate hydrology and hydroperiod of the pond (i.e. how long the pond holds water). It is important to distinguish long-term - often anthropogenically driven - changes in hydrology, from natural variation. The hydroperiod of all temporary ponds inevitably varies somewhat between years, depending on vagaries of the climate. Such shifts will usually favour some species over others in individual years but they are not likely to alter the fundamental ecology of the site. What should be avoided are much longer-term or more permanent, and usually man-made, changes in hydrology. These can result either from too much water or too little. Surface drainage for agriculture and the prevalence of lower groundwater tables in many areas have undoubtedly resulted in the loss of large numbers of temporary ponds, but *raised* water levels are now as much of a threat, often as a result of mistaken attempts to "save" ponds that are apparently "drying out". It is still not widely understood that a pond with no water can be good for aquatic wildlife and, therefore, that ponds which have dried up are not lost ponds. As a result, topping temporary ponds up or connecting them to streams or ditches, is common. Unfortunately this is particularly undesirable because in many parts of lowland Britain the inflows bring in pollutants to the pond as well as altering its hydrology.

A variety of changes are likely to be induced by maintaining ponds in a permanently wet condition. Sediment levels may begin to build up, particularly organic sediments, as there is reduced exposure to the atmosphere and less oxidative breakdown. Increased sediment accumulation changes the substratum of ponds and may alter nutrient regimes, potentially altering the vegetation composition and structure. Plants which have seeds that need exposure to the air to germinate, or that require bare inorganic soils to grow successfully, are likely

to be reduced in abundance. Making temporary ponds permanent also allows colonisation by animals that cannot tolerate periods of drought. Fish are likely to be a particular problem because of their impact both on the biota and the physical structure of the pond (e.g. increasing turbidity, reducing plant growth). In some ponds, maintaining permanent water may lead to an increase in pressure from waterfowl which are able to make use of the pond all year round.

Deepening of temporary ponds is equally damaging. Unfortunately, this is one of the commonest "management" responses to the drying out of ponds. Deepening a semi-permanent pond a little may not fundamentally damage it if the management is gentle and if the pond has only recently become shallow. If it has been temporary for some time, however, there is a real risk of damage to the biota. In practice, deepening can be very difficult to stop because dry ponds often look unappealing. For example in the village of Little Coxwell in Oxfordshire, a pond on the edge of the village was originally a grassy seasonal pond of rather high quality (Pond Action 1997). Local residents wanted to encourage wildlife and commissioned a survey to make recommendations about management of the pond. The survey showed that the pond had a good invertebrate fauna with some uncommon, temporary pond caddis-flies. Undoubtedly the best thing for conservation was to keep the pond unaltered, but for the parishioners ultimately aesthetics were more important. Consequently an excavator was brought in to deepen the pond and remove most of the aquatic vegetation.

A more positive example of the use of survey data comes from the village of Sound in Cheshire where, following surveys, local residents opted to make only very small changes to a long-established temporary pond which supported a population of the mud snail *Lymnaea glabra*, a Red Data Book species. At this site a small amount of recently accumulated sediment was removed so that the pond held water for a little longer during the year. However, although the hydroperiod was lengthened slightly, the pond still dried out in summer, ensuring that the overall character of the pond was unchanged and that, specifically, populations of the mud snail were retained.

One option when faced with the management of a shallow, temporary pond is to leave the site alone, and create another deeper, more permanent pond nearby to add to the range of habitats available. This is a laudable and often valuable aim, but should always be used with caution. For example, at Ravenglass Dunes in Cumbria, an important site for natterjack toad *Bufo calamita*, creation of semi-permanent ponds near existing temporary ponds led to increases in the abundance of common frog *Rana temporaria* and great crested newt *Triturus cristatus*. Unfortunately, these two species are, respectively, competitors with and predators on natterjack toad larvae, so that in this location the creation of deeper ponds had negative effects on the population of natterjack toads (Brian Banks, personal communication).

### **Managing shade and trees around temporary ponds**

When making decisions about managing vegetation and shade in temporary ponds, doing the right thing can be difficult. Again the best guide is specific information about the site, rather than blanket recommendations.

It is certainly true that removing vegetation or shade from temporary ponds is not automatically beneficial or necessary. However, it is hard to be prescriptive because many temporary pond animals thrive in dense vegetation (e.g. newt larvae, many water beetles) or utilise shaded temporary ponds (e.g. the diving beetles *Hydroporus neglectus* and *Agabus chalconatus*). Indeed, many high quality temporary ponds in semi-natural areas are characterised by dense stands of aquatic and wetland plants.

Equally, though, one of the features of temporary ponds is that when they are drying down and are still soft and muddy, a very low level of poaching by animal hooves (or disturbance by vehicles) will create a lot of bare mud. For many of our most uncommon plants like three-lobed crowfoot *Ranunculus tripartitus* and tassel stonewort, the combination of temporary water *and* bare ground (which reduces competition from other plants) is essential. The key to successful management, therefore, is to identify the species present in the pond, and understand and mimic the traditional regimes (like grazing) under which these species thrive best.

### **Maintaining a non-intensively managed catchment**

A non-invasive form of management, which is almost always benign, is to keep a non-intensively managed catchment around the pond. The DETR Lowland Pond Survey showed that temporary ponds in the lowland countryside are of a considerably poorer quality than those in semi-natural areas (Nicolet 2001). There is little doubt that water quality plays a major part in this. Any temporary pond that has a non-intensive landscape around it has, therefore, a very valuable asset which will both intercept pollutants and provide a habitat for animals like water beetles, dragonflies and amphibians which make use of the pond surroundings as well as the pond itself.

The temporary pond at Fringford in Oxfordshire noted above (Fig. 1a) provides a good example of the value of a buffer zone in helping to protect a pond. A small buffer of scrub around this pond, about 10 m wide, separates the pond from the surrounding arable farmland which is intensively managed, and this clearly helps to protect the site. Although protection of the entire catchment of this pond (which is probably less than 50 ha) would be better, this does indicate how quite a small buffer zone around a pond can have a beneficial effect in some circumstances.

### **Creating temporary ponds**

With comparatively few temporary ponds in the countryside, making new temporary ponds is an effective way of maintaining the biodiversity resource provided by these vulnerable habitats (Williams et al. 1998). Creating new ponds not only simulates the natural processes of pond creation that have occurred for thousands of years but, with careful siting, can enable designers to locate ponds in areas where they can be protected from pollution in the long-term.

To date there are relatively few examples where temporary ponds have been created. In the following sections three examples are given: two where temporary ponds were a deliberate part of habitat creation, and one where they were an accidental by-product of river restoration. Together they illustrate both the value of creating temporary ponds and some of the practical lessons that have been learnt.

#### **Example 1: Pinkhill Meadow, Oxfordshire**

Pinkhill Meadow is a 2.5 ha complex supporting a range of ponds located on the floodplain of the River Thames near Oxford. As a floodplain site, Pinkhill is a good example of a location where it was appropriate to create a mosaic of both permanent and temporary waters, and the final site contained a mosaic of over 40 temporary, semi-permanent and permanent ponds. The site was constructed over a two-year period in 1990-91 in a project jointly funded by Thames Water and the Environment Agency, with design advice from The Ponds Conservation Trust.

Over the last 10 years, Pinkhill's network of temporary ponds has proved to be increasingly valuable as the site has aged, because the ponds have distinctive communities, adding to the biodiversity of the site as a whole, and because some plants (like the water crowfoots) that were widely spread around the site in the first few years after construction, are now found only in the smaller temporary ponds. The latter have maintained the type of disturbance regime, with bare substrata, that the plants often need, whereas other more permanent ponds have become dominated by organic sediments. As a result, it appears that temporary ponds at Pinkhill are maintaining some species of plants at the site which would otherwise have become extinct after the early colonisation phase.

Creating temporary ponds at Pinkhill was relatively easy; holes dug in the impermeable alluvial clay of the Thames floodplain soon filled with water. Catchments for temporary ponds in these locations can be surprisingly small - for a small pond with an area of 10 m<sup>2</sup>, no more than 100 m<sup>2</sup> of catchment is needed to provide some water for annual wetting.

### **Example 2: Greenham Common, Berkshire**

Greenham Common is the site of the former United States Airforce base at which cruise missiles were based from 1983 to 1991. Formerly an extensive area of heathland, since the end of 2000 it has been opened to the public, following a major restoration project to remove the concrete runways and restore heathland habitat. The whole site, which is about 600 ha in area, is designated as a Site of Special Scientific Interest.

Heathlands, like Greenham Common, which are located on the tops of sand and gravel ridges are not areas where you would naturally expect to find permanent ponds. However, temporary ponds would be a natural habitat in such areas, and since 1999 The Ponds Conservation Trust has been involved in trying to recreate temporary ponds at Greenham, with support from the Greenham Common Trust.

An initial inspection of the site indicated that water was already standing in some places (Fig. 1b) although it was not always evident why. Certainly any holes dug on the site immediately went through to porous and very coarse gravels which did not hold water. The answer came from looking at the ponds which had formed during operations to remove the concrete runways. It became clear that these were often located near gravel spoil heaps or in the lowest spots in bare areas of gravel. Further investigation on the site revealed that the gravel matrix naturally contained very small amounts of fine silt, and rainwater was washing these out of the gravel to create sealed basins - a pond lining - next to the gravel heaps or at the bottom of low slopes. These shallow basins retained sufficient water to form temporary ponds.

Having made this observation, it was straightforward to create further temporary ponds in depressions or other areas with a large catchment that would be sure to receive an extensive surface runoff from bare gravels and, therefore, bring in sufficient silt to line the new pools. Perhaps the most interesting outcome of this work was the demonstration of a previously unreported mechanism by which temporary ponds can form, even in apparently extremely free-draining substrata. Since large areas of southern England have free-draining glacial gravels similar to those found at Greenham, our observations suggest that this mechanism for creating ponds could have been naturally widespread in many postglacial landscapes.

### **Example 3: Coleshill river restoration demonstration site, Oxfordshire/Wiltshire**

The Coleshill river restoration scheme, on the Oxfordshire/Wiltshire boundary near Swindon, was undertaken in 1995 by a large consortium of organisations co-ordinated by the River Restoration Centre, 50% funded by a European Union LIFE grant. Since 1994, we have been closely involved in monitoring the

progress of this site.

Like many river restoration projects, the Coleshill scheme focussed mainly on the river channel. In this case the primary objective of the project was to recreate the meander bends in the river. No permanent or temporary ponds were deliberately created as part of the work, although this would have been appropriate. However, some temporary ponds appeared in depressions remaining after the works were completed alongside the river, and in areas of piled spoil.

In winter 2000-01, we looked at the invertebrates in these temporary ponds and in adjacent areas of the restored river channel. The results of this comparison were quite surprising. In standard 3-minute hand-net samples the number of macroinvertebrate species was similar for both the ponds and the adjacent river, with about 20-25 species in each. However, whereas the river had no uncommon invertebrates, the tiny temporary ponds held at least eight nationally scarce species. Perhaps even more interesting, when these ponds were classified together with other similar data collected from the river and surrounding catchment in the same year, it was clear that their communities were completely different from those in the river, despite the fact that they were within 10-20 m of the channel and had been flooded by the river about one week before the survey.

Observations such as these seem to confirm that if restoration schemes like the Cole are undertaken, there is considerable benefit in including Stillwater systems, like temporary ponds, within the restoration scheme. With very little extra effort, adding these habitats as part of the restoration can add considerably to the value and biodiversity of the restored area.

## **Conclusions**

Adequate management of temporary ponds requires first that they are recognised as valuable habitats, constituting important conservation sites for rare plants and animals. This process is now taking place as land managers, policy makers and others begin to recognise the existence of temporary ponds, after many years of neglect.

Once recognised, they can be managed by employing a mixture of general principles, focussed particularly on maintaining their hydrology and water quality, supplemented by species-level survey data which will help to determine specific management requirements.

In addition to protecting existing sites there are likely to be considerable benefits in recreating temporary ponds and there are enormous opportunities for this work. It is now clear that temporary ponds would naturally be very common in many landscape-types (Williams et al. 2001a), and putting them back into the landscape can be both an appropriate and cost-effective component of restoration schemes.

A careful combination of these two approaches, combining management and

restoration, will ensure that existing sites are protected and also that populations of temporary pond species can be strengthened after centuries of decline.

## References

- Beebee, T. J. C. & Denton, J. S. (1996). *The natterjack toad conservation handbook*. English Nature, Peterborough.
- Biggs, J., Corfield, A., Walker, D., Whitfield, M. & Williams, P. (1994). New approaches to the management of ponds. *British Wildlife* 5, 273-287.
- Bratton, J. H. (1990). Seasonal pools: an overlooked invertebrate habitat. *British Wildlife* 2, 22-29.
- Collinson, N. H., Waker, D., Biggs, J., Corfield, A., Whitfield, M. & Williams, P.J. (1993). A new British record for *Haliplus furcatus* (Seidlitz). *Latissimus* 2, 13.
- Collinson, N. H., Biggs, J., Corfield, A., Hodson, M. J., Walker, D., Whitfield, M. & Williams, P. J. (1995). Temporary and permanent ponds: an assessment of the effects of drying out on the conservation value of aquatic macroinvertebrate communities. *Biological Conservation* 74, 125-134.
- Foster, G. F. (2000). *A review of the scarce and threatened Coleoptera of Great Britain. Part 3. Aquatic Coleoptera*. Joint Nature Conservancy Council, Peterborough.
- Griffiths R. A. (1997). Temporary ponds as amphibian habitats. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 7: 119-126.
- Grillas, P. & Roche, J. (1997). *Vegetation of temporary marshes*. Conservation of Mediterranean wetlands series (eds J. Skinner & A. J. Crivelli). Tour du Valat, France, 86 pp.
- Nicolet, P. (2001). Temporary ponds in the UK: a critical biodiversity resource for freshwater plants and animals. *Freshwater Forum* 17, 16-25.
- Pond Action (1997). *An ecological survey of the pond at Little Coxwell, near Faringdon, Oxfordshire*. Pond Action, Oxford.
- Williams, P. J., Biggs, J., Barr, C. J., Cummins, C. P., Gillespie, M. K., Rich, T. C. G., Baker, A., Baker, J., Beesley, J., Corfield, A., Dobson, D., Culling, A. S., Fox, G., Howard, D. C., Luursema, K., Rich, M., Samson, D., Scott, W. A., White, R. & Whitfield, M. (1998). *Lowland Pond Survey 1996*. Department of Environment, Transport and the Regions.
- Williams, P., Biggs, J., Whitfield, M., Thorne, A., Bryant, S., Fox, G. & Nicolet, P. (2000). *The pond book. A guide to the management and creation of ponds*. The Ponds Conservation Trust, Oxford.
- Williams, P., Biggs, J., Fox, G. Nicolet, P. & Whitfield, M. (2001a). History, origins and importance of temporary ponds. *Freshwater Forum* 17, 7-15.
- Williams, P., Davis, R., Hutchinson, N. & Lane, P. (2001b). *Species Action Plan for tassel stonewort (Tolypella intricta)*. Plantlife, London.