# The effectiveness and cost efficiency of different pond restoration techniques for bearded stonewort and other aquatic taxa

Froglife's *Second Life for Ponds* project, funded by SITA Trust's Enriching Nature Programme, looked at different pond restoration techniques for aquatic taxa at Hampton Nature Reserve in Peterborough. The site covers 126ha and consists of a series of over 300 ponds and their corresponding spoil heaps. It supports 10 species of stoneworts, including the critically endangered bearded stonewort *Chara canescens*, which has declined dramatically since new pond creation ceased. The ponds also support exceptional assemblages of aquatic invertebrates and the largest extant population of great crested newt *Triturus cristatus* in Great Britain and possibly in Europe, estimated as up to 30,000 adults. The site is designated as a Site of Special Scientific Interest (SSSI) and as a Special Area of Conservation (SAC).

## Second Life for Ponds

The aims of the project were: to implement the restoration and creation of ponds for the recolonisation of bearded stonewort *Chara canescens*; to monitor changes within the important existing non-target taxa (other aquatic plants and stoneworts, aquatic invertebrates, great crested newts and water voles); to evaluate four different pond management techniques in terms of their effectiveness for bearded stonewort *C. canescens* recolonisation, their side-effects on the non-target taxa, their effect on water and substrate chemistry, and how these correlate with target and non-target taxa, the cost-effectiveness of each restoration technique, considering both bearded stonewort *C. canescens* independently and the holistic effects of restoration on non-target taxa; to disseminate the results of the project and encourage land managers to use proven evidence-based conservation techniques.

The methodology, conducted between Autumn 2008 and Spring 2010 with monitoring at three-monthly intervals, combined practical habitat management with research and required 15 ponds in total. After initial baseline water quality and species surveys, the following restoration methods were undertaken in each of the three main clusters, scraping the sediment and vegetation back to bare clay: **partial manual clearance** with the assistance of volunteers (15 metres of the pond edge); **partial mechanical clearance** with an excavator (15 metres of the pond edge); **complete mechanical clearance** with an excavator. In addition there were **control ponds**, where no management was applied, and **new ponds were created**.

## Pond restoration on Hampton Nature Reserve: Conclusions

Complete clearance is best where pond restoration is primarily targeting *Chara canescens*. In this experiment it had the highest success rates (100%) and once present the species persisted throughout the survey period. This management technique also had the greatest effect in rejuvenating the stonewort community and aquatic plants generally. In the context of Hampton Nature Reserve, with many ponds of mid-late succession, complete restoration does not appear to negatively affect other important taxa and is beneficial overall. This illustrates the principle of maintaining through management a mosaic of habitat structures, which in this case are levels of pond succession.

## Cost-effectiveness of pond restoration methods

The cost-effectiveness relationship was explored through two main choices: partial mechanical vs. complete mechanical restoration, and volunteer (manual) vs. mechanical (contractor) restoration. Capital costs are relatively high but fixed, so while bigger projects accrue greater running costs they also become more cost efficient. This is also true when complete restoration is weighed against partial restoration. Both capital and running costs are lower for manual restoration, but it is a more lengthy and arduous task, becoming unfeasible with increased ponds or area; mechanical restoration is more efficient per unit of labour-hour (especially for larger projects).

Effectiveness is linked not to efficiency but to the results of the restoration work. On Hampton Nature Reserve the most effective technique for *Chara canescens* restoration, even taking into account impact on other taxa, is complete restoration. However, effectiveness will always be site-specific, weighing different interests against each other, hence the need to rely on principles and surveys rather than simple formulae.

## KEY FINDINGS

### Bearded stonewort

Initial results indicate that recolonisation following partial pond clearances does not persist for longer than a year, suggesting that if this restoration method is used a frequent management cycle would be required. On the other hand, *Chara canescens* has persisted for the full survey period in both newly created and completely restored ponds; as terrestrial habitat is locally scarce on Hampton Nature Reserve complete pond restoration is the optimum management strategy for *Chara canescens*.

### Aquatic plants and stoneworts

The pre-existing flora survived or recolonised remarkably well following management: only two species (both algae) were lost, neither of which were of conservation concern. Both partial and complete restoration appeared to boost stonewort species richness, although this boost was only truly sustained in completely restored ponds. Traditional advice regarding pond restoration for plants recommends restricting management to partial clearances in order to balance the potential losses to perennial plants with the benefits to annual aquatic plant communities such as stoneworts. However, where these latter communities are the dominant interest and the majority of aquatic vascular plants are either unaffected by, or even gain from, greater intervention, as was the case on Hampton Nature Reserve, then complete restoration should be favoured.

### Aquatic invertebrates

Habitat management led to considerable species loss, including substantial numbers of scarce species. Alongside the losses, however, habitat management has led to species turnover by creating opportunity for early succession and open structure species not found in more established ponds; this includes three which are Nationally Scarce and 20 not recorded from any of the ponds prior to management.

The benefits of complete clearance must be balanced against the losses of existing interest; in any isolated pond containing the level of invertebrate interest found here prior to management, or any pond in an old wetland or pond complex that might contain poorly mobile species, complete clearance would be unthinkable. If management is considered for invertebrates alone the default recommendation would remain, as usual, management for steady state conditions if possible. Complete restoration is uniquely viable on Hampton Nature Reserve due to the vast reservoir of later succession ponds. Where this does not apply, rotational partial clearance is the next preferred option. New pond creation should provide similar opportunities, but to date new ponds have not performed as well as completely restored ones.

### Great crested newts

Newts appeared to be unaffected by partial manual restoration and benefit from partial mechanical restoration, but contrary to expectations complete clearance did not seem to have a negative impact.

### Water voles

The only taxon studied which was unequivocally negatively affected by complete restoration was the water vole, which was absent from completely restored ponds. However, as water voles hold territories on a larger scale than individual ponds they can withstand the loss of individual ponds, so long as the number and density of ponds completely restored in a single area is limited.

**The full report and associated appendices, as well as an executive summary, are available to download from www.froglife.org/hnr/secondlifeforponds**

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