Dig (clean) ponds to save freshwater biodiversity: policy and practitioner briefing note

New research, published in April 2020, has provided striking evidence of the benefits of making new clean water ponds (CWPs) for reversing catchment-wide declines in freshwater biodiversity. The research was published in the journal Biological Conservation and has important practical implications for the management of freshwater biodiversity generally. The results support many other observations of the exceptional value and impact of ponds, despite their small size. This paper summarises the key practical points.

The link to the journal is here:
https://www.sciencedirect.com/science/article/abs/pii/S0006320719310626.

Please contact Penny Williams for a pdf copy at pwilliams@freshwaterhabitats.org.uk.

UNIVERSITY of York

Game & Wildlife CONSERVATION TRUST
The Allerton Project

Freshwater Habitats Trust

Environment Agency

This report is an output of the Water Friendly Farming project

What we learnt from the project: summary

Perhaps the most important finding of the research was how strikingly large and fast the positive response was resulting from clean water pond creation. At a time when most freshwater news is gloomy, ponds are a powerful vehicle for positive gains, with an impact out of all proportion to their size. In contrast, most catchment work to date (diffuse pollution control, river restoration) has had limited, or no, impact on freshwater biodiversity, or needs decades before any effects seem likely to occur[1].

The new research has important practical implications for reversing declines in freshwater biodiversity. In particular, the work provides further evidence of the exceptional value of ponds as a keystone habitat in maintaining freshwater biodiversity.

A central point of this observation is not so much the importance of the ponds themselves (though they can be very rich habitats), but that they are a vehicle for reliably bringing back clean water into landscapes and catchments when pollution is so widespread.

- Creating new CWPs can help to reverse – not just halt – freshwater biodiversity loss across the landscape.
- The new ponds didn't just protect against loss of pond species, but species from all freshwater habitat types.
- With urgent action needed to address climate change and other threats to freshwater biodiversity, creating new clean-water ponds can provide oases (and reduce between-waterbody distances) helping plants and animals to move across the landscape.
- Ponds pack a big bang for your buck – making just 20 CWPs was enough to increase freshwater plant biodiversity by over a quarter across a 10 km^2 area.
- Good news: amid the depressing news of continued loss of freshwater biodiversity, the work shows that there is something that we can do to make things better, immediately, for freshwater.

Key results from the project

Importantly the project found ***unprecedented and rapid increases in whole landscape freshwater biodiversity*** just from making clean, unpolluted ponds (CWPs). In the course of the 9-year project, which is still continuing, we found that creating just 20 clean water ponds across a 10 km^2 area of farmland increased the number of wetland plant species by more than a quarter (26%). Achieving this gain required a very modest land-take with less than 3 ha of pond surface area needed in the 1,000 ha project area (0.3%).

The number of regionally rare plants almost trebled (a 181% increase). Species that were largely extinct in the wider countryside returned once more.

Key results of the project were:

- The benefits gained from making ponds was greater than gained using any other enhancement method.
- Ponds with multi-uses (e.g. ecosystem services ponds used for intercepting pollutants and storing water), helped to increase biodiversity a little (i.e. compensated for some of the recent loss - see below), but did not compensate for loss of uncommon species. The

[1]Catchment Sensitive Farming Evaluation Report – Water Quality Phases 1 to 4 (2006-2018) (NE731). http://publications.naturalengland.org.uk/publication/4538826523672576.
"Up to now, most lowland stream restoration projects were unsuccessful in terms of ecological recovery" - dos Reis Oliveira et al. (2017) https://onlinelibrary.wiley.com/doi/pdf/10.1002/rra.3465

polluted ponds were not responsible for the large, 26%, increase in species diversity; this depended on CWP creation.

- This is the first study of biodiversity change across all waterbody types in the countryside; most other studies consider only one waterbody type (usually rivers, sometimes lakes) which often over-emphasises the significance of small changes.
- Freshwater biodiversity - in the absence of our practical interventions - declined in the landscape studied over the course of the previous 9 years (assessed using wetland plant species, a good surrogate of overall freshwater diversity[2], and considering all waterbody types in the area). We believe this is a typical result as the study area is representative of a large part of lowland England.
- Ponds were a linchpin habitat – they supported the most freshwater species and most rare species of all the freshwater habitats in the project area. Rather than being a minor part of the freshwater system, they are a critical part.
- Changes in pond biodiversity had a key impact on the total freshwater biodiversity in the catchment.
- There was anecdotal evidence that the new ponds acted as stepping-stones, helping species colonise existing ponds (e.g. Mare's-tail *Hippuris vulgaris*, Small Pondweed *Potamogeton pusillus*).

Interestingly, existing ponds that were also managed did not improve catchment wide diversity, mainly because the management did not improve their water quality.

The work ***contrasts strikingly with the effects of other catchment management studies*** which have shown little effect as a result of land management measures intended to protect freshwater wildlife (e.g. by reducing diffuse pollution). In the UK, for example, a recent review of Catchment Sensitive Farming showed that after 10 years there had been no effect on freshwater biodiversity (see Footnote 1).

In the present study, the effect on biodiversity is an order of magnitude greater than seen in most other studies which, to date, have shown little or no change in landscape level biodiversity, or only promise changes in the future. Equally, the results were much more rapid than most river restoration projects, which also generally have little impact (see Footnote 1).

CWP as a nature-based measure

Clean Water Ponds are an example of a nature-based measure. Nature-based measures are often assumed to be automatically beneficial for biodiversity even though there is not much concrete evidence to support this belief. The present study provides important ***evidence of what nature-based measures can, and can't***, achieve in the protection of freshwater biodiversity:

- Nature-based measures which trap and treat polluted water ***don't provide much biodiversity gain***. The present study shows that the polluted features provided only low quality additional habitat (notwithstanding whether they reduced pollution levels), supporting species which were common in other parts of the landscape. They did, however, provide some biodiversity benefit by adding enough new species to stop the ongoing background decline in landscape level diversity which occurred in their absence.

[2]One recent example of the effectiveness of wetland plants as indicators of overall freshwater diversity is https://onlinelibrary.wiley.com/doi/abs/10.1111/fwb.13369. There are many other examples.

- Ponds are a critical part of the water landscape: in the landscape studied the ponds supported the largest part of the wetland plant diversity. What happens to ponds had a disproportionate influence on the landscape freshwater biodiversity. Considering these factors, ponds are a linch-pin habitat for landscape scale freshwater biodiversity. The project area was not unusual – the land types in the project area are representative of about 1/3rd of lowland England so the results probably have wide relevance.

About clean water ponds

- Clean-water ponds can be made in many places – they just need to be (i) isolated from ditches or streams which are usually polluted and (ii) surrounded by land where no pollutants are added (e.g. unimproved grassland, woodland, heathland). They can be made in agricultural or urban areas if they have a wide buffer around them. ***Evidence from North America and empirical evidence in the UK suggests >50m is probably about enough***. Smaller buffers probably aren't good enough – recent literature reviews show that buffer less than 50 m are very unpredictable; sometimes they work, sometimes they don't. Certainty of effectiveness increases substantially above 50 m[3].
- It's ***vital not to dig up existing high quality habitat*** to make CWPs (there are a few special exceptions, like turf pits). There are lots of examples of 'new' ponds being carelessly dug in bits of existing wetlands. Britain has no shortage of degraded and disturbed ground where new ponds are a substantial improvement on what is there now. But don't forget that disturbance is itself a natural phenomenon and may be missing from your otherwise special landscape.
- CWPs are easy and cheap to make – though like everything, people creating them can benefit from the experience of skilled and experienced pond makers (see for example the Toolkit from the Freshwater Habitats Trust Million Ponds Project). People tend to assume that making ponds is so simple, anyone can do it. In practice, this view leads to substandard decision making and substandard ponds.
- Making new ponds is a very natural thing to do – it recreates a natural process that has been going on for many millions of years.
- New ponds are needed in both high quality landscapes like nature reserves and in the wider countryside.
- (For technical audience): Making new clean-water ponds in the lowlands can help to return communities of mesotrophic and oligotrophic species (e.g. old floras show how many species needing these conditions have been lost from, or are very rare in, the southern counties).
- Finding clean water sources is essential for clean water ponds: ditches, streams and rivers, as well as field drains, are worth avoiding. There's more information here: https://freshwaterhabitats.org.uk/projects/million-ponds/pond-creation-toolkit/.
- Sites like Pinkhill Meadow, a long-term demonstration site of the Freshwater Habitats Trust, Thames Water and the Environment Agency, show that new clean-water ponds can remain exceptionally rich for almost 30 years – with otters, dragonflies and rare plants.
- CWPs can be ark sites – e.g. at Pinkhill and Cutteslowe Meadow, both in Oxfordshire, rare floodplain meadow and wetland plants from the Thames Valley are being protected.

[3]Prosser et al. (2020). A review of the effectiveness of vegetated buffers to mitigate pesticide and nutrient transport into surface waters from agricultural areas. https://www.sciencedirect.com/science/article/pii/S0301479720301456

At many nature reserves it is ponds which are the critical habitat for endangered freshwater species.

Other general conclusions from the study

1. Over the course of the study there was clear evidence of on-going wetland plant loss in the existing waterbodies, leading to a roughly 10% loss in diversity over the 9 years of the project from the landscape as a whole. The census based survey approach means that these numbers are absolute values. They would not be detected in a sample-based survey approach.
2. The results are consistent with much other data: in all lowland catchments where surveys have used statistically rigorous designs to include all waterbody types, ponds have so far always proved to be the richest habitat type for wetland plants or invertebrates (although where surveys treat floodplain ponds as a part of the river, these results may be less obvious).
3. To understand the freshwater biodiversity of sites, landscapes or catchments you need to consider all of the waters, small and big, in that landscape. They are all connected (even if not literally directly physically connected), and the small ones are often the most important biologically.
4. The Water Framework Directive is missing a trick. Stuck in a 1980s timewarp, the WFD embeds John Downing's 'saliency error': that small habitats are not important[4]. As we revise the way we protect and monitor freshwater biodiversity, we have a great chance to update our approach to protecting freshwater biodiversity by monitoring landscapes, not waterbodies.

The methods in more detail

The project **censused** wetland plant diversity in three 10 km^2 headwater catchments over 9 years. Approximately 250 sites were surveyed annually, providing a complete record in unprecedented detail, of the occurrence of wetland plants in all of the landscapes freshwater: streams, ditches and ponds. There were no waterbodies large enough to be called rivers or lakes in our study catchments.

Following a baseline assessment in the first three years of the project, land management measures were introduced to hold back water and reduce pollutant runoff installed in one catchment. In a second catchment the same 'ecosystem services' measures were added and new habitats (clean water ponds, woody debris in streams) added.

The project compared clean water pond creation with a range of more traditional measures used around the world for protecting freshwater biodiversity. This included:

- adding woody debris to streams and managing existing ponds
- damming-up ditches to create pools that slowed water runoff and trapped sediments
- building interception ponds to filter out nutrients and other pollutants
- a range of other measures to control point source pollution including emptying septic tanks throughout the catchment, re-establishing a reed bed sewage treatment works, adding a biobed to control pesticide losses and preventing livestock access to streams.

[4]Downing (2009). Global limnology: up-scaling aquatic services and processes to planet Earth. https://www.tandfonline.com/doi/abs/10.1080/03680770.2009.11923903.

Together, these measures had some biodiversity benefit; they stopped the general decline in wetland plant biodiversity that occurred in the landscapes' steams, ditches and existing ponds over the course of the 9 years. However, the 'increase' in diversity from adding polluted water habitat was an order of magnitude lower than that achieved by the clean water ponds alone.

Some key facts about ponds

Despite 25 years of growing research on the importance of small waterbodies, ponds are still thought to be trivial by most environmental scientists and policy makers. People assume they are synonymous with gardens and village greens. In fact, ponds have been made by natural processes for millennia, as well as being created by people. In Britain they occur in all landscapes from the coast to the tops of mountains.

Ponds are the most numerous of all freshwater habitats, with estimates of up to 3 billion globally[5]. In the UK, and probably elsewhere, ponds support a wider variety of species than rivers or lakes.

Ponds are almost completely overlooked in water legislation and policy (they do figure in nature conservation policy to some extent). This is part of a 100-year long assumption by freshwater biologists that ponds are not important; in practice, ponds represent a significant part of the water environment by area (around 10% by area) and often a large part of the unpolluted water in a catchment.

[5]Pond numbers globally are reviewed in Biggs et al. (2017): https://link.springer.com/article/10.1007/s10750-016-3007-0.