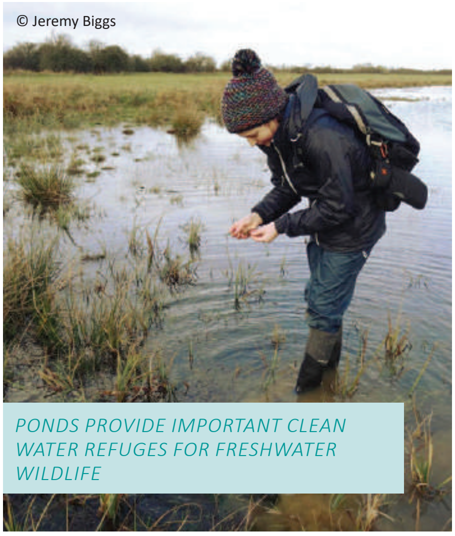
Catchment Based Approach
Partnerships for Action

BIODIVERSITY PACK
HABITAT GUIDE

PONDS

Ponds are permanent and seasonal standing water bodies up to 2 ha in area, often found 'nested' within other, larger habitat types. At the landscape scale they exhibit great diversity, including gradients of age, surface area, depth and shading. High quality ponds form significant features in certain landscapes, but even where present in lower densities, they play an important role by improving connectivity and providing clean water refuges for freshwater wildlife.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PONDS PROVIDE IMPORTANT CLEAN WATER REFUGES FOR FRESHWATER WILDLIFE

Freshwater and terrestrial wetland habitats are formed by the flow and retention of water in the landscape. Their nature is determined by landform and hydrological pathways, the characteristics of the water supply, and climatological and biological influences which generate a mosaic of rivers, lakes, ponds, wet grasslands, and other habitats of various degrees of wetness and types of hydrochemistry.

The UK Biodiversity Action Plan (published in 1994), described the biological resources of the UK which were identified as being the most threatened and required conservation action – our priority species and habitats. Detailed plans set out actions to protect and restore our threatened wildlife, and work continues today, as a key part of the delivery within **Biodiversity 2020** and the **Water Framework Directive (WFD)**. Across catchments, action to enhance habitats is intrinsically linked; with works to rivers able to benefit other freshwater habitats, and vice versa. Delivery on a catchment scale can take account of these synergies, and can look to secure opportunities to achieve biodiversity benefits across the full range of habitats present within a catchment.

WFD AND B2020 SYNERGIES: ACHIEVABLE

Ponds are largely excluded from the **Water Framework Directive** system of monitored waterbodies, but despite the absence of waterbody-specific targets, as 'surface waters' or components of dependent wetlands, their protection and enhancement remains within the objectives of the Directive. Where featured in Protected Area designations (SPAs, SACs), their protection becomes a more direct WFD target. Improvements in line with WFD such as the protection, management and creation of ponds can contribute to all targets under Outcome 1 of **Biodiversity 2020** which calls for Priority Habitats to be extended and maintained in favourable condition, degraded ecosystems to be restored, and areas of importance for biodiversity and ecosystem services to be safeguarded. Ponds are particularly important as a habitat for Priority species: indeed, 10% of all Priority species live in ponds.

Ponds are an intrinsic part of the freshwater landscape. Both man-made and natural ponds can be of high conservation value

PONDS IN A CATCHMENT CONTEXT

Ponds are an intrinsic part of the freshwater landscape, forming naturally due to geological and ecological events that create depressions where water accumulates, or through human activity (e.g. peat extraction, droving ponds, forge ponds). Both man-made and natural ponds can be of high conservation value and their physical, chemical and biological properties are more important for biodiversity than their origin.

Ponds are often seen as transient in the landscape because of their small size and the natural process of succession, yet under the right conditions, ponds can persist for thousands of years, – or even more if the ponds dry out and are grazed annually, preventing material accumulating as sediment. Examples include New Forest heathland ponds, and 'Pingos', created at the end of the last glaciation when ice lenses melted. As a typical pond ages however, it fills in through the process of succession; depending on local hydrological conditions, it can eventually become dry ground (terrestrialisation), or can turn into a fen, bog, or wet woodland. In a natural environment the pond resource would constantly be replenished with the creation of new ponds by natural landscape processes.

In high quality ponds, all stages of succession can support important plant and animal species and assemblages, and a range of pond types would naturally be found in the landscape. At one extreme, this might include old shaded temporary ponds that support rare flies, and at the other, newly excavated ponds, which provide a habitat for pioneer plants like stoneworts and specialist water beetles.

Across catchments, ponds provide important freshwater habitats, supporting both species restricted to ponds, and those found in other wetland habitats. They are an important repository, refuge and stepping stone for freshwater species, and house key components of a catchment's freshwater biodiversity.

NATURAL ECOSYSTEM FUNCTION IN PONDS

Natural water quality is the most important requirement for a pond to support a natural biological community, particularly nutrient concentrations, acidity and lack of pollutants. Water chemistry will naturally reflect the geology, soils and vegetation of a pond's catchment, determining a pond's natural trophic state, from nutrient poor to rich, as well as its pH. Acidity influences chemical and biological processes in ponds, affecting water quality and characteristic ecology. In contrast to running water habitats, low dissolved oxygen concentrations can occur naturally and many of the animals that inhabit ponds are adapted to such conditions - like water scorpions and water beetles, which have adaptations to obtain the oxygen they need for respiration from the atmosphere.

Pond substrate is generally determined by local soil type and geology. The substrate type in conjunction with the water level will strongly influence the invertebrates and fish able to live and reproduce there. For example, seasonally exposed muddy banks are important for a number of priority invertebrates and plants.

Shallow water is key for pond diversity, and generally more species are found in a few centimetres of water than in the deep water. A natural shoreline, which often includes extensive areas of shallow water, enables the development of a natural transition between terrestrial and freshwater habitats including marginal vegetation, which in turn provides habitat structure and is important for the emergence of species such as damselflies and dragonflies. Shallow, warm water is also the preferred habitat of tadpoles and fish fry.

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Most small ponds are naturally not directly connected to streams and rivers, and this hydrological isolation can result in characteristic assemblages, protected from sources of pollution in the wider catchment area. Such ponds are predominantly fed by surface water run off or by groundwater, (depending on the local geology), and their water levels fluctuate accordingly. These fluctuations are important in permanent and seasonal ponds as it creates an area neither truly terrestrial nor truly aquatic: the drawdown zone. This area can be one of the most diverse parts of the pond, and many species take advantage of the exposed substrate as water levels drop, including a range of dance flies and shore flies, whose larvae live in the mud, and a series of predatory ground and rove beetles. Many marginal plants characteristic of the drawdown zone, including species like purple loosestrife and water-forget-me-not as well as specialist bare mud species such as pillwort and bur-marigold, do not compete well with taller emergent vegetation that dominates the margins of ponds with more constant water levels and little disturbance.

Trees are a source of shade, leaf litter (food for water slater and shrimps) and woody materials (a refuge and a substrate for egg-laying). Shaded woodland ponds tend to have undeveloped plant communities, but can support a characteristic invertebrate assemblage including specialist beetles and dragonfly larvae. Open ponds, relatively unshaded by trees or with dappled shade, tend to have a diverse plant community including submerged, floating, emergent and marginal vegetation. Such vegetation-rich ponds provide an excellent habitat for animals which are often found in abundance, including amphibians and macro-invertebrates like water beetles, dragonflies, damselflies and water snails. Plants have many functions in a pond: they are a refuge from predators, a source of food, a support to emerge from, and a substrate for egg-laying.

Some species are pond specialists, restricted to this habitat alone, whilst others may also inhabit lakes and running

TEMPORARY PONDS CAN SUPPORT RARE INVERTEBRATES AND GOOD POPULATIONS OF AMPHIBIANS

AT A GLANCE GUIDE PONDS

Standing waters steadily infill, but if organic material is prevented from building up, succession can be slow; **Norfolk's pingos,** for instance, are **MORE THAN 8,000 YEARS OLD**

Many ponds support lush vegetation: **SPIKED WATER-MILFOIL** and **YELLOW WATER-LILY** are typical of **deep water**, while **SOFT RUSH** and **YELLOW IRIS** are characteristic of **marginal areas**

If **water levels alter seasonally**, species like **DANCE FLIES, SHORE FLIES** and **ROVE BEETLES** take advantage of the exposed mud

Ponds provide connectivity as part of the wider freshwater 'patchwork'. Species such as birds, amphibians and invertebrates use these waterbodies as **STEPPING STONES ACROSS THE LANDSCAPE**

waters or use both freshwater and associated terrestrial habitats. Some pond species are highly mobile and can move between ponds, taking advantage of resource availability as it occurs. Ponds are an important part of the wider freshwater network; many birds, amphibians and invertebrates use different water bodies as stepping stones across the wider landscape. This highlights the importance of protecting and managing all the different types of aquatic habitats at the landscape scale, and ensuring organisms can move between them, in order to protect aquatic biodiversity.

PRESSURES ON OUR PONDS

Ponds are often lost as a result of human impacts such as **drainage and infilling**. Those which persist can be seriously damaged by pollution, high sediment loads, hydrological and morphological modification, and by non-native species.

Nutrient enrichment can lead to increases in phytoplankton and reductions in water clarity and plant growth. Dead organic matter then accumulates, and is broken down by bacteria which use up oxygen, reducing its availability to other pond species. Increased temperatures and longer growing seasons may intensify these symptoms, meaning that climate change could disproportionately affect ponds, which are more susceptible to warming. Nutrient enrichment also gives a competitive advantage to some plants, like blanket weeds, bulrush or Nuttall's waterweed, which become dominant, leading to a loss of diversity.

Ponds of the uplands continue to experience acidic conditions due to **air pollution** where historically deposited sulphur is still being leached from soils. pH is recovering very slowly, although some acid-tolerant species are being replaced by species not present previously, perhaps due to climate change.

Other pollutants such as pesticides and heavy metals can also impact upon pond biodiversity. Ponds connected to water courses are likely to receive more pollutants than those which are hydrologically isolated and which have mainly semi-natural habitats in their catchment, like unimproved grassland or woodland.

Groundwater abstraction or land drainage can lower water levels, leading to pond loss or a reduction in pond extent. In particular, the draining of large peat bodies has led to a reduction in small dystrophic (peat-stained) pools. Ditch blocking for peatland restoration creates multiple new small standing waters; these appear to have a similar biological assemblage to natural ponds, but their long-term persistence is unknown.

Increased sediment and nutrient loads, lack of grazing, and drainage or abstraction can all accelerate successional processes, potentially leading to **terrestrialisation**. This, combined with deliberate infilling and the lack of natural pond-creating processes in the contemporary landscape, is resulting in a decline in the number of (particularly early successional) ponds. This process is exacerbated in ponds connected to watercourses as they receive higher nutrient and sediment loads.

In intensively-managed agricultural areas, **changes in land-use practices**, and particularly the conversion of grazed land to arable and the lack of active pond management, has led to a more uniform and reduced pond resource, with many ponds becoming shaded and silted up. In less intensively-managed areas, the maintenance of grazing and active management has kept a wider range of pond types present.

Invasive and **non-native species** can damage pond habitats and may have direct predatory or competitive impacts upon other species. Water bodies which are hydrologically connected are more likely to receive invasive species, as are ponds popular with visitors, indicating our role as vectors of dispersal.

Climate change will further disproportionately affect ponds as predicted drier, warmer summers contribute to pond loss and extreme rainfall events deliver increased nutrient and sediment loads. However, ponds can be created relatively easily & cheaply, presenting opportunities to compensate for ponds lost and to protect freshwater wildlife across catchments.

KEY PRESSURES ON PONDS

POLLUTION:
Air pollution and heavy metal and pesticide leaching impact negatively on pond biodiversity, particularly affecting rare species

ENRICHMENT:
Nutrient enrichment can lead to increases in phytoplankton and dead organic matter, which reduces water clarity, plant growth and oxygen supply

ABSTRACTION:
Abstraction of groundwater lowers water levels, leading to pond loss or reduction, and is a particular issue for peatland pools

MANAGEMENT:
Increased sediment loads, infilling, a lack of grazing and poor management can accelerate succession and lead to terrestrialisation

HABITAT LOSS:
Terrestrialisation and changes in land-use practices result in the loss and degradation of ponds and their associated habitats and species

INVASIVE SPECIES:
Non-native and invasive species can impact characteristic biological communities through direct competition or the alteration of habitats

KEY MANAGEMENT MESSAGES

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NEWLY CREATED PONDS PROVIDE HABITAT FOR PIONEER PLANTS LIKE STONEWORTS, BEFORE OTHER SPECIES COLONISE

- ## RESTORATION OF NATURAL PROCESSES

Measures that seek to restore natural processes – natural water quality, sediment and hydrological regimes – are an important component of pond restoration. Practitioners should seek to understand the pond 'landscape' as it would operate under natural processes and plan from that foundation, factoring in implications for related adjoining habitats. Whilst natural processes will play a role in pond *creation* (such as where water pools behind a fallen tree), to ensure the conservation of early successional pond species, in particular, will typically also require the *construction* of new ponds (see also 'Succession').

- ## LARGE-SCALE PERSPECTIVE

The condition of a pond depends in part upon what is happening in its surroundings - it is not only about addressing direct impacts within the pond itself. Restoring natural water quality, sediment and hydrological regimes will address impacts from within a pond's catchment.

- ## TAKING ACTION IN THE RIGHT ORDER

Within-pond management interventions aimed at reducing nutrient concentrations, such as sediment removal or biomanipulation, will not deliver the greatest possible biodiversity benefits unless inputs to the pond and its catchment are tackled first.

- ## TAKING THE LONG VIEW

Whilst active restoration may be needed to trigger recovery in some ponds, taking a longer-term approach allows natural recovery to play the fullest role possible. For instance, legacy levels of sulphur and nitrogen will decrease in the catchment soils of ponds recovering from acidification. A long-term vision encourages management decisions which are more sustainable, particularly if the seemingly 'immovable' socio-economic constraints of today may be resolved in the longer term. This approach enables the creation or management of ponds over time, resulting in a diverse pond landscape with ponds at various stages of succession.

- ## SPECIES MANAGEMENT

Species introductions are rarely necessary as ponds are colonised naturally, however any introductions or removals are most likely to be successful after pressures on the habitat have been addressed, or in clean water ponds specifically created to provide suitable habitat for plants and animals of conservation concern.

PONDS POPULAR WITH VISITORS ARE MORE LIKELY TO BECOME COLONISED BY INVASIVE PLANTS AND ANIMALS

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WHERE LAND IS AVAILABLE, NEW CLEAN WATER PONDS CAN BE CREATED TO REPLACE THOSE LOST TO SUCCESSION

• RATIONALISING CHANGES IN SPECIES DISTRIBUTION AND ABUNDANCE

The current distribution of many rare (and more common) pond species is limited as a result of previous habitat loss or degradation. Plans for species conservation and ecosystem restoration should therefore take into account the (positive and negative) implications for species of the restoration of natural processes, and of climate change. Suitable habitat needs to be maintained or created to prevent local or regional extinctions and to aid species recovery. Direct management, including reintroduction, can also be considered to assist in the transition to restored environmental conditions.

• SUCCESSION

Tackling increased sediment and nutrient loads is inherently more sustainable than repeatedly removing sediment to halt succession. Where natural succession/infilling produces new habitats of conservation value, it may be most appropriate to allow this to happen. New clean water ponds can be created to replace those lost to succession, and is particularly successful in semi-natural landscapes. In intensively managed agricultural landscapes where there is potentially less land available for pond creation, active management of the pond resource, involving partial scrub and sediment removal, can ensure that early successional ponds and the biodiversity they support remain part of the landscape. In such cases, a good understanding of the biodiversity that ponds support (including late successional species) should inform any management decisions.

• SEASONALITY

Natural hydrological regimes should be maintained and high quality temporary ponds should be protected from deepening. Seasonally exposed muds support an array of characteristic plants and animals, but can be destroyed by modifications such as drainage, infilling, deepening and inappropriate use of the drawdown zone. Natural water-level fluctuations are essential for their persistence and should be maintained.

• WATERSIDE VEGETATION

Important in its own right, semi-natural waterside vegetation is also a key part of a fully functioning hydrosere, providing habitat for characteristic fauna, stabilising margins and reducing nutrient and sediment loads. Tree roots and woody debris are particularly important for many invertebrates, and tree cover provides shade, protection from wind, and can mitigate against rising air temperatures. Fencing should be avoided where livestock grazing intensity can be reduced to suitably low levels that avoid heavy damage. Alternatively, set-back fencing should provide a sufficiently wide zone to allow the development/maintenance of the hydrosere, with access for periodic grazing or manual management.

• UNDERSTANDING THE LOCATION OF EXISTING FRESHWATER BIODIVERSITY

To maximise the benefits of restoration work, and eliminate damage to priority or endangered species, it is important to obtain a clear picture of the distribution of local freshwater biodiversity, (indeed, this knowledge is legally necessary for some species). Practitioners should take account of standing water, running water and wetland biodiversity. Specialist advice can be valuable; for example, work being undertaken by the Freshwater Habitats Trust to identify 'Important Freshwater Areas' could inform local delivery.

REFERENCES AND FURTHER READING

- A narrative for conserving freshwater and wetland habitats in England
- Climate Change Adaptation Manual - Standing Open Water
- Freshwater Habitats Trust website
- Norfolk ponds project website
- The Pond Book: A Guide to the Management and Creation of Ponds

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