
CONNECTIVITY

Too much of a good thing?

Is connectivity always the conservation gold standard for freshwater systems? **Henrietta Pringle**, **Alan Law**, and **Gavin Siriwardena** explain.

‘More, bigger, better and joined’ was the clear, yet bold, message delivered by Professor John Lawton in 2010. This promoted a step-change in conservation, with many of today’s initiatives centred on improving habitat quality and quantity, whilst increasing connectivity within the landscape (e.g. RSPB’s Futurescapes, Defra’s Nature Improvement Areas and Wildlife Trusts’ Living Landscapes). Where habitats are connected, individuals can easily disperse, which not only means that populations can persist if one patch becomes unsuitable, but also promotes environmental resilience, as links are provided to surrounding sources of food, mates and refugia.

However, connectivity, particularly within freshwater systems, can also increase exposure to factors that cause stress to the system (known as ‘stressors’). Just as connectivity allows the mixing of individuals and genetic materials, it also enables the spread of pollutants, disease and invasive species throughout connected waterbodies in the hydrological landscape – the ‘hydroscape’. The intrinsically high connectivity of freshwaters may contribute to the

unparalleled rates of biodiversity loss that they have experienced. Connectivity across the hydroscape has already been transformed by human activities and will continue to be altered; it will also become increasingly distorted by climate change (e.g. through floods and droughts). An integrated understanding of the hydroscape and the impacts of changing stressors and connectivity is therefore crucial to the long-term sustainability and functioning of freshwaters.

WHAT IS CONNECTIVITY?

BTO is currently working within a research consortium (led by the University of Stirling) to improve this understanding in an ambitious four-year project funded by the Natural Environment Research Council. In determining how connectivity and stressors interact to influence biodiversity and ecosystem function in freshwaters, the *Hydroscape* project will ultimately inform the work of organisations engaged in waterbody restoration, biological conservation, the control of invasive species, and diseases of wildlife and humans, at the

▼ *Hydroscape* includes Brinton Hall Lake in Norfolk and Hogganfield Loch in Glasgow.



Bird-mediated dispersal

Ecto-zoochory

Ever since Charles Darwin's experiments in 1859, birds have been recognised as a major means of dispersal for many organisms. Darwin noted that molluscs can be transported to a duck's next destination by attaching to their feet or feathers.

Waterbodies

Given that waterbirds regularly move between local wetlands and often migrate over long distances, they have the potential to connect multiple waterbodies, including those that are isolated hydrologically, at local, national and international scales.

Endozoochory

Organisms may also be transported by birds internally. Microorganisms, crustaceans, gastropods and seeds have all been shown to survive digestion by waterbirds, even after days in the gut.

international, national and local level.

Freshwater connectivity and dispersal potential can be defined in various ways. Consider an aquatic plant in a lake; to get there, it may have been transported downstream (hydrological connectivity), or brought to the lake by a bird or other animal (vector connectivity). This means that seemingly unconnected lakes and ponds may still share genetic material or be exposed to the same disease agents if they are visited by the same birds. BTO data on birds visiting waterbodies across Britain therefore play a crucial role in the project, feeding into several of the analyses, including those examining a) how the distribution of organisms is affected by connectivity within and between hydroscares, b) how this

relationship is affected by different stressors c) how connectivity influences the resilience of a waterbody to change and d) how freshwaters will respond to management actions designed to reduce pressures and/or alter connectivity, in a national context.

INTEGRATED HYDROSCAPE

Birds are not only vectors of connectivity, but they are one of the taxonomic groups – together with fish, dragonflies, beetles, molluscs and macrophytes – whose responses to stressors and connectivity *Hydroscape* is investigating. Both connectivity itself, and the mechanisms facilitating it, are likely to influence responses to stressors differently, depending on differences in mobility, modes of dispersal and how tightly the group is tied to water. By conducting multidisciplinary studies across a range of taxa and at both local and national scales, which this collaboration enables, we can develop a more integrated view of hydroscares and attempt to predict and to mitigate impacts of human-induced stressors on biodiversity.

Partners

Hydroscape is a consortium led by University of Stirling, and includes Centre for Ecology and Hydrology, University College London, Lancaster University, University of Glasgow, Natural History Museum and BTO. External partners and data providers include Michigan State University, Environment Agency, SEPA, SNH, Natural England, Broads Authority, British Dragonfly Society, Balfour-Browne Club, Norfolk Biodiversity Information Service. Visit hydroscapeblog.wordpress.com or follow [@HydroscapeNERC](https://twitter.com/HydroscapeNERC) on Twitter.



Hydroscape

Lakes and ponds that are seemingly unconnected may still share genetic material

How you can help

Thanks to our volunteers we are able to provide a detailed picture of bird distributions in freshwater habitats across the UK. For the purposes of *Hydroscape*, inland Wetland Bird Survey (WeBS) counts are the most relevant, yielding standardised and regular data on the number of birds using particular waterbodies. Whilst we have WeBS data for most of the waterbodies used in the local-scale field studies (24 waterbodies in each of North Norfolk, the Lake District and urban Glasgow), the national-scale analysis will require additional data where WeBS data are lacking. Using Breeding Bird Survey (BBS), Waterways

Breeding Bird Survey (WBBS) and BirdTrack records, we can fill in some of the gaps by producing information for 1–km squares across the country, and matching these records to waterbodies. However, monthly WeBS data would be an improvement on this. Projects like *Hydroscape* highlight the vital importance of BTO volunteer effort, but also the need for even greater survey coverage, so we encourage you all to check www.bto.org/volunteer-surveys for opportunities to help. Inland WeBS is an easy survey that can be done at a wide range of waterbodies and is a great way to make your birding count!