Data on biodiversity for freshwater managers

Are you dismayed by the declining health of your local rivers and lakes? **JAMIE PITTOCK** reports on an innovative European project, BioFresh, which is attempting to provide the tools needed for better freshwater biodiversity conservation.

A highlight of my Australian childhood was the annual Museum of Victoria open day, when the dusty storage rooms were thrown open to reveal shelves of pickled fish and crustaceans, and drawers full of mayflies and other aquatic wildlife. Like our governments, I paid less attention to the card files full of handwritten records on the wildlife. Later I volunteered to help a Museum researcher walk into the wildest river headwaters in the Victorian Alps, wading through snow-melt waters to capture and measure the ninth to thirteenth specimens of the endangered Spotted Tree Frog that had ever been recorded. In those days before the internet and global positioning systems, this required painstaking hand-written records of the location, the habitat and the dimensions of each frog.

Institutions like the Museum are repositories of decades of such environmental data that is essential knowledge in deciding how best to manage freshwater ecosystems. Questions such as which freshwater ecosystems should be put in nature reserves and those that could be developed, how much water can be taken from a river without unduly compromising its health, and how to build dams with wildlife passage devices to maintain valued fish population all require this sort of data to inform answers. Until recently, gathering this data required separate searches of the records of each relevant museum and similar organisations: a daunting task. In recognition that you cannot manage what you cannot measure, our national governments agreed under the Convention on Biological Diversity to share information on the world's biodiversity to enable more effective conservation. The OECD (Organisation for Economic Cooperation and Development) took a lead by establishing in 2001 the Global Biodiversity Information Facility (GBIF: www.gbif.org), a network of 57 countries and 47 organizations that encourages free and open access to biodiversity data via the internet. Now, the European Union (EU) has funded the first major international project to focus explicitly on freshwater biodiversity, called BioFresh.

River fish in Burkina Faso. The SUSFISH project in Burkina Faso is aiming to improve sustainable management of natural and man-made aquatic systems (http://susfish.boku.ac.at/summary.htm). Credit: Andreas Melcher.

Started in 2009 with EU funding of €6.5 million ($8.8 million), BioFresh aims to build an open access global information platform for scientists and ecosystem managers. Led by Professor Klement Tockner at the Leibniz Institute in Berlin, Germany, BioFresh integrates the freshwater biodiversity competencies and expertise of 19 European and international institutions and runs to 2014.

Dr Paul Jepson is an environmental policy expert at the UK's Oxford University, a BioFresh partner organisation. He explains that such eco-informatics and e-infrastructure are important 'because they will enable new forms of scientific analysis and collaboration, and importantly have the potential to extend engagement with science data sets beyond the traditional domains of institutionally-based scientists. In short, the creation of e-infrastructure involving inter-operable data networks and analyses opens up a future of enhanced citizen participation, thereby enrolling a broader community in the scientific and policy endeavour.'

A brown trout. Credit: LiTn / Shutterstock Images.

Saving brown trout in Europe

Dr Núria Bonada from the University of Barcelona, a BioFresh partner, explains: 'We are modelling future distributions of freshwater organisms in European catchments under global change scenarios. We have started by analysing the future distribution of brown trout in the Ebro, the Elbe and the Danube rivers. The results obtained are discouraging as this species will disappear in 2080 in about 80% of the reaches where it can be found today. Considering the natural, recreational and economic value of brown trout, measures to mitigate the effects of global change at catchment scale is urgently required.'

The priority for freshwater systems

Globally, freshwater ecosystems are most imperilled and are in particular need of better management. Freshwater ecosystems cover only 1% of the Earth's surface, yet are home to over 10% of all animals and over 35% of all vertebrate wildlife. In 2005 the UN Millennium Ecosystem Assessment concluded that freshwater ecosystems tend to have the highest proportion of species threatened with extinction, that the use of capture fisheries and freshwater is now well beyond levels that can be sustained even at current demands, much less future ones, and that there are important gaps in the distribution of protected areas in freshwater systems. Yet freshwater ecosystems also provide important benefits for people – river floodplains alone provide 25% of all continental ecosystem services.

Population growth, economic growth and climate change are all increasing the pressure on freshwater ecosystems. A key challenge for scientists is to quantify the quantity, quality and timing of water flows that ecosystems need to remain healthy and sustain biodiversity, versus the water that could be diverted for human consumption. Dr Jepson argues that it is it important to better conserve freshwater biodiversity for two reasons. 'One because it is likely to have a role in the continued provisions of ecosystem services deriving from freshwater. We don't yet fully understand the relationships between aquatic ecosystems and water as a liquid resource, but I think we'd expect that these exist and are important in certain places and certain times. I think the other one is the moral-aesthetic argument. Freshwater life is fascinating, beautiful and gives rise to all sorts of practices that enrich human life. In addition, it's "their" planet as well as ours!'

The BioFresh project

When our governments met in the Convention on Biological Diversity Conference of Parties in 2010 they adopted the new Aichi Biodiversity Targets (www.cbd.int/sp/targets) for 2020.

Targets focused on freshwater include: 'Target 11: By 2020, at least 17 percent of... inland water... areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas...'

'Target 14: By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded...'

Achieving these targets requires good information, which is where BioFresh comes in. Dr Jepson declares that BioFresh is an advance because: 'In short, no one has done this for freshwater biodiversity before.'

Professor Margaret Palmer, Chair of the freshwaterBIODIVERSITY Scientific Committee of the international scientific organisation DIVERSITAS comments: 'BioFresh is preparing to take on coordinating the archiving of data sets on freshwater biodiversity. The ability to identify and access data on global biodiversity has been a problem in the past and Diversitas welcomes this initiative.'

Dr Jeanne Nel, from CSIR South Africa and the President of the Society for Conservation Biology Freshwater Working Group, said: 'BioFresh has potential to contribute significantly,' citing the resources it is applying to data collation with partners from Europe, Africa, Australia and the USA, its application to both science and policy and use of social media tools.

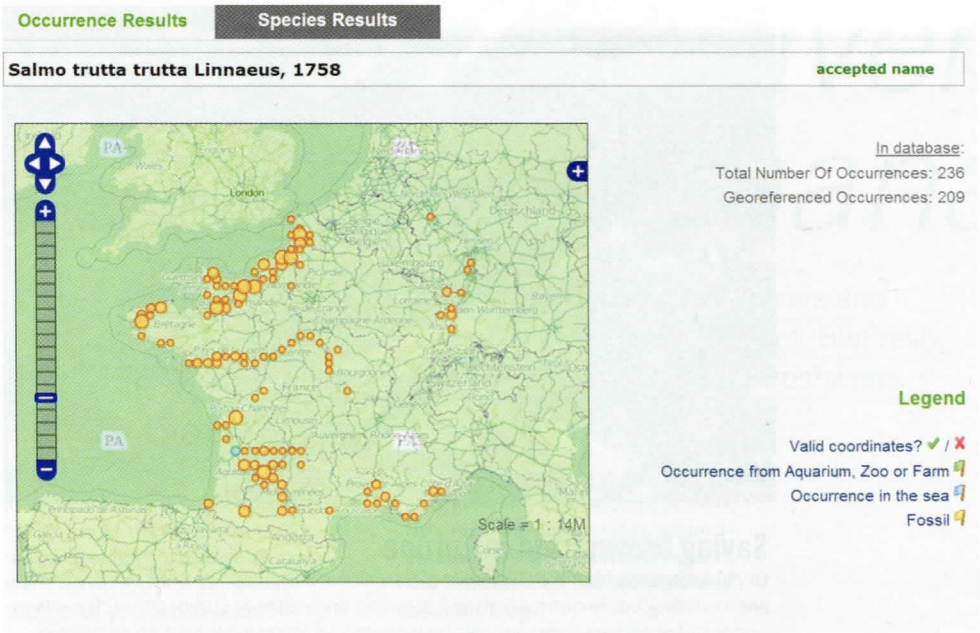
What can BioFresh contribute?

BioFresh will improve the capacity to protect and manage freshwater biodiversity by building an information platform as a gateway for scientific research. Specifically, BioFresh's remit is to use the assembled data to:

- Locate key hot spots of freshwater biodiversity and their vulnerabilities, and to suggest improved strategies for their conservation
- Increase the public awareness on the importance of freshwater biodiversity and the ecosystem services that depend upon it
- Support governments and international environmental agreements (such as the European Nature Directives, Water Framework Directive, Ramsar Convention and the Convention on Biological Diversity)
- Identify new research directions and develop novel approaches to biodiversity conservation research in freshwaters.

BioFresh already links information from 58 databases and more are undergoing quality control to ensure that the data can be compared. Dr Jepson explains that: 'the BioFresh portal as envisaged enables the science-policy interface to operate through a number of networks. Put simply we have the potential to open up previously cryptic and inaccessible information in an engaging and informative way.' BioFresh will use existing data to build predictive models of biodiversity change in order to support a broad range of management and conservation activities.

Dr Nel says that the Society for Conservation Biology's 'wide scientific and implementation audience' from developed and developing countries is one institution that will help disseminate the knowledge generated



Map of brown trout distribution on the BioFresh website.

by BioFresh.

BioFresh is one of a number of new science infrastructure projects that will provide more definitive, independent and credible scientific input into environmental policy that include GBIF and LifeWatch (www.lifewatch.eu). Together they will support the newly created Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES; www.ipbes.net), a biodiversity sister programme to the Intergovernmental Panel on Climate Change, which will significantly enhance the evidence-base used to support the development of European and international policies.

Dr Aaike De Wever, a science officer at the Royal Belgian Institute of Natural Sciences, a BioFresh partner, explains that: 'By specifically focusing on freshwater we hope to be able to accommodate specific needs and requests from scientists, water managers and policy makers in terms of access to freshwater data. Data are less likely to get lost. In addition, we plan to provide a number of freshwater specific models and tools on our data portal.'

Professor Daniel Hering, a freshwater biologist with the Universität Duisburg-Essen, another BioFresh partner, says: 'A strong part of BioFresh is to bring different data sources together, such as the International Union for the Conservation of Nature data (global, on a catchment level) or parts of the EU Water Framework Directive data (European, on a site level). Depending on how strongly the BioFresh grows, it will offer a much better basis for analysing population shifts or recolonization procedures. Further, for areas with high data density, it will offer opportunities to better understand the different components of biodiversity. It will be highly useful to identify 'key biodiversity areas', from the global down to the catchment scales. In particular [it will help] judge where hotspots of biodiversity still remain, from which restored areas could be recolonized.'

Who will be able to use BioFresh?

'Our policy is indeed to convince data holders to make their primary biodiversity data freely and openly available,' Dr De Wever explains. 'As to user-friendliness, we will try to keep the balance between keeping it very simple and meeting the demands of a wide range of users.'

The BioFresh blog and Cabinet of Freshwater Curiosities seek to promote freshwater conservation more broadly. Indeed readers can already use the BioFresh portal to access distribution data on many species. Professor Hering elaborates: 'That's crucial, as many scientists are not aware which data are [already] available to answer their questions – and we should consider that most of the data have been generated using tax money.'

Dr Jepson notes that 'we are aware that many big corporations generate biodiversity data as part of their impact assessments or other operational needs. Once established, these data platforms [BioFresh] would provide a repository for such data, and if companies and indeed anyone doing a localised survey were willing to contribute their data to such data commons I think we'd all benefit.'

Sceptics may ask whether BioFresh can really help developing countries or whether it is only for rich European countries. 'Certainly not, the scope for the BioFresh data portal is global', says Dr De Wever, 'At this stage, however, most of our efforts are focusing on the datasets held by project partners, which are admittedly European. But, in our meta-database (database of databases) and data portal we have already included a range of non-European datasets.'

'I don't think it is only for rich countries,' says Dr Jepson. 'Of course the EU has the resources to invest in the creation of science infrastructure, but once developed a lot of the technologies [such as standards and coding] will be there for everyone. [Many] of the data sets we are integrating are global and the tools / indexes we are developing to sit on top of these are global in scope, for example the climate vulnerability index.' Dr Nel concurs, saying: 'Developing countries can definitely benefit from BioFresh through the techniques that are being developed to extrapolate data to data poor areas. Another aspect that BioFresh has facilitated is the knowledge dissemination to developing countries by helping to fund workshops which bought together scientists from developed and developing countries.'

If we are to stem the dramatic loss of wildlife from our rivers and lakes strong action is required. BioFresh is a great advance in providing the data needed to facilitate better analyses and management. ●

Contributions wanted

BioFresh is inviting scientists, water agencies, non-governmental organisations and other institutions to make their data publicly available through the data portal. 'The visions and assembly of the e-science infrastructure we are assembling relies enormously on the good will and buy-in of data owners – the willingness to contribute to a shared resources, give up some ownership of their data in situations where we are not quite sure how things will pan out or develop,' says Dr Jepson. Potential contributors can contact the BioFresh network by email: data@freshwaterbiodiversity.eu. Contributing data increases the visibility of such datasets and ensures that this data can be reliably stored and used to provide maximum benefits for society. BioFresh provides full acknowledgement of contributors on the portal and provides clear citation guidelines for users of data.

More information

BioFresh: www.freshwaterbiodiversity.eu
BioFresh blog: biofreshblog.com
Cabinet of Freshwater Curiosities: cabinetoffreshwatercuriosities.com