



FRESHWATER BIOLOGICAL ASSOCIATION



Annual Review


2019-2020



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Foreword

We couldn't begin this review without addressing the unprecedented circumstances that we currently find ourselves experiencing. This year has presented the FBA with a number of challenging issues, the 2020/21 report will describe the full effects of the pandemic but for now we focus on 2019/20. This annual review charts our strong progress against a range of performance measures designed to explore progress inline with the FBA's current objectives and strategy.

2019/2020 has been an exciting year for the FBA. During this time the FBA has continued to provide existing services to members, produced several editions of FBA News and further developed training courses for freshwater enthusiasts and professionals alike. This has not only assisted in enhancing the reputation of the FBA as a leading scientific organisation but also provided support of the organisation's finances.

Of particular note during this period is the design and development of a brand new website; a project that has been in the pipeline for some time. At the beginning of this year, the brand new FBA website went live, along with a logo refresh that's more in keeping with contemporary design aesthetics. The new website incorporates a membership management platform, provides us with the opportunity to increase community engagement and allows us to strengthen our appeal to the wider public as a whole.

We're delighted to report that traffic to the website has already more than doubled in comparison to traffic from the previous period, and is continuing to grow on a daily basis. The Windermere



ferry camera remains to be the most visited page with over 20,000 visitors a month which has offered the opportunity for us to engage with local businesses in an advertising revenue capacity. On the whole, the new website offers a myriad of opportunities for further development and as such we are looking forward to further innovation.

2019/20 was an exciting year for developments in the world of citizen science at the FBA. In 2019 the Priority Habitats online data portal, lead by our partners at Natural England, went live to the public (www.priorityhabitats.org). Users are now able to submit data about the state of their local watercourses, in the form of naturalness surveys, helping to prioritise restoration work and inform future amendments to the priority habitats map for England. You can read more about these developments in the article featured later in this review, by Chris Mainstone and Ruth Hall.

A combination of winter weather, high flow conditions, salmonid spawning, and the coronavirus pandemic stifled Anglers' Riverfly Monitoring Initiative (ARMI) activity during the final quarter of 2019/20. However, it was a busy year for the project overall thanks to the efforts and commitment shown by 3718 trained volunteers, supported by Riverfly hubs and groups, Riverfly Partnership staff, and the Environment Agency. Volunteer monitors regularly sampled across 2600 river sites, identifying and reporting 226 trigger level breaches as a result. Excellent development progress was made with the Urban and Extended Riverfly schemes, although the intended national rollout had to be held back, again due to the coronavirus pandemic. The Riverfly Partnership is now hoping to launch the two new Riverfly Plus schemes from Spring 2021.

The Freshwater Pearl Mussel Ark went from strength-to-strength in 2019/20 with the introduction in spring 2019 of two new rearing systems. The aquarium and incubator systems are tailored more to the needs of our smallest juvenile mussels, and as such, survival has dramatically increased over the last reproductive season. These new systems are more reliable and flexible and allow for better monitoring, improving our growth and survival rates. Time is running out for many of England's freshwater mussel populations and so maximising the number of juveniles we have to release back to the wild is a key component of our release strategy going forward. The Irt Reintroductions Research project has several exciting experiments planned over the next 12 months which will focus on topics such as conservation genetics and the geographic distribution of the species within the River Irt. Watch this space for developments!

It's all change this year as we say our farewells to long standing CEO, Bill Brierley who after 5 years' at the helm of the FBA, retired in September 2020. It goes without saying that he will be greatly missed by all here at the FBA and further afield. We thank him for his service and wish him all the very best for his retirement. In the meantime, Lesley Hadwin, Tim Ashberry and Louise Lavictoire are leading the team until a new Executive Director to lead the organisation is appointed. We are very grateful for all their hard work and thank them for their commitment during this interim period.

We hope that you will enjoy reading about our accomplishments in this year's annual review and thank you for all your support as we adapt during these challenging times.

2019-2020 at a Glance



376.1k

impressions on
Twitter

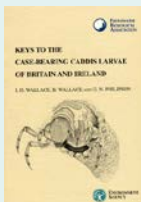
656

new followers on
Twitter

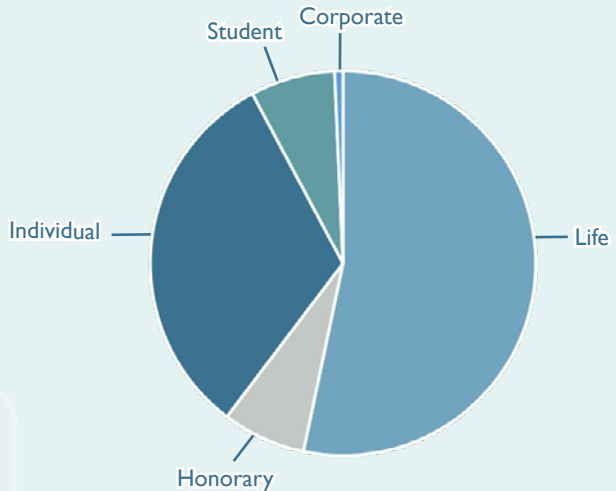
6 field & training
courses attended
by nearly **70**
attendees

550

Publications sold
Top 5



Types of Membership



Over **45k**
people reached
on **Facebook**

236
new followers on
Facebook

Developed our brand
new website

fba.org.uk

with
20,000

visitors to our **Ferry
Cam** each month!

Welcome to Our New Fellows

Fellows of the FBA are elected in recognition of their scientific excellence in freshwater ecology and/or their high-level contribution to the understanding and management of freshwater ecosystems. This year, we are delighted to welcome 5 new Fellows to the team: Martyn Kelly, Steve Ormerod, Suzanne McGowan, Rachel Stubbington & Bill Brierley. Read on for more information about each of them.

Martyn Kelly



Martyn is a freshwater ecologist, with a BSc from the University of London (Westfield College, later absorbed into Queen Mary University) and a PhD from Durham University, where he worked with Brian Whitton on aquatic bryophytes and where his interest in freshwater algae was kindled. From Durham, Martyn moved to the University of Jos in Nigeria where he was a Senior Lecturer for two years, before moving back to take up a NRA Research Fellowship, again at Durham. During this period, the Urban

Wastewater Treatment Directive was posing some significant challenges to the National Rivers Authority and his Fellowship changed direction somewhat in order to develop an ecological measure of the impact of nutrients on rivers. This was the Trophic Diatom Index (TDI), which has been the mainstay of his professional life ever since.

At the end of his Fellowship, Martyn moved into freelance consultancy, though he has maintained active engagement with universities, teaching in the Geography Department at Newcastle University for about 10 years and now as an honorary professor at the Geography Department at Nottingham University. The TDI, meanwhile, evolved into DARLEQ, a tool for assessing ecosystem health in relation to Water Framework

Directive objectives. The need to scale metric outcomes in relation to WFD, by the addition of an estimate of the state of the diatoms in the absence of significant human pressure, has led him on a 20-year search for the perfect river. Over the past seven years Martyn has also worked with the Environment Agency and others to adapt the approach to allow it to be used in conjunction with metabarcoding.

Engagement with the WFD led to more work in Europe, co-ordinating the drafting of CEN standards on the use of diatoms in ecological assessment and the European Commission's intercalibration exercise for phytobenthos (ensuring that all Member States shared a common level of ambition for ecological status). More recently (and despite Brexit), he has worked with the European Commission, Geoff Phillips and others on guidance on developing nutrient criteria to protect good status across Europe and has also worked with government agencies in Ireland, Luxembourg, Romania and Greece.

Since 2013, Martyn has been writing a blog, Of Microscopes and Monsters (www.microscopesandmonsters.wordpress.com), about algae and the unfashionable end of biodiversity. The impetus behind this is encapsulated by a quotation from David Attenborough: "No-one will protect what they don't care about, and no-one will care about what they have never experienced". Much of what we, as freshwater specialists, regard as important about the natural world is presented in dry and abstract terms and Martyn saw his blog as a counterbalance to this, explaining the wonders of the microscopic world to lay audiences. Alongside the words, he uses many of his own pictures: both photographs and paintings, the latter arising from a period spent studying fine art, leading to yet another degree. Martyn's paintings of the microscopic world have also featured in two international exhibitions (Museo della Scienze, Trento, Italy and Plantentuin (Botanic Garden), Meise, Italy).

Suzanne McGowan



Suzanne is interested in how, why and when lake ecosystems have changed through time. Her research is particularly focused on understanding change across recent centuries when human impacts such as nutrient pollution and hydrological modifications have intensified. Suzanne was trained as a palaeolimnologist, but commonly incorporates other approaches into her work including aquatic monitoring programmes, comparative large-scale surveys, and experiments spanning whole ecosystems, mesocosms and bioassays. She specialises in the application of chlorophyll and carotenoid pigments as

biomarkers of algae and cyanobacteria in sediments and waters, and has worked on many collaborative projects across the world applying these techniques and training students in their use. Based in Nottingham, she works locally with organisations including Nottinghamshire Wildlife Trust at Attenborough Nature Reserve to address water management issues. She also works internationally including ongoing research in West Greenland which investigates how Arctic lake-scapes are responding to recent environmental changes. She has worked in some of the most iconic lake systems in the world including Lake Baikal and Lake Victoria. Recently her interests have focused on addressing development challenges in sub/tropical regions, including work on lakes of the Yangtze floodplain, crater lakes in The Philippines, flood-pulse wetlands in Malaysia, the Red River Delta of Vietnam, and the Ganges-Brahmaputra-Meghna Delta in India and Bangladesh.

Suzanne received postdoctoral training from the Geological Survey of Denmark and Greenland (as a Marie Curie Fellow) and the University

of Regina in Canada. During her time as an academic in the School of Geography at the University of Nottingham she spent three years seconded to the Malaysia Campus as Head of School of Geography. She is currently a Professor of Freshwater Sciences at the University of Nottingham and a Visiting Research Associate at the British Geological Survey.

Steve Ormerod



Steve's passion for nature was sparked as a child when he was shown Salmon leaping and Dippers diving along the River Ribble near to his home town of Burnley. His research has since centred on global change effects on freshwater organisms, river birds and ecological process. Themes include climate change, biodiversity loss and pollution - ranging from acidification to the occurrence and effects of microplastics in river food webs. As well as Fellowships of the Winston Churchill Memorial Trust (1987), Chartered Institute of Ecology & Environmental Management (1997), Learned Society of Wales (2013)

and the Royal Society of Biology (2013) he has been awarded the past-president's Medal of CIEEM (2011) and the Marsh Award for Marine and Freshwater Conservation (2011).

A former Council Member of the FBA, Steve has had extensive involvement with government, NGOs and environmental business, for example as past board member of the Countryside Council for Wales, Chairman and Vice President of the Royal Society for the Protection of Birds, Chairman of the Science Development Group of the Centre for Ecology and Hydrology, Chairman of Dwr Cymru/ Welsh Water Environment Advisory Panel and Chairman of the

invertebrate charity, Buglife. In 2018, he was made Deputy Chairman of Natural Resources Wales and member of the UK Joint Nature Conservation Committee (JNCC). He is currently Professor of Ecology at Cardiff University and co-director of the University Water Research Institute.

Rachel Stubbington



Rachel is a freshwater ecologist with over 10 years' experience of research and undergraduate to postgraduate-level teaching in freshwater ecology. Her research focuses on the macroinvertebrate communities of perennial and temporary rivers. Rachel's specific interests include how communities respond to hydrological variability including low flows and surface drying, and encompass persistence of desiccation-tolerant forms and migration of benthic organisms into subsurface sediments.

She worked at the Environment Agency during her BSc and is committed to collaborating with industry scientists to develop effective approaches for biomonitoring temporary streams, to support their ecological resilience.

From 2016 to 2020, Rachel led the Community Ecology and Biomonitoring Working Group in the EU COST Action Science and Management of Intermittent Rivers and Ephemeral Streams (SMIRES), including the organization and chairing of seven EU-level workshops aiming to improve understanding of – and capacity to manage – dynamic river ecosystems. She was also a leading member of the SMIRES Steering Committee, a Management Committee member, and the Science Communication Manager.

Her role in SMIRES enabled her to position the UK at the forefront

of the advancement of temporary river research and its application to ecosystem management. Since 2016, Rachel has co-supervised three post-doctoral fellows, two PhD students and several other supporting researchers with Environment Agency colleagues. Their research is unique in characterizing the aquatic–terrestrial biodiversity of temporary streams, specifically winterbourne chalk streams. More recently, they have been attempting to look beyond the chalk, and are starting to explore the diversity of temporary streams in the New Forest National Park.

Rachel believes in wide, timely dissemination of research to scientific and broader audiences. She has published 50 peer-reviewed journal papers and two book chapters since 2006. She was lead Guest Editor the 2019 Fundamental and Applied Limnology (FAL) Special Issue on Temporary Streams in Temperate Zones, enabling her to promote UK contributions that evidence our emerging leadership in this discipline. Rachel is now a Chief Editor for FAL. Beyond academia, and led the writing of The Natural Capital of Temporary Streams for the NERC-funded Valuing Nature Programme, to showcase the value of dynamic rivers to a target audience of managers. She has written for the online magazine The Ecologist and has supported her research team members in contributing articles to FBA News. Rachel has hosted the annual Temporary Rivers workshop since 2016 (including online delivery to an international audience in 2020), providing an opportunity for >100 registrants from across industry, academia and the third sector to share knowledge and best practice.

Rachel has been an FBA member since her PhD and greatly values its role in supporting freshwater scientists. She shares the FBA's life-long commitment to advancing the science and management of freshwater ecosystems. She is therefore honoured to be a new Fellow, a role in which she intends to contribute to ensuring the future of FBA at the forefront of UK – and wider – freshwater ecology.

Bill Brierley



Bill became interested in freshwater biology in his teenage years whilst fishing on the canals and rivers in Worcestershire and as an undergraduate at Royal Holloway College. He gained a sound background in aquatic ecology and algology from Nan Duncan, John Dodge and others. Bill then undertook a PhD studying the effects of artificial mixing on the growth and succession of phytoplankton in reservoirs at the University of Leicester, supervised by (now Fellow) David Harper and part funded by Severn Trent Water. During this period he visited FBA Windermere and was inspired following meetings with John Lund, Jack Talling, Graham Harris and Colin Reynolds. He was also inspired by Brian Moss, the WRC Lakes group and Roger Jones. Whilst at Leicester, Bill was joint organiser of an expedition to study the phytoplankton of Lake Naivasha in Kenya for 3 months as part of a multidisciplinary team investigating the lake ecology. His research interest in temporal and spatial patterns and variability in freshwater communities was kindled at this point. He was also on the organising committee and joint editor of the international meeting 'The ecological bases for lake and reservoir management' held in Leicester in 1996.

Bill spent much of his career working in the Environment Agency and predecessors in a variety of roles - operational biologist, National Research and Development - Ecosystems Science and with the Monitoring Strategy team developing the groundwork of the recent Strategic Monitoring Review. Bill has worked on phytoplankton, eutrophication, understanding variability and uncertainty in freshwater communities and its relevance to monitoring and management of lakes

and rivers. Bill taught on Open University summer schools and was a tutor for many years on environmental courses and has taught on phytoplankton courses for the FBA.

Bill's long-term interest in understanding variability and uncertainty of biological communities and its relevance to monitoring and management of our freshwaters has been the focus of his and several colleagues work over many years. This outcome of the work is now incorporated into our reporting to the EU for the Water Framework Directive. He sat on an EU working group on the harmonisation of eutrophication monitoring and regulations. He was also a panel member of the National Ecosystems Assessment group on Wetlands and Freshwaters, the EA representative on the Defra Evidence Biodiversity Investment strategy group and was one of the originating members of the Better Thames Network, a partnership between the EA universities and research organisations to co-ordinate and undertake research in the River Thames catchment

Bill has been a member of the FBA for many years and was a member of Council from 2008 to 2012, and led the strategy group which developed the new strategy that was adopted in 2011. Additionally, he chaired the FBA's Data and Information Science and Advisory Group from 2006 to 2013. Bill became CEO in 2015, seeing the FBA through significant changes that have given the organisation the opportunity to grow in the 21st century. He retired from his role this year and we are thrilled to have him on board as a new Fellow of the FBA.

In Collaboration with the FBA

River and Lake Priority Habitat Webpages

The river and lake priority habitat webpages are now live (and can be found at <https://priorityhabitats.org/>). These have been developed by the FBA, Natural England and Cartographer and are hosted on the FBA website. They are a one stop shop for everything you would like to know about river and lake priority habitat. They also link to the cartographer data portal, where anyone can add data on habitat naturalness, restoration priorities, and chalk rivers. The data collected via this portal are displayed on maps on the website and will be used in strategic-decision making processes.

Priority habitat naturalness data

Being recognised as priority habitat provides an additional mechanism to protect and enhance habitat. Maps of priority habitat are used by Natural England, the Environment Agency and planning authorities to highlight where decision-making needs to take particular account of the habitat present, for instance in the targeting of agri-environment measures and the consideration of planning applications and flood defence permits.

In England the most naturally functioning water bodies are included on the river and lake priority habitat maps. (Figure 1). These water bodies were mostly identified from national datasets such as those collected through WFD monitoring. Consequently there are likely to be many naturally functioning smaller freshwater habitats, e.g. headwater streams and smaller lakes that are unmonitored, so have not been identified as priority habitat and don't receive the protection and attention they should. The data portal allows anyone to submit information on the naturalness of any river/stream or lake that they know about. These data will then be used to update the priority habitat maps, so these water bodies can be protected and enhanced where appropriate. Since this facility went live more data

has been added by both citizen scientists and partner organisations such as the National Trust.

Restoration priorities

As part of the ongoing work to inform the WFD River Basin Management Plans (RBMPs) and The 25 Year Environment Plan Nature Recovery Network (NRN), anyone can provide information on the rivers/streams and lakes where they consider it a priority to restore natural functioning, bringing biodiversity as well as ecosystem services benefits. These should be sites that have the potential for natural processes to be restored, although there does not need to be a current commitment to do so. It is about mapping local opportunities and priorities. Consequently, whilst anyone can add information on sites they would like to restore, local Catchment Partnerships oversee this process and can submit this information to the RBMPs. This information will also form part of the NRN toolkit. This facility

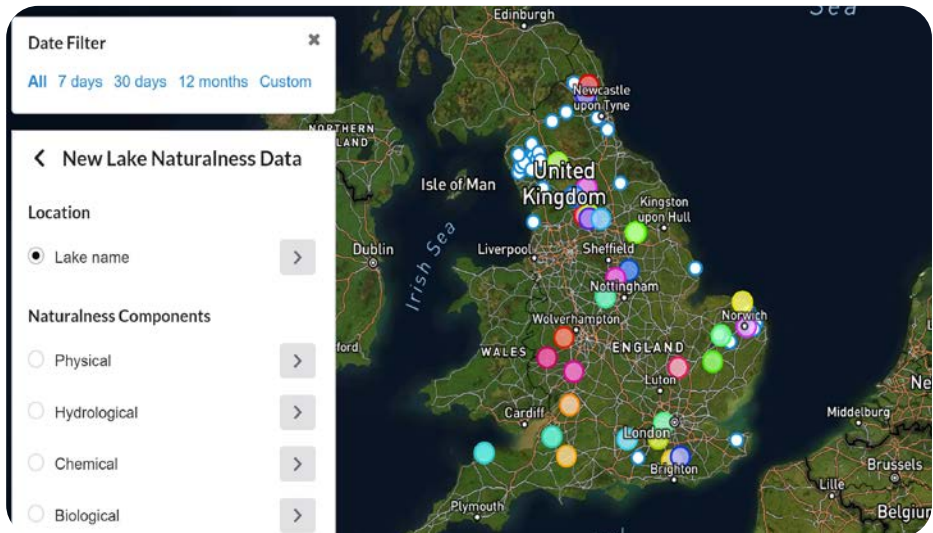


Figure 1: Lake naturalness data throughout England. These maps can be viewed and navigated on the FBA Priority Habitats website.

has only just gone live so we are awaiting the first submissions, but data will be available to view on the website.

Refining the chalk rivers map

This new facility has been established to agree refinements to the original UK BAP map of chalk rivers produced in 2006. An updated map has been created that can be viewed on the website, stakeholders can suggest amendment to this map via the data portal. Once there has been sufficient feedback, proposals will be evaluated and the map will be finalised and used to replace the original map in strategic decision-making processes.

What next?

The FBA will continue to work with NE on this initiative developing a proactive and strategic outreach programme encouraging uptake and participation by a range of partners and individuals so that these maps can help protect and direct conservation efforts for lakes and



Figure 2: An example of a lake in need of restoration



Figure 3: A chalk river

rivers. There are also plans to turn this facility into an app so data can be more easily recorded when out on the lake or river bank.

Chris Mainstone

Natural England

Ruth Hall

Natural England

RICT2 Web Pages: Updating RICT information on FBA website

We launched a new version of the River Invertebrate Classification Tool (RICT2) on the new FBA website at the beginning of April. RICT is software that implements the River Invertebrate Prediction and classification System (RIVPACS), an ecological model that has been in continuous development by the staff at the FBA River Laboratory since the late 1970s. The website was designed by Mark Battista and during COVID-19 lockdown it was managed by Siobhan Noade.

The website is maintained by the FBA for the UK's environmental protection agencies in England, Wales, Scotland and Northern Ireland under a contract from the Environment Agency, because RICT includes the UK's official river invertebrate status classification that is used for setting statutory environmental quality objectives and measuring compliance with them. It is used by the agencies for managing rivers and work to restore their environmental quality, for assessing the impact of pollution and for managing water abstraction. The contract ensures that the web-pages can be kept up to date, for example three updates to the user guide, technical description and reference database and four versions of the data input template have been uploaded since the launch.

The FBA website has always had a page devoted to RICT and RIVPACS, but it is now the sole portal to it. There are five webpages for RICT. The first is the main landing page that takes users to the RICT software, to user guides, to background information and to training. The landing page also includes notes on the availability of the RICT software and information about functions that may not work or have changed. RICT software is hosted on the Microsoft Azure Machine Learning website and the RICT Applications web page

River Invertebrate Prediction & Classification Systems (RIVPACS) & The River Invertebrate Classification Tool (RICT)

Invertebrate communities are excellent indicators of river health for professionals and amateurs. Biotic indices based on the sensitivity of each species to pollution or the number of different invertebrates help with this. Invertebrate communities and therefore the value of biotic indices vary widely between sites of the same quality, so we can't use them directly to indicate environmental health. How do we know if what we find in our sample is indicative of a healthy ecosystem?

The River Prediction and Classification System (RIVPACS) model, implemented in RICT software, allows us to determine the proportional reduction in the value of biotic indices, which represents a similar level of damage in any type of stream. RIVPACS predicts the value that we would expect at any site in the UK in its near natural state, from a small number of physical measurements. Comparing this prediction with what we actually find, we can estimate the proportional reduction. We use RICT in this way for the UK's official river quality assessments and statutory environmental quality objectives. RICT predicts species composition and the values of many different indices. RIVPACS has been developed continuously by ecologists at the FBA River Lab since 1977 and they still support this version of RICT. RICT is freely accessible to anyone including researchers, students, water companies and consultants. The FBA offers training courses for those wanting to learn more.



Figure 1: RICT2 Homepage on the newly updated FBA website. The multitude of sections has allowed for the inclusion of a significant volume of content.

includes links to the various RICT programmes that either predict biotic indices or the species and their abundances that we would expect at any site in Great Britain or Northern Ireland if its quality was good, or undertake the official status classification.

As well as using RICT software as a web application on the Azure website, users can download the programmes, which are written in R, and the internal data files so that they can investigate and modify them. That should make RICT more useful for researchers. The user guide web page includes software user and programming guides including step-by-step slide presentations and videos, a data input template with test datasets, a technical specification, and instructions for collecting and analysing invertebrate samples for RIVPACS. The 'References and Reports' web page includes the latest version of the RIVPACS reference database and research and development reports. The Training Courses web page leads to information about the FBA's training courses including the regular courses on RIVPACS and RICT.

A version of RICT software that implements an experimental version of the RIVPACS model will be launched in the next month or two and we will continue to enhance the website with more guides, reports and reference material.

John Murray-Bligh

National Ecology Advisor
Environment Agency

Research in a Pandemic

SARS-Cov-2 Movement In Freshwaters

This has certainly been an “interesting” year to date – with many challenges along the way, but also opportunities to push forward with some of the emerging technologies and new approaches we have been developing over recent years. In many ways, the pandemic has simply massively accelerated some key trends in freshwater science that were already underway – with the uptake of microbial molecular biomonitoring being a case in point - and many of us have had to pivot our research priorities at short notice to cope and adapt to what is already a very different world from where we were 12 months ago. I certainly never imagined I would be having so many Teams meetings about viral loads and faeces in urban sewers this time last year – and it is most definitely not what I originally signed up to study when I started out as a freshwater ecologist!

Currently, I am involved in a pretty disparate set of research projects that span multiple levels of biological organisation – from genes-to-ecosystems – different branches in the Tree of Life – from viruses to vertebrates – and also wildly differing systems - from pristine Arctic salmon rivers to the sewers of London. Most of this work is well outside my original (mostly entomological) training, so it has been pretty exciting to dip my toe into such a wide range of different disciplines and to work alongside the real experts in each of them. These various projects also involve in assessing the impacts of multiple stressors (particularly chemical pollution and climate change, through our NERC ERCITE Project - <https://nerc.ukri.org/research/funded/programmes/chemicals/>) on natural systems, as well as exploring the potential impacts of emerging biotic threats, including gauging how the spread of the SARS-Cov-2 virus behind the COVID-19 pandemic could affect both natural and artificial ecosystems and the wildlife that connects them (Figure 1).

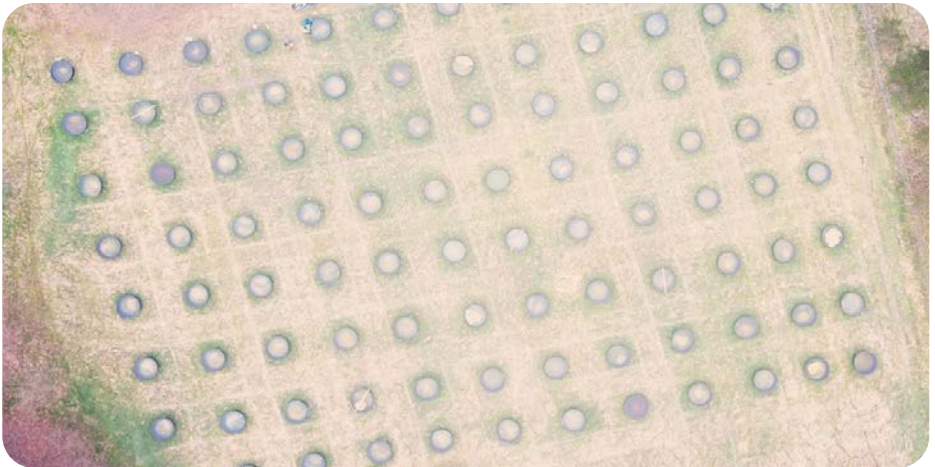


Figure 1: In the large-scale Silwood Park Mesocosm Facility at Imperial College London researchers are testing just how long SARS-CoV-2 RNA will persist across a wide range of environmental conditions. At the facility, 96 freshwater mesocosms are subjected to combinations of +1-8°C of warming gradient and additions of chemical pollutants. These experiments will provide data to fine tune models to help us predict how long (viable) SARS-CoV-2 RNA can be detected in “wild” freshwaters.

I was very kindly invited to give one of the keynote talks at the British Ecological Society Aquatic Group (BESAG) meeting last month, with a request to focus on SARS-Cov-2, how it moves through our freshwaters, and what the direct and indirect consequences of that might be in the future. Much of the talk was inevitably rather speculative “horizon-scanning”, as we are still just scraping the surface in terms of our understanding of the ecology of this virus, but also there are some areas where surprisingly rapid advances have been made, particularly through the emergency funding schemes set up over the summer via NERC and the UKRI. It is now becoming increasingly clear that our freshwaters will be altered in fundamental ways by the pandemic – from indirect benefits resulting from sudden improvements in water quality in urban areas, as pollution levels have plummeted, through to more worrying aspects related to the potential for infections to spread into wild reservoirs, especially via species that are in close contact with humans and possible environmental sources of contamination in freshwaters (e.g., bats, mink, rats). Here, I will give a brief taste of some of that emerging research in a COVID-19 project I am directly involved in as a Co-Investigator, and which is led by Prof Vincent Savolainen at Imperial College London (<https://envirology.github.io/research.html>).

Given that the RNA of the virus is detectable in faeces for prolonged periods, efforts have so far concentrated on trying to map its prevalence using sewage samples. Because live viruses have also been detected in the stools of infected patients, there is growing concern about the risks of faecal-oral transmission to humans and/or wildlife via sewage outflows and overspill. This new project, funded by the UKRI and NERC, is focused on the environmental impact of COVID-19, in partnership with the Freshwater Biological Association. Using high-tech genetic technologies, we will assess the potential

for sewage to contribute to transmission to humans and wildlife, from sewage outflows (via effluent discharge, storm overflows, and other forms of run-off) down to rivers and estuaries, and also in faeces from wildlife. We are also exploring possible means of using our artificial and natural freshwaters as a means of developing “early warning biosensors” for population-level testing that could help target individual testing more effectively and help minimise the need for large-scale lockdowns. It is still early days and we have only just begun on a very steep learning curve (especially for me, given my background is in stream food webs and not virology!), but there is huge potential here to be able to develop new tools for monitoring and improving both environmental and human health in the long term.

In the broader sense, this type of research is now being taken up around the world, and it looks certain to transform the biomonitoring of fresh waters, not just in the UK, but globally too: the molecular revolution has well and truly arrived now, and it has just been supercharged by the threat of SARS-Cov-2. I am convinced this will be the catalyst for huge changes in how we monitor, model and manage our freshwaters in the coming years; we are at Year Zero and our science needs to move fast to adapt to this rapidly changing world.

Guy Woodward
FBA Board Member

Freshwater Mussel Reintroductions Research

Good progress is being made with the Mussel Reintroductions Research project at the FBA. The first 18 months consisted of a flurry of changes to the mussel captive breeding systems at the FBA, resulting in a significant increase in survival and growth of individuals in new cohorts. Proposed changes to propagation systems were outlined in a report detailing a number of changes which could be made to increase success and efficiency at the FBA Pearl Mussel Ark. A second report was also produced outlining what is currently known about mussel reintroductions, and what lessons can be learned from reintroductions of other species. This literature review was the starting point for thoughts and discussions on how we proceed with reintroductions in the Irt.

One of the priority activities for us and our partners at West Cumbria Rivers Trust in 2020 was to assess the habitat in the Irt to see just how much of the existing habitat is suitable for mussels and what condition it is in. Unfortunately, this work coincided with the national COVID lockdown which decreased the number and size of sites we could cover during 2020. Of the sites we did survey however, we found that whilst suitable mussel habitat was present, the condition was generally poor, meaning that natural recruitment is unlikely in the Irt at this time. More survey work is planned for next spring, but this exercise highlighted the importance of collecting baseline data which can be used to assess the impact of restoration activities in future. It has also helped us to concentrate where our reintroduction sites might be in 2021 and 2022.

Another question we needed to consider is why the current distribution in the Irt is concentrated in the lower river and doesn't extend up to the top of the catchment. There is some anecdotal evidence that mussels may have been distributed throughout the

A



B



Figure 1:A) Concrete mussel silo with blue flow-through vent that leads to B) the cup filled with juvenile mussels, allowing water flow through

river in the past, but no solid evidence. Therefore, in summer 2020 we deployed a number of ‘mussel silos’ at different sites throughout the catchment to test whether juveniles could grow and survive at different sites. Mussel silos are heavy concrete domes with a hole in

the middle where a ‘cup’ containing mussels can be placed (Figure 1 A.). Water flows up from the bottom of the silo through the cup and exits at the top allowing food and oxygen to be delivered to the juveniles whilst they are held in this system (Figure 1 B.). Monitoring is therefore quick and easy. The silos have been in the river for almost 3 months already and survival has been 100 % at all sites. This indicates that (so far) enough food and oxygen are reaching juveniles at all sites and therefore the water quality is sufficient for juvenile mussels throughout the catchment. Silos will be kept in place over the winter and survival and growth will be monitored in 2021 to assess the suitability of sites.

At the Freshwater Mussel Reintroductions Research project we are taking an holistic approach to mussel reintroductions and considering a wide range of factors to assess what makes a successful reintroduction strategy. We have already begun to consider the mussel habitat and water quality within the Irt and how these may affect released juvenile mussels. Over the next couple of years, we are turning our attention to how reintroductions may affect population genetics and the effects of stress on individuals and how this affects reintroduction success. Follow the FBA on our social media for updates of how this project is progressing.

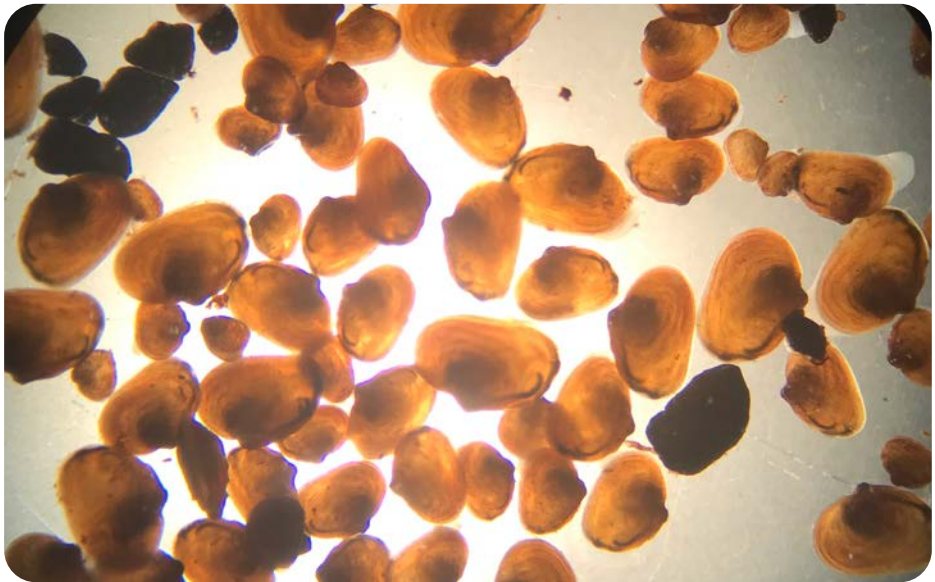
Louise Lavictoire

Mussel Reintroductions Research
Officer & Interim Head of Science

This Year at the Ark

2020 has been an exciting year for the pearl mussel project! The new rearing systems that have been trialed in the 2019-20 life cycle year have proved a success, with survival rates ranging from 22-55%. The one-year olds have now outgrown their first system and have been transferred into a tray system which will give them more room to grow. The project has gained an invaluable insight into how mussel growth is affected by temperature and food availability, and this research has enabled us to select the best rearing method for each river population.

The warmer climate of 2020 has resulted in the glochidia (mussel larvae) being released by the mussels earlier than usual. These glochidia can develop faster in warmer water and for some of our populations the juveniles are already excysting from (dropping off) the fish. The collection nets are now being set and checked every



Juvenile mussels, seen here under the microscope, spent last winter in the Heated Aquarium System.

day for juveniles. The newly excysted juveniles require warm water and food to be able to survive, however Windermere water is now too cold for them to grow. Therefore, the juveniles are being placed into a Heated Aquarium System (HAS). The water temperature is kept at 16°C and is fed with an artificial algal diet, so the mussels can continue to grow throughout the winter months. This method was first trialed in 2019 when one population started excysting early in November and it still holds >4000 mussels one year later.

Another exciting addition to the pearl mussel project is our new flume system. The flumes are designed to mimic a mussel's natural habitat, with faster flows, natural light, and more sizeable substrate. They are like "mussel boot camps" as the larger juveniles (>2cm) are placed into this system to prepare them for reintroduction.

We are ever grateful to our dedicated staff and the continued funding from all our partners, particularly Natural England and the Environment Agency, without which we would not be able to continue this important work.

Heather Marples

Pearl Mussel Officer

Afterword

Farewell from our CEO

I have been associated and involved with the FBA since I was 17. In recent years I sat on and became chair of the Data and Information Services Advisory Group, served on the Board from 2008 to 2012 (where I developed ideas around a UK freshwater Cooperative Research Partnership), and led the development of the FBA strategy (2012 to 2017).

When I arrived at Ferry Landing in February 2015, I believe we all knew the challenges the FBA faced, and it was very clear to me that these changes needed to happen quickly. What I had not realised was the number of fundamental changes that were required to take the organisation forwards. The Board and Executive embarked on a period of growth as the environmental sector started to recover from the global financial crisis and many potential opportunities were becoming apparent. The changes required to make this transition involved reviewing and updating our governance, modernising our Articles of Association, our staff structures – job descriptions and salary model, HR and financial systems and putting in place operating systems and a scheme of delegation.

The staff, Board and Fellows have continued to work incredibly hard since 2017. We have delivered training courses, new publications and increased our membership through targeting student members. The success of the holidays lets has surpassed all our expectations and has underpinned us meeting many of our charitable activities. The success of the Biffa project work has led to four years funding from United Utilities to investigate and improve the reintroduction of mussels into a river in Cumbria. We launched the FBA's new website (<https://www.fba.org.uk/>) earlier this year and the new Riverfly website and updated database (<https://www.riverflies.org/>). The FBA

has been working with Natural England on their Freshwater Priority Habitats Programme. This work has developed protocols, a website and database for amateurs and others to report on the state of freshwater habitats in England (https://www.fba.org.uk/FBA/Public/Get_Involved/Priority-Habitats.aspx). A new phase has just started to pilot training and recording Priority Habitats with volunteers in Cumbria and several other areas of England.

I need to thank all the FBA staff who have worked tirelessly, enthusiastically and with great professionalism through these last three years. This has not only allowed the FBA to maintain delivery of our key activities, but they have continued to work to make efficiencies and change the way of working so that projects, courses and publications are only delivered if they break even or make a profit. A significant example of this was completed earlier this year when we switched all our IT to an external provider. This was very fortuitous for several reasons. Firstly, all staff were provided with laptops and all our data and files were moved to cloud storage and accessible anywhere, rather than on an internal network based on servers at both sites. This work was completed in early February and allowed the FBA to work throughout the UK lockdown from home. It also reduced our ongoing IT costs by approximately 50%.

As you are all aware this has been an extremely difficult year for all of us personally and for many charities. The global pandemic has meant that the Board and staff have had to accelerate the transition that we were going through to ensure the FBA remains sustainable and can grow in the future. As you are aware we are in the process of selling the Pearsall Building at Ferry Landing and negotiating the lease of offices and a lab on the shores of Windermere.

Many of the decisions that the Board, myself and the executive have

had to make and execute over the last three years have been very difficult, but essential and should, with hindsight, have been made many years ago. I hope that the small part I have played in the last few years has left the Freshwater Biological Association in a better place than it was when I joined. I believe that the FBA needs to work closely in partnership with many of the organisations that we currently have built relationships with over the last decade. We also need to foster and continue to develop the freshwater community in the UK and grow our relationship with the European freshwater community through EFFS through using digital and traditional communications. The FBA needs to be able to move forwards with a new and energetic leader in place and become a significant advocate for freshwaters and their sound management.

I would like to thank all the staff, Fellows, the Board, especially Geoff Bateman, Ron Middleton, and Evan Dollar for all the support, guidance, and wise counsel over the last five years. I would like to request that everyone supports the Staff and Board through the next few months and years in what is undoubtedly going to be a very challenging but exciting and promising period in the Associations history. The changes that are currently taking place will hopefully mean that rather than concentrating our time and efforts on financial viability and the future of the estate, we can all concentrate on freshwaters.

To all of you, our members, thank you for your continued support to an inspiring organisation and one that I hope will continue to encourage 17 year olds and others to become interested and passionate about our precious freshwaters.

Bill Brierley
Former CEO of the FBA



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