fba News

FRESHWATER BIOLOGICAL ASSOCIATION

The Freshwater Biological Association Newsletter
No. 83 Winter 2021

COP26: Climate Change in Freshwaters

Large-scale release of endangered mussels in Cumbria

Caddisfly food and case-making preferences

Freshwater Algae Group Meeting at Malham Tarn

The hyporheic zone in river restoration

Rare temporary stream specialists in artificial habitats

FRESHWATER BIOLOGICAL ASSOCIATION

The Freshwater Biological Association (FBA) is an independent membership association and a registered charity.

Founded in 1929 we are dedicated to increasing the understanding and sustainable management of fresh waters.

Our aim is to encourage as many people as possible to be interested in fresh waters and understand the importance of sound evidence and information in protecting and managing our precious waters.

We do this by:

- Disseminating information through websites, publications, online webinars, meetings and courses;
- Providing high quality training both scientific and practical;
- Facilitating innovative and essential research, including undertaking targeted research;
- Providing sound independent advice and opinion

We have specialist facilities on the shores of Windermere in Cumbria which can be used for:

- Conferences and meetings
- Training courses
- Wet laboratory facilities

Building a freshwater community

We promote and share freshwater information and science through national and international scientific meetings, by hosting Annual Scientific Meetings and attending Regional Freshwater Group meetings. We value the importance of international collaboration, as a founding member of the European Federation of Freshwater Sciences (EFFS), and a keen coordinator in the biennial Symposium for European Freshwater Sciences (SEFS). Working closely with other organisations, on issues in freshwater and catchment management, we aim to encourage wider interest in freshwater biodiversity, and an understanding of sustainable management issues.

Sharing knowledge

We run a flagship **Freshwater Pearl Mussel** captive breeding ark, focussed in conserving and reintroducing the endangered mollusc into its natural habitat.

Having access to the expertise of our Fellows and external tutors, we run freshwater plant and animal identification courses for both specialists and enthusiasts both at our Windermere site and across the UK. We also offer bespoke sampling, recording and monitoring lab and field-based training. We work with, and welcome, partners, universities and participants from around the world!

Membership

Membership is open to individuals and organisations who are interested in freshwater science and wish to support the FBA. Members receive our regular newsletter, FBA News, and are entitled to discount on a range of FBA products including: publications, courses and facilities hire.

Annual membership rates for 2021 are as follows:
Individual Member..... £41
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FBA News **Article Submissions**

FBA News is published three times annually (Spring, Summer, Autumn/Winter) and is distributed to all FBA members. We welcome and encourage article submissions from our member community. These should be submitted electronically, as a Microsoft Word document or in the body of an email.

If you wish to submit an article, please contact Siobhan Noade snoade@fba.org.uk or Mark Battista mbattista@fba.org.uk

FBA **Membership**

If you have recently changed your contact information associated with your FBA Membership, please contact **Mark Battista** mbattista@fba.org.uk to ensure you receive any updates, promotions or notices concerning your membership

Cover photo: River mussel release by Mark Battista

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Foreword

Photo of Richard Chadd

It's with great sadness and heavy hearts that we announce the untimely death of Board Member & FBA News Editor Richard Chadd. Richard was an incredibly influential figure in the world of freshwater, a long-term champion for invertebrate monitoring & assessment, a much-loved colleague, teacher & more.

Throughout his life, Richard inspired so many with his knowledge, wisdom and lively conversation. He will be very sorely missed by all of us here at the FBA and by all who had the pleasure of knowing him. Our thoughts and well-wishes are with his family at this difficult time.

We invite readers, friends and colleagues to send us their memories, pictures, tributes and stories of Richard for inclusion in the spring edition of FBA News when we look forward to featuring a celebration of Richard's life and eminent career in freshwater.

In this Issue

A huge thank you to all who have contributed to our autumn/winter edition and provided us with some wonderful insights into their work.

Firstly, we hear from Jane Thomas about the fascinating work she has undertaken to describe what plant species caddis fly larva (*Glyphotaelius pellucidus*) eat and wear. These observations give us a fantastic insight into the diet and fashion (!) preferences of this species. We also hear from a number of our very own fellows and their associated colleagues about their work on the importance of the hyporheic zone in river restoration, and the importance of ditches to temporary stream specialists such as the mayfly *Paraleptophlebia werneri* and stonefly *Nemoura lacustris*. We also have an update about the freshwater pearl mussel (*Margaritifera margaritifera*) breeding and release work being undertaken by FBA and West Cumbria Rivers Trust and information about the joint Quekett/British Phycological Society freshwater algae meeting at Malham Tarn.

Dr Katie Whitlock provides a useful review of the book "Fishes of the Genus *Sinocyclocheilus* (Cypriniformes:Cyprinidae) in China: Systematics, Biology, Biogeography and Cave Adaptation", we have an update from Executive Director Simon Johnson, two "In memoriam" pieces about Clive Pinder and David Kinsman and news from the Riverfly Partnership.

Once again, a big thank you to all of our contributors. If you would like to contribute to the next issue of FBA News, please contact info@fba.org.uk

Observations on food and case-making preferences of larvae of the caddis *Glyphotaelius pellucidus*

Jane Thomas
Caddis Recorder

Jane Thomas, a retired teacher and keen caddis recorder ran an experiment at home in the interest of figuring out the preferred food choice and case making materials of ***Glyphotaelius pellucidus****.*

Figure 1: Photos displaying the life cycle of the caddisfly larvae *Glyphotaelius pellucidus*. From the top left, clockwise are the egg sack hanging on a leaf, caddis larvae moulting and adult *Glyphotaelius pellucidus* before their release.

In early September 2020, I collected a blob of jelly hanging from a Teasel leaf over a concrete path. Initially I had no idea what it was but a little research suggested it was most likely an egg mass of *Glyphotaelius pellucidus* and they should have been laid on vegetation overhanging a pond. I took the eggs home to raise.

I set up a basic tray of pond water with the leaf suspended over the side – the jelly just dipping into the water. Gradually the jelly became less firm and I could see the larvae moving about inside it. Two weeks after collection, the eggs started to hatch, and over the next couple of days, all came out of the jelly into the water.

When I set the tray up, I had added a handful of vegetation from my pond, which included Duckweed, Starwort and the moss *Cratoneuron filicinum* which grows in abundance in my pond. The tiny larvae made their first cases of whole Duckweed leaves or Starwort roots chopped into sections.

Since I had a batch of caddisfly larvae I thought it might be interesting to see which leaves the larvae would eat, and which they would wear – I had read that they eat Sycamore and wear Oak, but suspected that there could be a broader range of leaves used.

I set up a soaking tray so that all leaves could be soaked for at least a day in rainwater before I offered them, and generally I only offered brown withered leaves – or leaves that had been shed naturally. I did also offer several different fresh green leaves.

As the larvae grew, I moved them into a small tank in my garage; this had an air bubbler. The temperature was generally about 2°C above the ambient outside temperature and the lowest temperature I recorded was 1°C. Each week I removed the build-up of droppings, using a pipette and made sure there was a supply of the different foods and case-making materials.

I introduced different leaves to the tank, and observed if they were eaten or worn – or both (Table 1). These activities produced quite different damage to the leaves. A leaf was pecked at if it was eaten, usually the veins being left behind. If it was worn, then large semi-circular areas were cut out – often very quickly after a leaf was added to the tank. Leaves were offered for a few days then removed if no interest was shown. Dead Sycamore leaves, were always available and they did seem a popular food, with leaves completely consumed apart from the veins. The provision of Sycamore leaves was important as it ensured that choices were made not out of desperation at having no other food available.

As the larvae grew they became able to tackle tougher leaves but with some leaves, it was not obvious if they were being eaten, for instance the moss in the tank, which the larvae tended to hide in. To find out what they were eating, I examined some of the droppings under the microscope – it was quite obvious they were eating everything in the tank – including the moss, Duckweed and Starwort (leaves and roots) - fragments of all were clearly present in the droppings. The food did not seem to have been broken down much during digestion.

Did you know?
Only some caddisfly larvae make cases for protection. Other species have hard plates on their exoskeleton to keep them protected instead.

Figure 2: Some examples of food sources offered to the caddis larvae, with the circle cut-out in the top leaf

Regarding food preferences, I found that the larvae showed little interest, if any, in fresh green leaves from the garden, such as Dandelion, Creeping buttercup or Bramble (to eat or incorporate into a case). They were very interested in any leaves that you might expect to find in a pond, such as deciduous tree leaves, withered Meadowsweet, Yellow flag iris, and rotting Bogbean – they were also keen on withered Dock leaves. I had left the Teasel leaf that the eggs had been laid on in the water, and once it was fully withered and slimy, they ate that too.

On the suggestion of Sharon Flint, I offered the larvae various vegetables – they were extremely keen on carrot and any colour of sweet pepper I offered them.

There were some leaves that the larvae only ate, and

some they only wore, but a considerable number that were both eaten and worn. There did seem to be some nibbling of cases of other larvae which Ian Wallace says is very common in the wild and which he calls case cannibalism.

It was interesting to see that in the case of Sycamore, any tar spots were cut out and added to their cases rather than being eaten and when I offered a Hawthorn leaf with a galled base, they seemed to eat the galled part first.

I offered well soaked Oak leaves, which were used for cases, but they didn't seem that keen, much preferring things like Alder and Ash – or Sycamore.
Observations on pupation and emergence of the adults.

As the larvae grew and the tank became increasingly crowded, I removed some of the larvae and returned them to the wild. However I ended up with 11 larvae, which pupated. By mid-February (22 weeks after hatching) larval activity had ceased. The pupal cases it transpired were very well hidden amongst the materials in the tank so I decided not to disturb them too much for risk of damage. I added a large stone and some dead water mint twigs. The first adult emerged at the end of the first week in May (11 weeks after I last saw active larvae), climbing up one of the water mint twigs to emerge overnight. The rest of them emerged over the next 2 weeks. Nine climbed the twigs to emerge but two emerged directly from the surface of the water, which Ian Wallace says has not been observed for this species before. Emergence was always over-night, and despite checking the tank frequently during the evenings, I did not see any actually emerging, so I guess it happened in the early hours. The adults were all ready to fly when I saw them in the morning.

Figure 3: Caddis larvae in a self-constructed case from materials offered to it by Jane Thomas during her experiment

Thanks

Many thanks to Sharon Flint for her help and encouragement and Ian Wallace for some additional comments.

I found this a very enjoyable project – the larvae seemed quite feisty little characters and I spent many hours watching their antics. I have made an album following the progress of the larvae as they grew: **https://flic.kr/s/aHsmQzUUCB**

Caddisfly larvae food & case preference

Table 1: The table displays the food source offered to the caddis larvae and indicates whether the food source was worn or eaten. The level of interest in the food source is indicated by a number scale: 1=very keen, immediately eaten or worn, 2=moderate interest and 3=little to no interest.

Food	Eat	Wear	Level of Interest	Comments
Alder	N	Y	1	Leaves cut up and worn as soon as they landed in the tank
Apple	Y	N	2	
Ash	N	Y	1	All cut up for cases
Beech	Y	Y	2	Mainly eat
Bogbean (soggy rotten leaf)	Y	N	1	Eaten immediately
Bramble (fresh green leaf)	N	N	3	No interest
Bramble (withered leaf)	Y	N	2	Just grazed the top surface. Not much interest.
Buddlea (shed green leaf, frosted)	Y	N	2	
Carrot	Y	N	2	Carrot skin not eaten.
Cherry (ornamental)	N	Y	2	
Crab apple	Y	Y	3	Not much interest
Creeping Buttercup (green leaf)	N	N	3	
Dandelion (green leaf)	N	Y	3	Not much interest
Dock (rotten leaf)	Y	N	1	
Dock (withered leaf)	Y	Y	2	Mainly eat
Dogwood (green mottled leaf with brown edges)	Y	Y	2	Brown edges eaten, greener parts used for clothing
Duckweed (fresh green leaves)	Y	Y		Earliest clothing with Starwort roots
Elm (yellow mottled leaf)	Y	N	2	
Field maple	N	Y	2	

Frogbit (rotten leaf)	Y	N	3	Not much interest, but the leaves floated and the larvae were too heavy to easily reach the surface when this was offered
Green pepper	Y	N	1	Enthusiastically eaten. Skin left and worn occasionally.
Hawthorn	Y	N	2	Leaf base galled by Dasineura crataegi – they seem to have eaten the galled part first
Hazel	Y	Y	2	Wear first then eat very slowly
Hazel (green mildewed leaf)	N	Y	2	
Hornbeam	N	Y	2	
Horse Chestnut	Y	N	1	Very keen on this
Japanese knotweed	Y	Y	2	
Laburnum	Y	N		Soaked separately and offered to 2 larvae separately. One had no interest, the other ate a little from the edge of the leaf
Lombardy poplar	N	N	3	
Meadowsweet (withered leaf)	Y	Y	1	The best thing since orange pepper! Mainly eaten
Oak	N	Y	2	
Orange pepper	Y	N	1	Very keen on this
Pond moss	Y	N		*Cratoneuron filicinum*
Red pepper	Y	N	2	
Rose	Y	N	3	Not much interest
Silver birch	Y	Y	2	
Starwort (fresh green leaves)	Y	Y		Roots and leaves worn – earliest clothing was chopped Starwort roots and Duckweed leaves
Sycamore	Y	Y	1	Mainly eat. Leaves reduced to just veins. Black tar spots are worn.
Teasel (natal leaf)	Y	N	2	The eggs were laid on teasel, and the withered leaf remained in the tank after hatching
Walnut	Y	N	1	
Water mint	Y	N	3	Not much interest
White water lily (soggy rotten leaf)	Y	N	1	
Willow	N	Y	2	Not used when first offered, but cut up and worn when offered later.
Yellow flag iris (withered leaf)	Y	N	2	
Yellow pepper	Y	N	2	

Figure 4: Various leaves offered to the caddis larvae during the experiment

Book Review

Dr. Katie Whitlock
Environment & Business Senior Advisor (NERP), Environment Agency

This article details a review of the book **Fishes of the Genus *Sinocyclocheilus* (Cypriniformes: Cyprinidae) in China: Systematics, Biology, Biogeography and Cave Adaptation** by Y. Zhao, C. Zhang & G. Proudlove, kindly and helpfully reviewed by Dr. Katie Whitlock from the Environment Agency

I have to say that before encountering this book, I was completely oblivious to the fact that China has an extensive karst landscape and caves that, at least in my mind, are more commonly associated with Central and North America. These karst landforms support a large number of cave fishes, many of which are endemic to China. These unique habitats offer perfect conditions for evolutionary processes as their inhabitants adapt and evolve to these subterranean environments. A perfect book to intrigue a fisheries scientist with a background in evolutionary genetics.

karst landscape: *landscape underlain by limestone which has been eroded by dissolution, producing ridges, towers, fissures, sinkholes and other characteristic landforms.*

Whilst fairly niche, this book does provide the reader with a broad introduction to the biodiversity of subterranean fishes on a global scale and the challenges involved in their study. Even the definition of a cave fish is apparently more complicated than it may first seem, with the authors seeking to draw a consensus from previous classifications. A **cave fish** 'should be a species that, under a natural state of affairs, as a distinctive population, must complete all or most of their life cycle in dark caves or underground environments. Without dark caves or underground environments, they would not be able to properly complete their lifecycle'.

The main chapters of the book then present a deep-dive (excuse the pun) into the endemic (to China), and species-rich genus, *Sinocyclocheilus*. Although species from the genus were first described in the early 1900s and have been the focus of considerable research, the book highlights significant challenges in resolving some of the most fundamental basics, from classification and ecology to physiology, behaviour and ultimately how to conserve small, isolated populations of endemic species.

Cave fishes are **weird and wonderful** and the book contains good quality photographic plates of the majority of the individual species within the genus. This beautifully illustrates the unique adaptations described in the introductory chapters including degeneration of the eyes, improved sensory capabilities (barbels, olfactory enhanced organs and developed lateral lines) and the 'humpback' and 'horn' structure developed by some species. The aptly named *Sinocyclocheilus broadihornes* and *S. rhinocerous* demonstrating this latter character, the function of which is apparently yet to be determined.

The book represents an **extensive and detailed scientific study** of the genus which brings together all available information and seeks to apply a consistent and rigorous approach to the analysis of specimens within different clades. In this respect it plays an important role in advancing understanding of the diversity and distribution patterns, providing an important platform of information for conservation work. Most cave fishes in China are classified as endangered, with the majority of species limited to an independent body of water or single cave. A total of 12 new species of *Sinocyclocheilus* were described during the in-depth research study. Without studies such as this, the chances of a species disappearing before we can discover them will only increase.

The importance of the hyporheic zone in river restoration

Tim Johns[1], Judy England[1] & Anne Robertson[2]
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*The **hyporheic zone** is an integral part of a river ecosystems, yet is rarely considered within river restoration. Here we present an over view of the importance of the hyporheic zone and why it should be monitored and assessed within restoration activities.*

Where one thing ends and another begins is sometimes hard to determine, and much like where the ocean meets the sky on a distant horizon it evokes a sense of mystery. The subterranean ecotone where the surface water of a river meets the groundwater below, is one such example. Termed the 'hyporheic zone', literally meaning underground flow, it describes the saturated zone below the base of a river, and extending horizontally into the floodplain, where these waters are in transition.

Figure 1: Sampling the hyporheic zone using a Bou Rouge sampler. Photo by Judy England.

The **hyporheic zone (HZ)**, first described by Orghidan (1959) over 60 years ago, has been the focus of much hydrological and ecological study, resulting in a recognition of its importance in river ecosystem functioning. Vital to this functioning is the connectivity between the surface river and the HZ seen in the vertical movement of water between the open stream and the groundwater; the hyporheic exchange flow. This dynamic and complex two-way flow controls the transport of solutes and is influenced by the river's physical features and prevailing chemical conditions. In essence the HZ acts as a **bioreactor for the river ecosystem**, the 'rivers liver' if you like, facilitating biogeochemical reactions, enabling energy, carbon and nutrients recycling and helping attenuate pollutants. The faunal community that dwell within the HZ - the hyporheos, play an important part in delivering these services; from biofilms, comprising bacteria and fungi, that metabolise dissolved compounds, to the protozoa which graze upon them helping sustain and invigorate the biofilm's reactive surfaces, to the meio- and macro-invertebrate fauna that mix and irrigate the sediments, stimulating biogeochemical activity.

The ability of the hyporheos to mediate these biogeochemical processes very much depends on the physical and chemical nature of the HZ, with sediment pore size and dissolved oxygen being important factors. Generally, larger particle size means larger

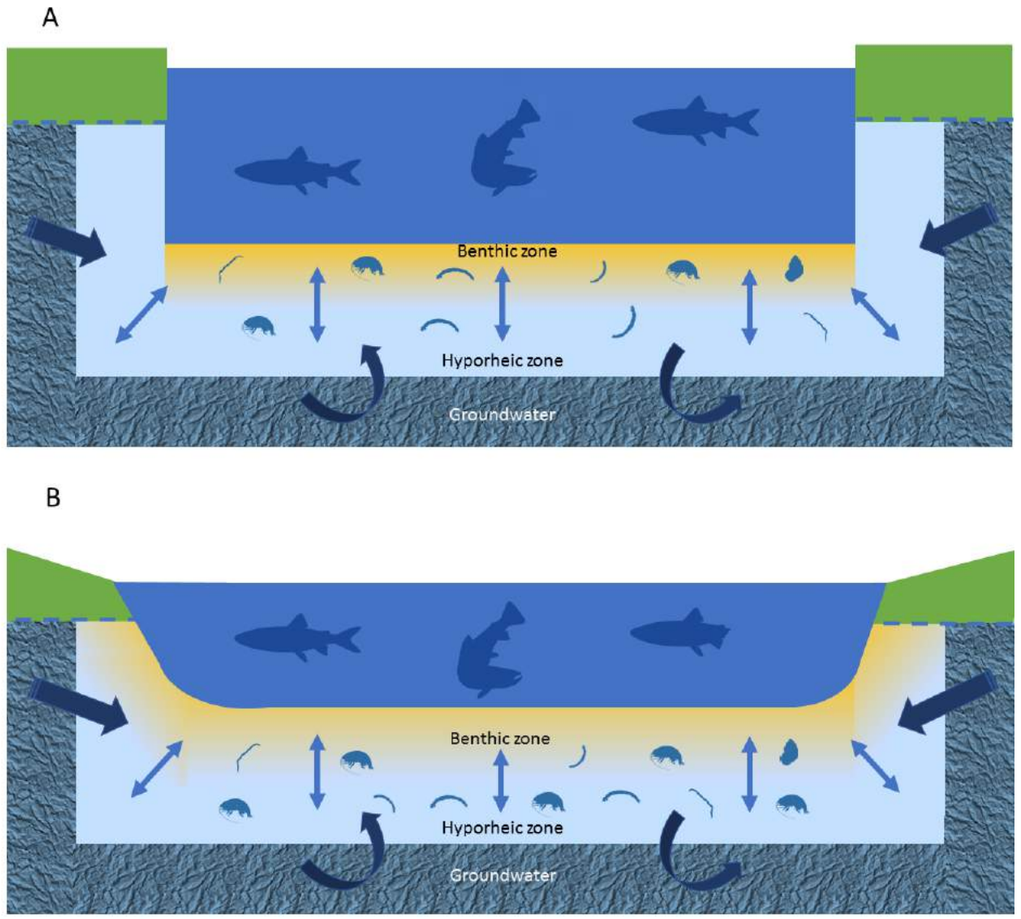

Figure 2: A schematic diagram of the hyporheic zone before (A) and after restoration (B).

pore size resulting in higher supplies of organic matter and dissolved oxygen to the hyporheos via the hyporheic exchange flow and also greater habitat availability for the hyporheos. Activities that reduce the porosity and permeability of the HZ, such as the blinding of interstices through an increase in fine sediment, perhaps as a result of agricultural activity, will negatively affect the composition, distribution and abundance of the hyporheos by limiting habitat availability and constraining the delivery of organic matter and dissolved oxygen. By decreasing the hydrological exchange the HZ can become disconnected from the rest of the river system and its biogeochemical functioning reduced.

The HZ is important in the life cycle of salmonid fish; they build their nests in this habitat and the young hatchlings spend some time living there before leaving for the benthic zone. The HZ is also home to a variety of invertebrate fauna. Some are temporary residents who may take refuge there for a short time from unfavourable surface conditions such as droughts and floods or who spend the early part of their lives there taking advantage of the relative lack of larger predators. Some invertebrates, typically those with a small body size that enables them to move through the interstices, are permanent residents. A small group of organisms, known as stygobites, are unique to the HZ and groundwater, and are of intrinsic biodiversity value.

Where rivers have been physically modified, such as for land drainage, realignment for mills and urban development, the river ecosystem, including the integrity of HZ zone, may be compromised. Vast sums of money are spent each year on restoration actions to restore natural river processes. However, appraisal of ecological benefits remains limited. Where monitoring and appraisal is applied, it often focusses on fish, plants or benthic invertebrate communities. Rarely is the HZ fully considered and it is unclear whether the benthic community condition serves as a realistic proxy for the health of the hyporheos. Ground-water-fed rivers such as chalk streams are of particular concern because flows that flush out fine sediments are rare and the HZ in these streams is especially vulnerable to clogging of the interstices resulting in a reduction in its bioreactor capacity and habitat provision.

We undertook a long term Before-After-Control-Impact assessment examining the removal of an impoundment on the River Lambourn on both the hyporheos and benthos. The Lambourn is a chalk stream located in Berkshire. An impounding weir structure was notched to restore hydraulic and sediment connectivity. The weir modification reduced the impounding effects of approximately 150 m of river and was accompanied with channel narrowing using reworked gravels and brushwood.

The results of the assessment (Robertson et al. 2021) found that the hyporheos and the benthos responded differently to the restoration activity. Five years after the restoration there was a clear signal of higher diversity in the hyporheos of the impact reach relative to the control reach, and diversity was higher than pre-restoration, likely as a result of improved surface water/groundwater exchange. In contrast, a signal of restoration on benthic assemblage diversity and composition was not detected. This appears to be a common finding and there is increasing recognition that reach scale restoration interventions can be fragile; beneficial effects may be reduced by disturbance to the system and reach-scale improvements may be short lived unless they are complemented with catchment-scale interventions such as changes in agricultural practices to reduce fertilizer and fine sediment inputs.

Thus monitoring the benthos cannot be used as a proxy for the health of the hyporheos and given the importance of the hyporheic zone in the provision of ecosystem function and services such as pollution attenuation and the supply of disturbance and predation refuges, it is clear that the hyporheic zone should be included in future monitoring protocols that aim to assess river restoration success.

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Ditching misconceptions:

Rare temporary stream specialists in artificial habitats

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Introduction

Ditches are among the most widespread aquatic habitats in the UK (Brown et al., 2006), providing drainage for the country's dense road infrastructure and extensive agricultural land. Despite their prevalence, ditches are often assumed to be species-poor due to their exposure to road runoff, pesticides and fertilisers. However, ditches can support high aquatic macroinvertebrate diversity (Hill et al., 2016), with some ditches rivalling the number of families recorded at unimpacted river 'reference' sites (Gething & Little, 2020). Thus, ditches may play a key role in increasing habitat provision for macroinvertebrates, and could prove particularly valuable in buffering local populations against disturbance events such as flash floods, drying or pollution incidents, which alter community structure and function.

Spatially isolated species with narrow environmental preferences, such as the temporary stream specialists in the chalk streams of southern England, may be particularly vulnerable to disturbance events (Macadam et al., 2021). These specialists, including the Nationally Scarce mayfly *Paraleptophlebia werneri* (Macadam, 2016), the Nationally Rare stonefly *Nemoura lacustris* (Macadam, 2015) and the IUCN Vulnerable diving beetle *Agabus brunneus* (Foster, 2010) are adapted to predictable flow cessation and drying events, which they may require to complete their life cycles (Tapia et al., 2018; Macadam et al., 2021). As such, these specialists are often thought to be restricted to drying headwater streams (often termed 'winterbournes'), leaving their populations with few sources of colonists to support recovery after disturbance events, such as abnormally wet years with no dry phase. However, the discovery of *P. werneri* juveniles in Suffolk ditches (Chalkley, 2006) suggests that winterbournes and ditches can both provide suitable habitat for such specialist species (Figure 1). Ditches increase the area and diversity of habitats within catchments (Armitage et al., 2003; Gething, 2021), and may thus represent a refuge from which specialists can repopulate winterbourne assemblages lost during disturbance events.

To determine whether ditches consistently provide suitable habitat, and thus have the potential to rescue nearby stream-based populations impacted by disturbance events, we undertook a field campaign to locate temporary stream specialists.

Method

We defined streams as the main watercourse within a sub-catchment, with their channels being predominantly groundwater-fed and ranging in form from heavily modified to semi-natural, while ditches were defined as channels engineered for surface water drainage. We sampled 21 stream and 22 ditch sites that experience flow cessation and/or drying across nine sub-catchments in southern England (Figure 2). Our survey identified one stream and at least one ditch in each sub-catchment, except the Candover Brook sub-catchment, where we found no ditches. We nonetheless surveyed Candover Brook—which supports *P. werneri* and *N. lacustris* populations (Bunting et al., 2021)—to characterise specialists in a temporary stream lacking nearby ditch-based populations. Samples were collected from each

Figure 1: The Candover Brook (left) and the River Lavant (right) winterbournes, which share similar habitat characteristics with nearby ditches (centre).

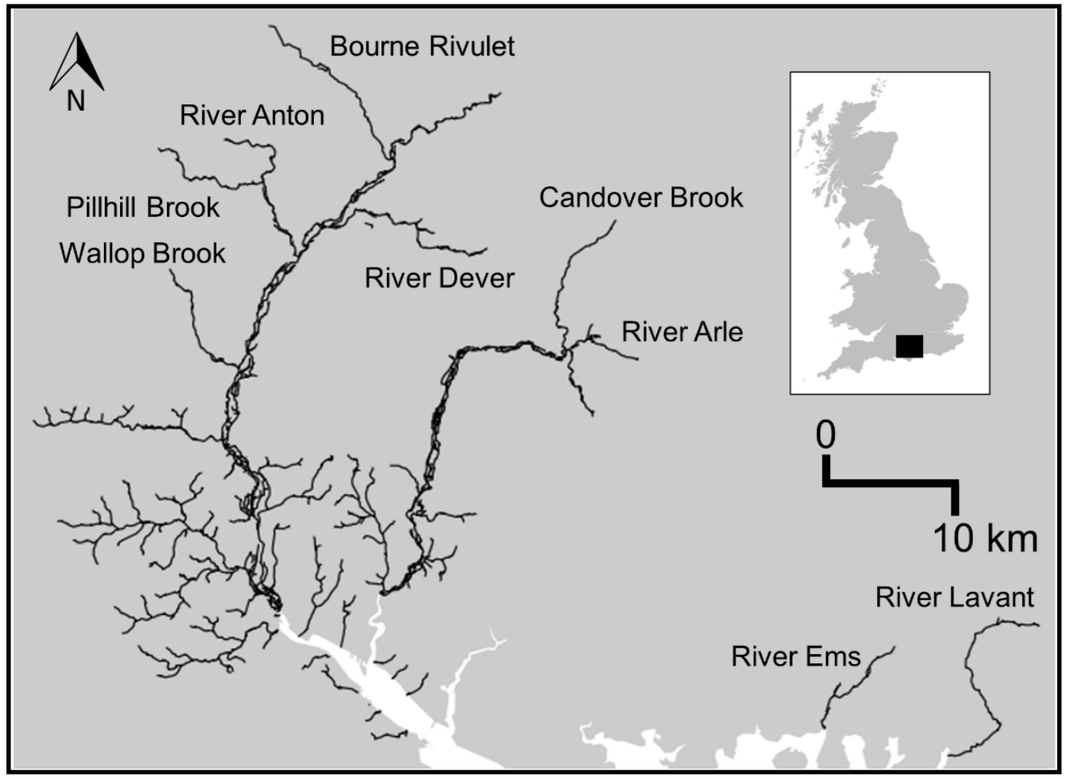

Figure 2: The study area in southern England, indicating the nine sub-catchments.

site in March, May and June using a 1-minute kick sampling method, and temporary stream specialists were identified. We used iRecord to compare our results with previous records of temporary stream specialists in the study area.

Results and Discussion

We recorded two specialists, *Paraleptophlebia werneri* and/or *N. lacustris* (Figure 3), in streams in five of the nine sub-catchments. In three of these sub-catchments (i.e. those of the Bourne Rivulet and Rivers Ems and Lavant: Figure 2), at least one specialist was also recorded in a ditch. These occurrences show that ditches can provide suitable habitats for specialists—which are therefore not restricted to winterbournes, as previously thought (Tapia et al., 2018).

One of the two sub-catchments in which specialists were identified in the stream but not in ditches was the Candover Brook, in which no ditch sites were identified. The second (Pillhill Brook) contained a single ditch site with "flashy", ephemeral flow, which is only wet in the hours–to–days after heavy rainfall (Figure 4), and supported only true fly larvae and oligochaete worms. The erratic hydrology of this ditch contrasts with the seasonal wet–dry cycle of many winterbournes (Berrie, 1992), which likely prevented specialists from sustaining populations.

In sub-catchments that supported specialists, *P. werneri* and *N. lacustris* were frequently the most abundant insects in ditches and were often the only representatives of their respective orders. Ditches supported lower abundances of the specialists than streams (mean ± SE: 17 ± 10 and 45 ± 13 individuals per sample, respectively). Additionally, sub-catchments with ditch populations supported a higher abundance of specialists in their stream than those lacking ditch populations (69 ± 21 and 3 ± 2 individuals per sample, respectively). The higher abundance of specialists in sub-catchments with nearby ditch-based populations suggests that ditches help to maintain stream populations, and in particular may act as refuges that provide colonists which enable rapid recovery of stream populations after disturbance events (see the concept of "rescue effects" in Sarremejane et al., 2021).

Nemoura lacustris have previously been reported from 17 temporary streams in southern England (Tapia et al., 2018; Bunting et al., 2021). We found *N. lacustris* in five streams, two of which (Bourne Rivulet and Pillhill Brook) we believe are new records. In contrast, our *P. werneri* records are not new additions to the fauna of any sub-catchments, but do extend the species' known range within some streams. For example, our observations extend records of *P. werneri* from

Figure 3: Temporary stream specialist mayfly *Paraleptophlebia werneri* (left) and stonefly *Nemoura lacustris* (right) specimens from ditches.

Figure 4: A ditch in the Pillhill Brook sub-catchment, which flowed in response to rainfall (left) but was otherwise dry (right).

Figure 5: The ditch-like winterbourne headwaters of the Candover Brook taking road run-off during a heavy rainfall event.

1 km to 6 km upstream of the perennial head on the Bourne Rivulet.

Our study demonstrates that ditches, although often perceived as sub-optimal aquatic habitats, play a role in supporting populations of Nationally Rare and Scarce temporary stream specialists. Given that many winterbournes now share physical characteristics with ditches, and that winterbournes and ditches are exposed to comparable human impacts (e.g. road run-off: Figure 5), it is perhaps unsurprising that specialists that tolerate winterbourne conditions can also survive in ditches. Thus, we call for further research to characterise the full range of within-catchment habitats that support populations of rare specialists, and for the biodiversity value of temporary waterbodies to be more broadly recognised during conservation and restoration initiatives.

Acknowledgements

We thank Andy House and Wessex Water Ltd. for access to data that inspired this project, and Gloria

Tapia for guidance on specimen identification. We also thank Maggie Shelton for landowner introductions, the landowners for access to sampling sites and Jessica Goldring, Avreen Roque, Magdalena Chaborska, Olivia Greenway and Sam Davies for help with sample processing.

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Are You A Riverfly Fanatic?

If so, check out www.riverflies.org for projects that you can get involved in, or email naomi@riverflies.org for more information

Population reinforcement of the endangered freshwater pearl mussel in Cumbria

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Figure 1: The Irt is an oligotrophic (nutrient poor) river, once home to one of the largest pearl mussel populations in England.

In 2019, the Freshwater Biological Association (FBA) and West Cumbria Rivers Trust (WCRT) embarked upon an ambitious project to restore a degraded mussel river in West Cumbria, and to carry out large-scale population reinforcements to save the population from extinction.

The **River Irt** catchment in Cumbria is approximately 115 km^2 with the river covering 22km from its source at the mouth of Wast Water to the sea. This boulder/cobble/gravel river (Figure 1) meanders through a mosaic of habitat types from semi-natural wet woodland at the top of the catchment, through to more intensive dairy and arable farming at the bottom. Repeated mussel surveys carried out between 1995 and the present documented a slow decline in abundance of the freshwater pearl mussel, with most recent estimates putting the population at a critically low level of around 300 individuals. The freshwater pearl mussel (*Margaritifera margaritifera*) can live to be over 100 years old (Bauer, 1992) but populations have been declining for several decades due to pressures such as land-use intensification, poor water quality, siltation and declines in salmon and trout populations, which the freshwater pearl mussel uses as a host for it's young (**find out more here!**). These pressures particularly affect juvenile mussels, which are more vulnerable to poor substrate

Figure 2: Captive breeding allows the control of environmental conditions so that juveniles can survive their most vulnerable life cycle stage and grow large enough to be released into the river. These mussels are 7 years old and average around 17 mm in length.

conditions and typically die before they are old enough to contribute to the next generation. Today, mussel populations tend to consist only of aging adult mussels, with no juveniles surviving to replace them when they die. As a result, it was estimated that the River Irt population had only 30 years until the population was lost.

Supported by United Utilities, Natural England and the Environment Agency, staff from FBA and WCRT spent the summer releasing 1300 juvenile mussels back into the River Irt, boosting the population by >400 % in the space of two months. Most

Figure 3: Restoration activities carried out by WCRT include re-connecting paleo-channels (top left and right before and after respectively), fencing the river bank to create buffer strips (bottom left) and replacing boulders in the river to increase habitat diversity (bottom right).

importantly, these population reinforcements are starting to redress the aging demographic and bring juvenile mussels back to the river so that they can spend the next 100 years contributing to the next generation and helping to kick-start the population. Juvenile mussels are reared at the FBA's Freshwater Pearl Mussel Ark to a size where they can survive life in the river (Figure 2). This usually takes around eight years! When they drop off the fish, juvenile mussels are tiny (~0.4 mm length!) and take a long time to grow. By seven years old they are typically around 20 mm long and are more capable of surviving the sub-optimal habitat currently found in mussel rivers. Whilst the FBA is busy rearing small mussels at the Ark, WCRT is busy with the huge task of catchment-scale restoration, repairing degraded habitats and liaising with land managers and local fishing groups to improve habitat diversity and quality (Figure 3). This work follows on from three years of catchment restoration activities in the Irt undertaken by WCRT between 2015 – 2018, funded by Biffa Award. It's over this kind of timescale (>10 years) that we can hope to make a difference to this population and start to turn around its fortunes.

So, how are we carrying out these population reinforcements? How will we know if they have worked? What kind of monitoring will be needed in future? We are fortunate that we have a research budget so we can delve into these questions in some detail to try and inform our future release strategies both on the Irt and in other mussel rivers. We spent the first two years of the project researching previous release methods (literature review), considering how our releases could adhere to best-practice guidelines (IUCN/SSC, 2013; Killeen and Moorkens, 2016), honing our captive breeding methods at the Ark to increase output, carrying out small-scale biomonitoring trials using mussel silos (Barnhart et al., 2007), and doing habitat surveys to identify priority areas for releases and restoration (Figure 4). All of these activities identified three sites which should be capable of supporting high juvenile survival, plus one site where there are questions about its suitability, but where the habitat condition was excellent. We also had encouraging indications that one of these priority sites would support high survival due to the persistence of juveniles released in 2017 as part of a

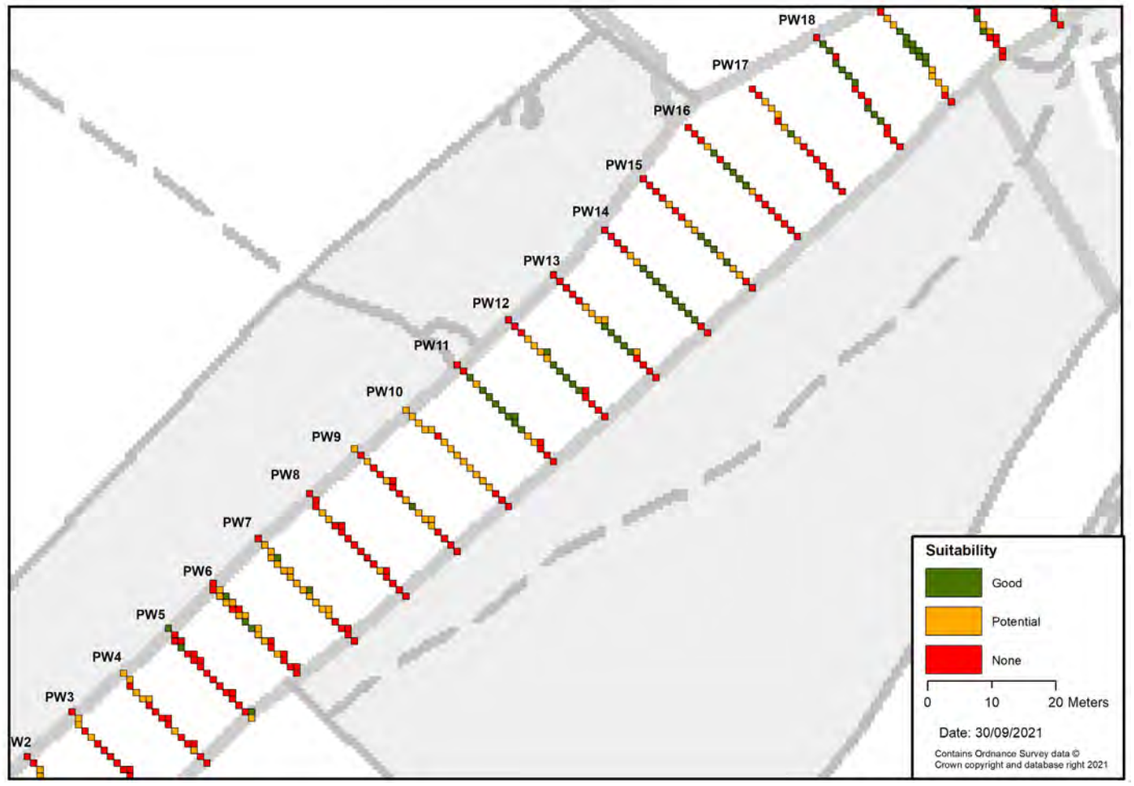

Figure 4: Example of site surveys looking for suitable juvenile mussel habitat. Green = habitat suitable, orange = habitat is potentially suitable in some years, red = habitat unsuitable for juvenile mussels.

pilot study during the preceding project. We have a healthy 'stock' of juveniles at the FBA Ark with >3000 mussels across three age cohorts ready for release. Juveniles ear-marked for release in 2021 ranged in size from 14.5 - 70.7 mm (median = 20 mm) and all were large enough to tag which enables future monitoring activities. Mussels were tagged with two different methods. A simple numeric tag attached to one valve with super glue allows for quick and easy identification of visible mussels in the field, whilst a **PIT (Passive Integrated Transponder) tag**, attached to the second valve with dental cement, enables us to monitor individuals which are buried and therefore impossible to see without destructive sampling methods (Figure 5). The unique code of each PIT tag is picked up by antenna and stored on a reader for analysis at a later date (Figure 6).

This year (2021) we began large-scale releases of tagged mussels at the three identified priority sites and released between 300 and 600 individuals at each site (Figure 7). At the fourth 'questionable' site, we

Figure 5: Hallprint tags (yellow) and PIT tags covered in dental cement help us to monitor juvenile mussels on the surface and within the sediment.

released 50 individuals to test site suitability. Most of these released mussels are still juveniles and will only become sub-adults and start breeding when they are around 12 years old and reach approx. 65 mm. That means that the population is not out of the woods yet. Continued catchment-scale restoration, monitoring and additional population reinforcements of a similar scale will be needed over several years to reestablish a functioning and self-sustaining population. Both

Figure 6: Scanning the river bed for hidden mussels using a Biomark antenna and reader.

FBA and WCRT are dedicated to continuing this vital work in the catchment for this population and hope it will provide some useful learning points for other projects attempting to achieve similar objectives. Watch this space for future updates!

Figure 7: Juvenile (arrow) mussel placed next to an adult in the river.

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Find Out More About Our Pearl Mussel Projects

Learn about the Pearl Mussel Ark Project here:
https://bit.ly/3vEZrjB

Learn more about our Freshwater Mussel Reintroductions Project highlighted in this article here:
https://bit.ly/2XwJe3h

Support our work here:
https://fba.org.uk/donate

ASSOCIATION NEWS

Executive Director's Column

"We now have a clear plan for organisational stability and growth"

Simon Johnson
Executive Director
sjohnson@fba.org.uk

I am hugely honoured and excited to be the FBA's new Executive Director.

Since my arrival in August, I have been working with the Chair and Board to undertake a review of our operations and develop a strategic growth plan that will guide us to our centenary, in 2029.

Our plan will be enabled by three interlinked "strategic priorities" that will underpin our work over the next 8 years.

1. Freshwater Science

Lies at the heart of everything we do. FBA will deliver, develop and disseminate targeted freshwater science. This will enable better and faster action to address the pressures (and gaps in knowledge) affecting freshwater habitats and species.

2. Advocacy and Learning

Increasing awareness of the critical importance of freshwaters and the need for conservation and science action. FBA will provide high quality, engaging and accessible freshwater science training/learning opportunities for professional, civic and educational audiences.

3. Organisational Strength

FBA is acknowledged as a professional, effective and financially resilient NGO that is attractive to members, funders and partners. A safe pair of hands!

We now have a clear plan for organisational stability and growth. We will build on our strengths, increase our influence/income and advance action-focused freshwater science to benefit people and nature.

I look forward to keeping you informed about our progress.

Simon Johnson
Executive Director

Joint Quekett/British Phycological Society freshwater algae meeting at Malham Tarn Field Centre, North Yorkshire

Allan Pentecost
FBA Fellow

Photo of Malham Tarn by Martyn Kelly

The Malham Tarn area of North Yorkshire is situated among some of the best karst landscape in England. It is also renowned for its Tarn and associated wetlands which enjoy RAMSAR status and possess a rich and varied flora. The freshwater algae of this area have been studied for over a century beginning with the Wests, father and son who visited in the last decade of the 19th century. Soon after the Field Studies Council became established in Tarn House after WW2, John Lund was asked to run a freshwater algae course. This he did through the 1950's and it culminated in an important paper on the algae of the area which soon inspired others to visit and undertake research. As a result, the Tarn and its surroundings is one of the most intensively studied areas for freshwater algae in Britain and indeed in Europe. It was therefore considered a good location to hold an informal but well-planned meeting on the algae with coordination by FBA Fellow Martyn Kelly.

The weekend began with a field trip to upper Gordale, where Gordale Beck and some of its feeder springs are accompanied by several highly calcareous flushes that deposit travertine (calcareous tufa). They are known for their rich cyanobacterium flora and collections were made from a good many areas. The area is noted particularly for its abundant calcified *Rivularia* colonies and the rare desmid *Oocardium stratum* although the latter was not seen on this visit. Some members of the group also collected phytoplankton from the Tarn sluice and were delighted to find colonies of the cyanobacterium *Gloeotrichia echinulata*. Friday evening was spent examining the material after an introductory talk on the Malham algae. The next morning was spent examining the extensive wetlands on Tarn Fen, to the west of the Tarn. A good boardwalk made access to the site easy and we sampled from several areas known to have a rich algal flora. These were the two fishponds which date back at least to the 19th century. Although dug out of peat, they receive some calcareous water from adjacent seepages. They are now becoming filled with vegetation and peat but the main pond has abundant *Utricularia* making it a good spot for collecting desmids. The second pond has recently been invaded by *Phragmites* and open areas of water were scarce although bryophyte squeezings yielded additional species. We then proceeded to the edge of Tarn Moss, a much more acidic spot than the fishponds but the Moss ponds were not sampled on this occasion. We proceeded now to the 'Midge Pits', a series of over a dozen deep pits dug into the peat about 30 years ago to encourage midge populations which were being studied at the time. Their edges are now degraded and the water mostly covered by *Sphagnum cuspidatum*. An earlier study had shown a gradient of alkalinity and pH in the pits so we sampled two that had been reported to have contrasting chemistries. Finally, we proceeded to a site where some research had been undertaken on the euglenoids of *Sphagnum* then back to the laboratory where the material was examined.

Plenty of material was collected and everyone found something of interest, although the fishponds desmids were not as diverse as they have been in the past. The algae of the two midge pits were few in number and there was no significant difference in the pH or conductivity of the water, the situation has clearly changed since the previous study. Further talks were given by Martyn Kelly (benthic ecology), Elizabeth Haworth (problems in diatom identification), David John (algal classification and identification) and Zainib Henderson (algal capture by coverslip). Zainib surprised many of us with her account of freshwater foraminifera.

Sunday was spent in the laboratory with the examination of the material, interspersed with a number of informal discussions. The previous few weeks of dry weather meant that the Dales streams were often reduced to trickles or seeps leaving in places large areas of damp filamentous green algae at their edges. Such algae consisting largely of the Zygnemales are a conspicuous feature of the area. Members of the group cannot be properly identified unless reproducing but the dry weather meant that a good number were found in fruit and could be named for the first time.

I think it is safe to say that everyone gained useful knowledge from the meeting and appreciated the opportunity to talk about algae and discuss wider aspects of freshwater biology and we have Martyn to thank for organising the meeting and making it a successful time. We also acknowledge the support given by the British Phycological Society and the Quekett Microscopical Society, several of whose members were in attendance.

Special thanks to all participants: *Chris Adams, Anne Barbour, Joan Bingley, Julie Gething, Zaineb Henderson, Dannae Hesketh, David John, Judy John, Liz Haworth, Heather Kelly, Martyn Kelly, Mel Lacan, Clare Liversage, Allan Pentecost, Anne Phillips, Geoff Phillips, Liz Phillips, Malcolm Scott, Paul Smith, Peter Vaughan, Kris Westerberg-Liptrot, Nicola Wiltshire.*

Climate Change in Freshwaters

A Call for Urgent Action

In the run up to COP26, the World Aquatic Scientific Societies highlight the immense threats faced by aquatic ecosystems and call for urgent action on climate change. This alarming message puts water resources and aquatic biodiversity front and centre. Indeed, freshwaters are both disproportionately important and disproportionately at risk from climate change and other human pressures. Although freshwater ecosystems host 10 times the biodiversity per area than the land and the sea, they are often overlooked.

Freshwater vertebrate populations are declining at a rate almost double that of those on land and in the sea surface, while the planet's lakes are warming more rapidly, on average at almost three times the rate of the latter. And yet freshwaters are severely underrated in calls for action on climate change and the global biodiversity crisis. The Convention on Biological Diversity's framework "to preserve and protect nature and its essential services to people" focuses on the land and the sea, overlooking the pivotal role of freshwaters in the earth system. The Freshwater Biological Association provides essential conservation actions, long-term data, and training to equip amateurs and professionals to engage with the nature and climate emergencies. In the midst of COP26, we echo the call from WWF and the World Aquatic Scientific Societies to encourage world leaders to recognise the extraordinary importance of freshwaters. This is easily achieved by making a small textual change – focus on the land, freshwaters, and the sea. That tiny change has huge implications for the natural world and our place in it. Freshwater ecosystems must no longer be an afterthought. They are the planet's most essential support for life – human and beyond.

We would really appreciate it if you could take the time to share posts in regards to this on our social media channels and/or disseminate among your contacts.

Statement of World Aquatic Scientific Societies on the Need to Take Urgent Action against Human-Caused Climate Change, Based on Scientific Evidence

The Riverfly Partnership

Hosted by the Freshwater Biological Association

The Riverfly Partnership is a dynamic network of organisations, representing anglers, conservationists, entomologists, scientists, water course managers and relevant authorities, working together to: - protect the water quality of our rivers; - further the understanding of riverfly populations; - and actively conserve riverfly habitats.

Thank You

We take this opportunity to thank all involved for their continued efforts and support towards the Riverfly Monitoring Initiative in such unprecedented circumstances. Despite the pandemic, volunteers have persevered to deliver some amazing results.

From January to July 2021, volunteers have:

- Uploaded **3778** records to the ARMI database
- Captured information from **757** sites, in **349** rivers, across **105** catchments.
- Highlighted **197** trigger level breaches.

We are thrilled with this progress and cannot thank them enough!

During the pandemic, we have been convening with hub coordinators and tutors to deliver training in a way that is safe and accessible for all. If you completed your training this year, you will know that a large portion of the theory material was delivered online, along with an end-of-study test. This format has worked very well, with over 500 tests undertaken since the online material was released. A huge thank you to all of our coordinators and tutors for their flexibility and continued enthusiasm while running with this new format!

New Ventures

At the end of this Summer, Ben Fitch sadly left his position as Riverfly Project Manager. After 7 years with Riverflies, we know many of you will be as sorry to see him go as we are. Ben was keen to express his gratitude to each and every person who has been involved in ARMI, the Riverfly Partnership and Riverfly Plus over the years. Having met so many wonderful and committed people in his time, he has decided to stay on as a Riverfly volunteer.

Alex Domenge has now undertaken the role of Riverfly Partnership Coordinator, and is joined in this role by Naomi Lumsden - a keen bug enthusiast who is excited to be a part of the team!

Online ARMI Training

The online option for training was released at the end of May this year. To date, the video has been watched 750 times, and the test has been completed 534 times by 397 people. The theory guide is now available to all trained monitors. We are delighted to be able to offer a new item in the toolkit for all our ARMI participants.

Tutor, Stuart Crofts in the ARMI online training video

The guide, methodology and testing were completed with the help of many partners; monitors, agency contacts and tutors all of whom played an integral role. Special thanks to Michael Dickson, Stuart Crofts, Simon Stebbings, Katherine Ryan, Rebecca Lewis, James Morgan and Judith Milner.

Urban Riverfly Update

Photo by Nicola Edgar

We are gearing up to release the Urban Riverfly in Spring. In preparation for this, we will be reviewing our data to find areas that will be well suited to Urban Riverfly. These will be waterways with sites that have trigger levels at 5 or lower, or groups that only record baetid and *gammarus*. Urban Riverfly training will cover ARMI training, so in the future, new groups will be able to get started with both ARMI and Urban Riverfly should they wish to.

Thank you to Nicola Edgar of the Environment Agency who came up with the idea and developed the methodology and scheme alongside Jess Andrews of the Environment Agency.

Extended Riverfly Update

We hope to have the Extended Riverfly option available this coming Spring. The ID Chart has been released, at £10 per copy, and we are happy to say it has been very popular so far. The guide has been designed as a stand-alone item that allows for bankside identification of 33 groups, and some evaluations based on what you find. A pilot was conducted earlier this month, and the online training option is currently being finalised.

Thank you to John Davy-Bowker of the FBA, Angus Menzies of the Dorset Wildlife Trust, Richard Chadd of the Environment Agency, Will Bartle of the Lincolnshire Chalk Streams Project and Phoebe Shaw Stewart of ZSL who created the training material and methodology. A special thanks to Vitacress for sponsoring the production.

New Features

We have been working to provide you with great new features over at the Riverflies website. Recently launched, the Riverfly Plus interactive page gives an insight into the factors that affect river health, both positively and negatively, and introduces the projects within the Riverfly Plus family that deal with these factors.

We have uploaded an up to date trigger level setting guide for the benefit of our coordinators and keen volunteers. You can now also find the option to 'Enter a Site' under the coordinator menu on the website - this is a quick and easy option for getting accepted sites put into the database.

The Riverfly Partnership

Find out about projects, access resources, view the ARMI database and more at:

www.riverflies.org

Scottish Freshwater Group's 105th Meeting

Dr. Louise Lavictoire
Interim Head of Science

On 21st October, I was guest coordinator of the 105th Scottish Freshwater Group meeting, hosted by UKCEH, and held virtually via Zoom. The Scottish Freshwater Group (SFG) is an active and inclusive group of scientists, practitioners and enthusiasts, striving to shape meaningful outcomes for Scotland's freshwater and beyond. The SFG meets twice annually in spring and autumn to focus on themes of interest or open discussions on freshwater topics and presents the activities of action teams that focus on a wide range of topics including citizen science, climate change and sustainability.

The 105th SFG meeting focussed on the theme of "Valuing & protecting freshwaters: the role of science, policy and practice". Speakers from a range of backgrounds provided excellent discussions with both oral and poster presentations focusing on the value of freshwaters and how science, policy and practice can meet to influence protection and restoration of this valuable resource. We heard from members carrying out cutting edge research to better understand freshwater habitats, the pressures they are under, and the issues facing some of our freshwater species from migrating salmonids to rare macrophytes like the slender naiad. We discussed the development of novel techniques such as smart sensors and sunlight-activated materials for water treatment which help bring safe, fresh water to some of the world's most rural communities. We heard about the excellent work on the ground to restore rivers and to assess the impacts of sediment, sewage and diffuse pollution on habitats and species and also had a much-appreciated creative perspective that explored the underwater soundscape of the Cairngorms National Park. You can see some of the wonderful contributions from SFG 105 on the website here.

My personal thanks go out to the entire SFG team who helped make this day such a success and the whole process so enjoyable.

If you're not an SFG member but would like to join the next meeting on 21 April 2022, then you can sign up (it's free!) to receive more details here.

We hope to see you all at the next meeting.

WOULD YOU LIKE TO CONTRIBUTE TO FUTURE EDITIONS OF FBA NEWS?

If you have research at any academic level, are a freshwater enthusiast, do your own freshwater exploration or just have something you'd like to share,
we want to hear from you!

GET IN TOUCH

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Association News

In Memoriam... David Kinsman

Glen George
FBA Fellow

David Kinsman was titled Assistant Director Windermere of the FBA during the 1980's. Please continue reading below for a beautiful tribute and history of his life from his friend and colleague, Glen George.


David Kinsman. Photo by Ellen Rooney

David Kinsman was born in Bristol where he attended Cotham Grammar School, an institution that claims to have educated seven Nobel Laureates. His interest in birds and wetlands was kindled when he visited the Wildfowl Trust at Slimbridge and met Peter Scott. In the 1950's, young men were still required to spend 18 months in one of the armed forces. David chose to join the Royal Air Force and served as a radar operator for Fighter Command on the Shetland Islands. Not surprisingly, he spent much of his spare time studying birds at locations that are regarded as some of the best birdwatching areas in Britain.

In 1958, David joined the geology department at Imperial College and stayed on to complete a Ph.D. on 'Recent carbonate sedimentation near Abu Dhabi.' In 1964, he was awarded a Fulbright Fellowship to continue the work at Princeton University and joined the faculty there the following year. As Assistant Professor his research area was the diagenesis of carbonate sediments, a topic that meant he had to spend time working in the tropics. His expeditions included an extended period of work on Lake Turkana and some time spent on the 'Glomar Challenger' coring the Indian Ocean. In his last years at Princeton, David spent some time working on the effects of acid rain and was responsible for leading a large multidisciplinary project on the New Jersey Pine Barrens. His experience there may well have caught the eye of those searching for a new Assistant Deputy Director at Windermere where more work was planned on the impact of acid rain.

David was appointed to lead the Division that covered algal ecology, palaeolimnology and chemistry and provide advice on the refurbishment of the analytical facilities. When he arrived at Windermere, people assumed that he had acquired an American accent during his stay at Princeton. In fact, this was only partly true since those familiar with the history of English would know that the characteristic drawl had its roots in the Bristol area! He had, however, acquired some American expressions and I can recall several conversations that started 'Hey, you guys, have you thought….'

David always defined his role in management as being that of an enabler. In this role, he provided advice on new areas of research and did his best to provide the facilities required to do the work. Fortunately, his time at the FBA coincided with a period of rapid growth which allowed him to recruit a third of the staff in his Division. He was also able to modernize the facilities required for research which included an electron microscope suite, new ponds with a treated water supply and a refurbished aquarium building. The other facility planned by David was the radioisotope laboratory in the Pearsall Building. This was to prove invaluable in April 1986 when the Chernobyl disaster led to widespread radioactive contamination. Since he had benefited from working in other countries, he also provided opportunities for staff to travel. The FBA had always attracted a steady stream of visitors but they usually came to consult staff rather than to work on collaborative projects. Under David's encouragement, this situation changed, with many scientists from around the world visiting the laboratory for extended periods of research.

My abiding memories of his time as Assistant Deputy Director are of a productive laboratory where problems were solved with good grace and humour. This humour found a new outlet in the satirical sketches that became a regular feature of our in-house Christmas dinners. As a 'new' member of staff, David was often the butt of these jokes and I can still remember his amusement when Gwyn Jones appeared as his alter ego wearing a black wig and an oversized Shetland sweater!

David was a fine, kind, multi-talented human being and, like his beloved sheep, was colourful, tough and resilient.

A longer version of this appreciation can be found at: https://fba.org.uk/FBA/Public/News/Obituaries/In-Memoriam...David-Kinsman.aspx

In Memoriam... Clive Pinder

Peter S. Cranston
Research School of Biological Sciences,
The Australian National University

This piece has previously been published in CHIRONOMUS Journal of Chironomidae Research, No. 34, 2021 with the title 'L. C (Clive) V. Pinder, 6th December 1943 - 31 July 2021. An appreciation from 'far away and long ago". All rights for use belong to them and not the Freshwater Biological Association.

Clive Pinder, who has died aged 77, was a long time researcher at the Freshwater Biological Association's River lab. Clive made a difficult taxonomic group accessible, even mandatory in freshwater ecology, allowing biologists to include these insects and for palaeoecologists to use larval midge subfossils in climate reconstruction. From his early days in Nottinghamshire Clive was a naturalist, retaining a life-long interest in birds but his education was in agricultural science at Newcastle University. A post-PhD relocation with his wife Carolyn to the FBA in Wareham, Dorset, had Clive exposed to our ignorance of the most diverse of freshwater organisms, non-biting midges (chironomids), that by abundance alone had to be important in limnology. In 1969 the field was complicated by lack of associations of the diversity of the aquatic immature stages with named adult stages (the midges) and incompatible taxonomic schemes according to nationality and publication language of the scattered researchers. The need for identification of larval and pupal immature stages was clear, but in UK the classification was solely on male adults. With strong support from the FBA Clive argued that without stable nomenclature and regionally compatible identifications, little progress was possible with the immature stages. Aided by artist-assistant Angela Matthews, who tirelessly produced microscope slides and especially the artwork for hundreds of genitalia. Pinder's Key to Adult Males of British Chironomidae appeared as FBA Scientific Publication No.37 (1978) to wide acclaim for the clarity ('user friendliness') of a modern synthesis of the British fauna. Further guides were produced, expanding into global collaborations across the northern hemisphere for immature stages. Most were produced between 1976 and 2000 when he took retirement but these contributions remain justifiably highly cited. I met Clive first in the thatched Kings Arms, Wareham, early in the 1970s. as a PhD student visiting the rising guru of the midges. From the first discussions, our collaboration continued over the years. However for a tribute to Clive, our eminent Japanese colleague Professor Mutsunori ('Nori') Tokeshi cannot be bettered: Clive and I forged a close relationship over many years, even after I moved to Japan spending more time on marine rather than freshwater research. My year-long stay at Pinder's family home in 1979-1980 started everything: my career in science, my deep love of things British and, indeed, overall approaches to life. Clive was the first English gentleman that I came into contact with, lively and yet measured, conscientious and full of wit, from whom I learned an awful lot, in particular the philosophy of enjoying life. Of course, I also learnt science from him, but life is bigger than that, as we all know.

A longer version of this appreciation can be found at https://www.ntnu.no/ojs/index.php/chironomus/article/view/4101