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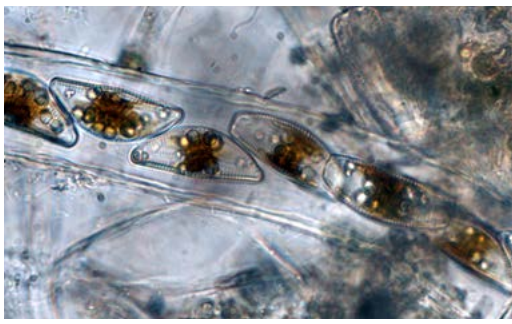
Catchments Newsletter

Integrated Catchment Management: sharing science and stories



Ireland's freshwaters: a world of wonder and discovery awaits you...

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White-clawed Crayfish - an endangered species. Photo: Hugh Feeley.

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Editorial

Welcome to the Spring 2018 Catchments Newsletter.

As we approach the publication of Ireland's River Basin Management Plan for 2018-2021 this Spring, the next phase of the management and planning process is now beginning. The focus over the next four years is for targeted, on-the-ground, more local assessment, advice and support to be carried out, to address specific water quality problems with appropriate local solutions. Thirty-five new staff are currently being recruited for a new, regionally based, assessment team, which is a Local Authority shared service being led by Tipperary and Kilkenny County Councils. This team will be supported by 30 new agricultural sustainability advisors (10 from the dairy industry, and 20 based in the regions in Teagasc). Over the next four years the combined team, with support from other public bodies where appropriate, will be working in priority catchments to identify and implement the right measure in the right place.

The Catchments Unit will support these new teams with training, advice, and further development of the online Water Framework Directive Application to hold all the results so that they can be shared across the public sector. We will also be turning our attention towards addressing some of the scientific questions that have arisen through the process to date, and will no doubt surface as part of the work being carried out by the new teams. A key part of implementing these measures will be getting buy-in from local communities. The work of the Waters and Communities Office has been vital to communicate what is happening to local communities around Ireland, and will continue to play an important role in getting local communities involved.

We have several articles in this issue that focus on how local communities and land-owners can get rewarded for enhancing their local environment – including paying farmers for better biodiversity and protecting water quality, prizes for TidyTowns and other community groups, and savings for Smart Farmers. We also have an example from the UK of a reverse auction, where farmers bid to be paid for reducing nitrogen use on their land. Ideas like these can help with implementation for the 2nd Cycle of the Water Framework Directive between now and 2021.

This is an exciting time in catchment management in Ireland... we have a plan, a new team, much better collaboration across public bodies, increasingly invigorated communities with an interest in their local environment, and a shared vision of working together to achieve water quality improvements. As always, our focus in the Catchments Unit is on the right measure in the right place – and remembering that by working together, we can achieve more.

Jenny Deakin, EPA Catchments Unit

One thing you can do: help save the White-clawed Crayfish

Our cover for this Newsletter features the White-clawed Crayfish.

White-clawed Crayfish is an endangered species and what is probably the largest surviving population of this species live in Ireland.

This species is under threat from Crayfish Plague. This disease is spread by spores in the water that can stick to boats, angling equipment and wet gear.

Crayfish Plague has been detected in the Barrow, Suir, Bruskey, Loorha and Deel rivers.

Crayfish Plague kills 100% of White-clawed Crayfish that come into contact with it.

What you can do:

You can help save this species by making sure you Clean, Check and Dry any gear you use in your local river or lake.

We have printed a poster about how to do this in the centre of this Newsletter.

If you can, we'd ask you to put this poster up somewhere in your community where others will see it, and encourage others to Clean, Check and Dry to help save this endangered species.

You can read more about protecting the White-clayed Crayfish on the National Biodiversity Data Centre website: www.biodiversityireland.ie/projects/invasive-species/crayfish-plague/

Richard Branson and the Cool Planet Experience team at the launch.

Cool Planet Experience launched in Powerscourt, County Wicklow

The Cool Planet Experience, a visitor centre dedicated to climate change, was launched by Richard Branson on 10 January 2018, in Powerscourt, County Wicklow.

The Cool Planet Experience is the world's first permanent visitor centre dedicated to climate change and connects science, engineering, gaming and drama to present the story of climate change in a new way. It is the first of 10 that are planned to open around the world in the next 3 years.

Sir Richard Branson was on hand to do the ribbon cutting at the launch event, and to share his direct experience of climate change when he and his family bunkered down on Necker Island while a Category 4 hurricane ripped through the Caribbean.

It takes about an hour to complete the Cool Planet Experience, and it is full of interesting facts and games centred around climate change. It personalises the story to you – at the start you receive a wristband that you tag on, and enter simple information about your day-to-day life. This is then collated to tell you your carbon footprint, shown as the number of trees it is equivalent to.

As you go through the centre, you tag on to different interactions or games, culminating at the end with an opportunity to make a pledge. Simplifying the message, this is a fantastic opportunity for kids and adults alike to have a real understanding of climate change issues facing Ireland. More than that, it provides visitors with an opportunity to have a better understanding of their own personal impact and the magnitude of the global challenge ahead.

The Cool Planet Experience will be a fantastic day out for everyone, so if you are heading to Powerscourt make sure you stop by and visit. They are particularly focusing on school groups, so make sure if you have kids in primary or secondary that you start spreading the word. Coupled with Powerscourt Gardens it could be a great day out.

Cool Planet Champions – giving free, interactive presentations on climate change for your business, school or organisation

The EPA has sponsored the Cool Planet Champions programme, which saw the training of 26 Champions that are available in every county in Ireland to give climate change presentations or to become involved in climate action within their local communities. You can contact the Cool Planet Experience if you want your local champion to come to your business, group, school or organisation for a free, interactive presentation on climate change, what it means for Ireland, and what it means for you.

Claire Camilleri, EPA Climate Secretariat

www.cpe.cool

TidyTowns - Waters and Communities Special Award

TidyTowns and other community groups groups can win a Waters and Communities Award, which is sponsored by Inland Fisheries Ireland, Waterways Ireland and the Local Authority Waters and Communities Office. Sheevaun Thompson tells us all about the 2017 award winner, and how you can enter your group for the 2018 awards...

Presenting the overall winner of the Waters & Communities Award at the SuperValu TidyTowns Awards Ceremony held on 25th Sept 2017 at the Helix, Dublin City University were Donnachadh Byrne, IFI, Deputy John Ring, Minister for Rural & Community Development, Enda Fields, Emyvale TidyTowns, Sheevaun Thompson, Waters & Communities Office and Rosanna Nolan, Waterways Ireland.

The Waters and Communities Special Award aims to encourage communities to get more involved with their local waterbodies by helping to preserve, promote and fully use their local natural heritage.

Last year, the overall winner of the award was Emyvale TidyTowns group from County Monaghan. They were presented with prize money of €2,000 and a bespoke birdbox by the Minister for Rural & Community Development, Deputy John Ring, TD at the TidyTowns Awards Ceremony in September 2017. All other winners and runner ups were presented with their prizes at regional awards ceremonies.

TidyTowns Waters and Communities Award 2017 Overall Winner - Emyvale County Monaghan

Raising awareness is the motto of Emyvale TidyTowns in County Monaghan. In 2017 they had some great initiatives:

- Emy Lough and river clean ups
- Citizen Science project to monitor Emy Lough in conjunction with Emy and District Anglers
- Started a water bottle and silt traps river awareness project
- Conducted an initial wildflower survey of Emy Lough

Emyvales' upcycled pallet bat boxes.

- Worked with Monaghan County Council to identify dumping hotspots near the river and lake
- Upcycled timber pallets to make new bee, bat and bird boxes
- TidyTowns members got involved in the River Blackwater Catchment Trust, an initiative to control invasive species, and the Steering Committee of the 'Our Water, Our Community' initiative headed up by Dundalk IT

Can your community group win the Waters and Communities Award in 2018?

After receiving almost 60 entries from across Ireland in the inaugural year of the TidyTowns Waters and Communities Award in 2017, the Award is set to run again in 2018.

A total prize fund of €7,000 will be divided between the winning community groups.

Community groups who have shown an appreciation for their water environment and water heritage from June 2017 to May 2018 will be considered. Examples include: clean ups; provision or upgrading of amenities; support to biodiversity and heritage; promotion of angling; awareness raising; etc.

How to enter:

Details of the application process will be announced on 28 March 2018 in conjunction with the main SuperValu TidyTowns Awards, and the other Special Awards.

See www.tidytowns.ie for further details.

Sheevaun Thompson, Local Authority Waters and Communities Office

An expanded version of this article highlighting all the regional winners and runners up will be available on www.catchments.ie

Source to Tap project in the Erne and Derg catchments launched

Lisa Stewart tells us about a major €5.3 million cross-border project to improve water quality in rivers and lakes in the Erne and Derg catchment areas, which provide drinking water for parts of Fermanagh, Tyrone, Donegal, Cavan, Leitrim and Longford.

Source to Tap project team: Lyndsey Herron, Lisa Stewart, Diane Foster and Patrick Gallagher.

Source to Tap is a cross-border partnership project that will focus on the River Erne and the River Derg catchments, which are part of our shared drinking water sources. The Derg and Erne drinking water catchments are predominantly rural in nature. The main land uses are forestry, farming and peatland. Certain types of land use management can cause materials such as sediments and herbicides to run off the land and drain into the raw water, the same raw water which Northern Ireland (NI) Water abstracts for drinking water.

These materials must be removed in Water Treatment Works (WTWs) to produce drinking water that meets strict drinking water quality standards. High concentrations of herbicides and variations in colour and turbidity causes increased capital and operational costs to treat and remove these materials. Therefore, it is more cost effective for us to identify these pressures at source and keep our rivers and lakes clean.

Exploring innovative solutions and improving land use management practice

The Project will explore innovative solutions to improving land use management practice that will reduce impacts on raw water quality. The project will put community and stakeholder engagement at the heart of the project and will work with farmers, land managers, forestry providers, and the wider community to help identify and share best practice approaches to protecting drinking water sources.

The partners will work together to deliver work packages aimed at Learning and Outreach, Best Practice Forestry pilot projects, a Peat Restoration pilot project and a cross-border pilot Land Incentive Scheme (LIS) in the Derg catchment.

Monitoring and evaluation

Each of these activities will be monitored and the results evaluated to establish the cost effectiveness of the measures. Best practice from each of these work packages will enable us to produce a Sustainable Catchment Area Management Plan (SCAMP), so that these ideas and practices can be replicated in other drinking water source areas in the United Kingdom, Ireland and beyond.

Funding and project partners

NI Water secured the funding from the European Union's INTERREG VA Programme, the Department for Agriculture, Environment and Rural Affairs (DAERA) in Northern Ireland, and the Department for Housing, Planning and Local Government (DHPLG) in Ireland. The funding is managed by the Special EU Programmes Body (SEUPB) and will run from 2017 to 2021.

NI Water will lead a partnership, which includes Irish Water, The Rivers Trust, Ulster University, Agri-Food and Bioscience Institute (AFBI) and East Border Region. Together the partners will work together to test pilots for how to protect raw water quality at source across both jurisdictions.

Lisa Stewart, Source to Tap Project Officer

www.sourcetotap.eu
www.facebook.com/SourcetoTapEU/
Twitter: @SourcetoTapEU

Interreg Northern Ireland - Ireland - Scotland

source to tap

Celebrating community success in Ashbourne

Community Water Officer Aoife McGrath tells us how a community action group is helping tackle litter and pollution in and around the River Broadmeadow in County Meath.

The Ashbourne community are helping to restore the River Broadmeadow to its former glory. In 2017, the community formed the Broadmeadow River Action Group to help tackle litter pollution and diffuse urban pollution on the River. During its first year, the voluntary group achieved some commendable results. This included organising multiple river-clean up days; being awarded a €7,000 grant under the Anti-Dumping Initiative; and hosting a memorable Family Fun Day to mark Water Heritage Day.

Working with the Waters and Communities Office, the community are steadfast in their goals for 2018. Major plans are afoot to continue the regular clean-up days; as well as organising more family fun days; and working with Inland Fisheries Ireland to roll out its "SomethingFishy" Education programme to the local schools. 2017 has been a year of remarkable success for the newly formed Broadmeadow River Action Group – congratulations to all the local volunteers involved.

Aoife McGrath, Community Water Officer, Local Authority Waters and Communities Office

Broadmeadow River and some flowers.

Results of the 2017 Anti-Dumping Grant showing Broadmeadow Riverbank after being cleaned and planted (left) and some of the hard working volunteers on site during the work (right)

Broadmeadow River Family Fun Day, 27 August 2017.

Some River Explorers checking out the Royal Canal in Castleknock, County Dublin.

Discovering the wildlife living in the water.

River Explorers – using their waterway responsibly

In late 2017, the River Explorers programme helped 330 fifth & sixth class primary school children across Ireland protect their local environment and take pride in their local river, lake or canal, teaching them to 'Use their waterway responsibly'.

The River Explorers project worked on raising awareness and educating primary school students on their environmental impacts on local waterbodies, and how they can minimise these impacts and keep their local waterway clean. It was all about empowering students to connect with their natural environment and enjoy their natural heritage responsibly and ethically.

Through outdoor and hands-on learning, skills training, resource development and raising public awareness, the programme offered exciting and innovative learning approaches for primary schools.

River Explorers took part in two sessions. In the morning, they were taught how to identify the wealth of biodiversity living on or near their local rivers and canals, how their use of these waterways impacts on biodiversity, and the measures they can take to minimise this impact.

In the afternoon, students had the opportunity to go out and discover the vast array of wildlife that calls the inland waterways their home. Students identified some of the plants and trees along canal and river banks, and even came face to face with some mini beasts living in these ecosystems.

Leave No Trace Ireland and Waterways Ireland were partners in the delivery of the River Explorers programme, which was funded under Local Agenda 21.

Greater Pond Snail Lymnaea stagnalis - widespread in lakes, ponds and some slower rivers.

Eithne Larkin, Leave No Trace Ireland

www.leavenotrace.ie
www.waterwaysireland.ie

Teagasc Agricultural Catchments Programme joins Twitter - @TeagascACP

Teagasc catchment researcher Per-Erik Mellander updating farmers on latest Agricultural Catchment Programme findings in December 2017.

Better water quality and supporting the production of high-quality food are the twin aims of the Agricultural Catchments Programme (ACP). Agricultural Catchments Programme staff have been working with 300 farmers across six catchments for nearly ten years. A new Twitter feed has been set up to let people find out more about this work.

The Teagasc ACP is funded by the Department of Agriculture, Food and the Marine.

Tom O'Connell, Agricultural Catchments Programme Communications Officer

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Twitter: @TeagascACP

Holistic Hydrogeology of the South Irish Midlands

A Hydrogeologist is a scientist who studies groundwater in the rocks and soils beneath our feet. Robbie Meehan tells us about the International Association of Hydrogeologists (IAH) Ireland annual field trip in 2017. They visited Offaly and Laois during Storm Brian, which ensured there was plenty of water for them to study…

The Irish Midlands have long been known as a sacred landscape with long-famed sites such as Clonmacnoise, Croghan Hill and Durrow underpinning this. The idea of the IAH field trip in October 2017 was to examine the rich hydrogeological heritage of the region, by visiting a wide variety of sites with very different hydrogeological influences.

On the outward journey from Dublin, Storm Brian was raging. Driving through Westmeath was like driving through a very long car wash. However, at Clonmacnoise, despite still-driving rain and high winds, Damien Doherty introduced the sand and gravel aquifer body that centred on Clonmacnoise, which had recently been mapped in a project by Geological Survey Ireland. After a short and wet discussion, Dr John Feehan brought all on foot from a roadside stop at Creevagh, south of Clonmacnoise and along the Shannon floodplain, to view one of the strange phenomena that are the mushroom rocks of the Midlands.

In the afternoon, Dr Ray Flynn (Queens University) took us to the first of two stops related to Clara Bog; this one in a kettle hole adjacent to an esker just outside Clara. At the second stop, Dr Paul Johnston of Trinity College, Ray and John Cody of the Bog Restoration project led a superb presentation and discussion about bog reclamation, as well as the historical studies that have taken place on Clara Bog over the last thirty years. The final stop was a wastewater treatment demonstration facility, at Molloy Environmental Systems in Tullamore. Dr Laurence Gill (TCD) introduced the principles of wastewater treatment for single houses, and John Molloy and Michael Cahill showed us the demonstration facility itself.

A mushroom rock on a sunnier day in Carrowmurragh, County Roscommon. Beneath the stone you can clearly see erosion from 3 former lake levels. Photo: Robbie Meehan.

The Sunday morning focussed on the Cullahill Group Water Scheme Zone of Contribution (ZOC) in County Laois, with stops at the pumphouse and the spring source, discussing issues with elevated nitrates. Jimmy Walsh from Cullahill, Roisin Dowd Smith, Dr Taly Hunter Williams (GSI) and Dr Catherine Coxon (TCD) outlined the studies that have been completed on the ZOC in the last few years.

Robbie Meehan, IAH Fieldtrip Secretary

The International Association of Hydrogeologists (IAH) Irish Group have an interest in the promotion and development of the science and engineering of groundwater issues. Regular activities of the Irish Group consist of an annual two-day conference, an annual weekend fieldtrip, and a series of monthly lectures/technical discussion meetings.

www.iah-ireland.org/

Irish Groundwater Newsletter: https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/Pages/Groundwater-Newsletter.aspx

John Feehan explains the theories behind mushroom stone formation. Photo: Malcom Doak.

Articles

Ireland's freshwaters: a world of wonder and discovery awaits you

Ireland's freshwaters are host to an amazing world of animals, plants and other organisms. These organisms, many of whom are dependent on good water quality, can tell us much about our environment. The EPA uses this information as part of its water quality reporting. EPA Ecologist Hugh Feeley describes the wonderful web of life that exists just below the surface of our rivers, lakes, streams and wetlands...

How many times have you passed a river, lake or stream and considered what lies beneath? I've been lucky enough to have spent the past ten years or so involved in both research, and monitoring and assessment of our streams, rivers, lakes and wetlands. This work has taken me to all four corners of the island and every day is different. I try to expect the unexpected and to paraphrase a quote from Albert Einstein:

"The important thing is not to stop questioning. Curiosity has its own reason for existing...It is enough if one tries merely to comprehend a little of this mystery every day....."

Embracing this idea, I enjoy nothing better than to find something new. Every time I arrive at a river or a lake the professional in me wants to get on with the job in hand and move on, another site ticked off on my list, but the biologist in me is curious to know what lurks beneath the riffles or the waves.

Hugh at Lough Owel, Co Westmeath, holding a juvenile White-clawed Crayfish. Photo: © Ruth Little.

Stonefly - nymphs and Insects

I remember the first time I saw the nymph of the large stonefly *Perla bipunctata* that grows up to 35 mm in length and lives in many of our rivers as an immature nymph for over three years before becoming a flying adult; I had never considered such a large and beautiful insect could exist, and in Ireland! Suddenly a world of discovery and wonder opened before me. I had caught a bug, one of discovery, that has shaped my career to date.

The immature stage of the large stonefly, Perla bipuncata, which can reach 35 mm in length. Photo: © Jan-Robert Baars.

I have been lucky enough to encounter a vast array of amazing animals and plants that live in Irish freshwater throughout my career. The aquatic insects are my favourite, but there are all sorts of other weird and wonderful biota, namely algae, fungi, plants, invertebrates and fish, inhabiting our rivers, lakes and streams.

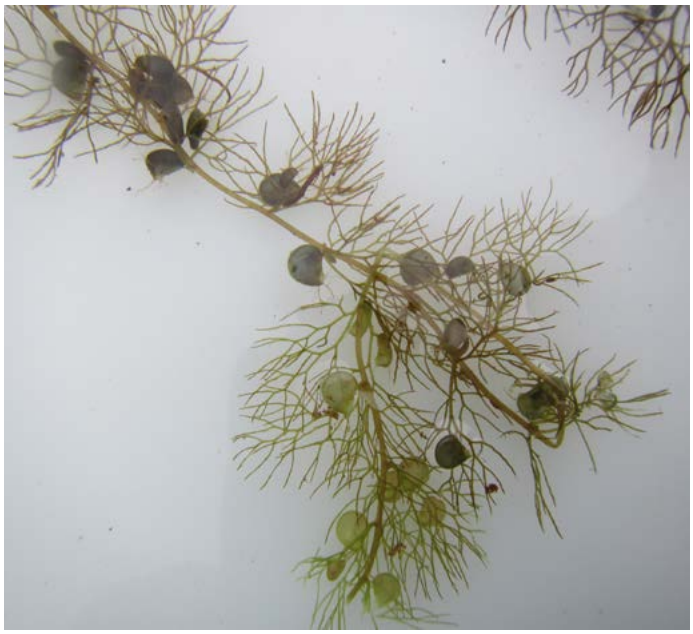
Animals that use hairs to move and feed

Ophrydium versatile, a ciliate protist, best described as a microscopic animal recognisable by their hair-like 'cilia' which they use for movement and for feeding. These animals have a mutually beneficial (symbiotic) relationship with green algae found in lakes containing dissolved limestone. This is but one of a remarkable number of organisms that form colonies and make their home in our waterways up and down the country.

Ophrydium versatile, a ciliate protist with symbiotic green algae found in calcareous lakes.

Bladderworts – carnivorous plants that feed on plankton

We have a diverse array of freshwater plants in Ireland, and although it's an area I've only recently ventured into I'm amazed at what there is to find. Thanks to my colleagues in the EPA Ecological Monitoring and Assessment Unit, I have recently discovered the remarkable aquatic plant known scientifically as *Utricularia*, or commonly as bladderworts. These are carnivorous plants relatively common in Irish lakes, feeding mainly on *Daphina*, a small planktonic animal, using sophisticated mechanical bladder-like traps which take only a split second to activate.



Utricularia sp., commonly known as bladderworts, a carnivorous plant that feeds on small planktonic animals.

Freshwater Sponges

Similarly, only recently have I started to take notice of our freshwater sponges. There are relatively common animals found in our rivers and lakes. Sponges and algae have a mutually beneficial symbiotic relationship, and are green because of the algae. The sponge, using its complex structure, provides a safe place for the algae to grow and, in turn, the algae processes sunlight into energy and provides food to the sponge. I've also recently discovered that there is a fly, or more accurately a spongefly (or Sisyridae), whose larvae feed exclusively on freshwater sponges! This discovery shouldn't have surprised me but it did.

A freshwater sponge from the Figile River, County Kildare.

Freshwater Pearl Mussels

Other invertebrates that inhabit our waterways and amaze me every time I encountered them are the freshwater pearl mussels, known scientifically as *Margaritifera margaritifera*. These amazing creatures have a unique and complex life cycle, with their young living as tiny larvae that parasitize passing trout or salmon, and only become shelled adults after 7 to 15 years, in several complicated steps I won't elaborate on. They exhibit a trait known as 'negligible senescence' or more simply a lack of aging, with individuals known to live for up to 130 years, making them one of the longest-lived invertebrates in the world, and Ireland's longest living animal. They are found in many clean, low-nutrient, fast-flowing, well-oxygenated, gravely rivers. They are currently estimated to occur throughout Ireland in approximately 160 rivers, and a handful of associated lakes. They grow extremely slowly as adults and feed by inhaling water through siphons which filter out tiny organic particles.

The freshwater pearl mussel, Margaritifera margaritifera, filtering out tiny organic particles in a river in County Kerry.

Unfortunately, the freshwater pearl mussel is a highly threatened species, categorised as critically endangered in Ireland, with 90% of all freshwater pearl mussels having died out across Europe during the twentieth century. I count myself lucky to have seen this beautiful freshwater creature on a handful of occasions. Hopefully future generations will also have this privilege, but with each passing year this prospect appears to dwindle, as not enough new mussels are establishing and surviving to replace the dying older mussels. Existing populations, generally found in the less densely populated, less developed, and less intensively farmed regions, are unfortunately predicted by experts to go extinct within the current generation unless drastic action and conservation efforts are undertaken.

The freshwater pearl mussel, Margaritifera margaritifera, love clean, low-nutrient, fast-flowing, well-oxygenated, gravely rivers.

Mayflies, caddisflies, dragonflies and damselflies

Irish freshwaters are full of life, but it is the insects that really grab my attention. My interest in the stonefly (or Plecoptera) is well known but I always love finding and learning about other groups such as the mayflies, caddisflies, dragonflies and damselflies, amongst others, too. These insects, often short-lived as adults, inhabit nearly all lakes, rivers and streams in every corner of the island and yet most people do not even know they exist, or at least only at a superficial level.

An adult male caddisfly, Sericostoma personatum, encountered along a river in County Clare.

Insects that have been living on earth for 250 million years

The list of insects found in our waterways is well over 3,000 species and they come in a variety of shapes and sizes, with some looking like they have come out of the latest sci-fi movie! This diversity, however, is a result of millions of years of evolution and adaption to their environment. Stoneflies, ubiquitous across Irish rivers and many lakes, are over 250 million years old, dating back to the Permian period during the age of the supercontinent Pangaea, when all our current continents were joined together, and predating infamous dinosaurs, such as *Tyrannosaurus rex*, by 180 million years. Aquatic insects are amazingly adaptable; some eat algae, some eat leaf material and some eat other animals, creating a complex food-web that ensures the healthy functioning of our freshwater ecosystems.

A Calopterygidae damselfly larvae common in slow-flowing rivers.

Insect life: camouflage, adaptability and armour

Many of these insects have remarkable adaptions, including camouflaged pigmentation, adaptable life strategies and other weird and wonderful survival and reproductive tactics. As larvae, the caddisflies create elaborate cases made from a variety sand, gravel, stones, twigs and leaves, in which they live, each constructed specifically, with many case formations unique to a species or family. Probably the most amazing features of aquatic insects is their transition from immature larval stage (which can last from anywhere between a few months to several years), to the reproductive adult stage. This transformation, triggered by a combination of temperature, morphological development and genetics, allows insects to not only reproduce successfully but to also spread to new waterways and expand their range.

The immature stage of the mayfly, Ecdyonurus sp., with its camouflaged pigmentation.

Several Goeridae caddisfly larvae within their unique stone cases.

An adult mayfly, Ephemera danica, comonly known as a green drake by anglers.

Insects: drumming in different dialects to attract a mate

The adults also have amazing behaviours during their often-fleeting time alive. For example, the stoneflies have a mate-locating behaviour known as 'drumming'. This behaviour involves the male creating a low frequency 'drum' sound by striking its abdomen off the underlying substrate. Females respond in kind until they find each other and mate. What's amazing about this drumming behaviour is that the drumming frequency produced is species and sex specific. More amazingly is that research has highlighted that the drum produced by the same species in different geographic areas has resulted in different 'dialects'; something one would never associate with freshwater insects.

The beautiful view of the Killarney lakes from Lady's View in the heart of Killarney National Park, County Kerry.

Landscapes to inspire a sense of wonder

Even if you are not interested in the wonderful life that makes their home in our waters, it can be worth just admiring the beauty of our landscapes, which are only enhanced by the presence of healthy freshwaters. Whether it is the beautiful view of the Killarney lakes from Lady's View in the heart of Killarney National Park, or an old bridge crossing a meandering river, we are surrounded by an array of history and cultural heritage, a sense of place, a sense of wonder, and even a sense of home, which are vital to the satisfaction felt by society but is often taken for granted. I believe this is what drives our interest and quest for knowledge of the nature within, and the eagerness of some of us to preserve our wildlife and ecosystems for the experience they provide us, and for their protection for future generations.

An old bridge (Corlea Bridge) over the Bleach River, County Clare.

Invasive species and loss of our highest quality waters

Unfortunately, I write this article in the context of change. Every year the threat grows from invasive species being introduced to our freshwaters, endangering our native species and the natural balance which makes our rivers and lakes thrive.

The introduction of the Zebra mussel, for example, has been detrimental to the normal healthy functioning of so many of our lakes and rivers, with new waterbodies affected each year. More recently disease has threatened our native and protected white-clawed crayfish.

A group of invasive Zebra mussels (Dreissena polymorpha) common in many Irish lakes and rivers.

The white-clawed crayfish, Austropotamobius pallipes, currently threatened by disease in some Irish rivers.

More worryingly, the dramatic loss of our highest quality waters since the 1980s, as highlighted by the latest EPA Water Quality Report, is alarming and needs urgent attention. Human activities, such as effluent release, pesticides and fine sedimentation, continue to put pressures on our freshwaters. The new 'Blue Dot' programme in the forthcoming River Basin Management Plan will protect the health and wellbeing of our most precious and healthiest waters. Their protection, restoration and enhancement is not only the responsibility of the Government, its agencies or the European Union, but something that should be the responsibility of every member of society, as we all benefit.

I want my children, and their children, to be able to discover all our freshwater species just as I have. I write this piece with optimistic enthusiasm for our freshwaters future being bright and unpolluted.

Next time you walk long a lake shore, stand on a bridge overlooking a river, or jump from stone to stone to cross a babbling brook just stop and think of what life lurks below. Whether it is the simple joy of just turning over a rock in a river and seeing a stonefly, such as *Perla bipunctata*, or a mayfly, such as *Ecdyonurus,* for the first time, discovering the amazing freshwater pearl mussel, or just enjoying the beauty and tranquillity waterways provide us, the important thing is to be curious, to not stop questioning and most of all to comprehend a little of that mystery with surrounds us each day. In its simplest terms, and put so eloquently by Sir David Attenborough when he said:

"an understanding of the natural world and what's in it is a source of not only great curiosity but great fulfilment"

So, if you do one thing this year, go experience and enjoy your local river, lake or stream, and most of all go discover the world of wonder that exists below the riffles and the waves for yourself - you never know what you may find!

Hugh Feeley, EPA Ecology Unit

EPA Ecological Monitoring and Assessment: The EPA Ecology team monitor the ecological health of Ireland's waters. The organisms that live there are important indicators of water quality. The outcome of these scientific assessments are reported in EPA Water Quality Reports.

www.epa.ie/water/wm/
www.epa.ie/pubs/reports/water/
Twitter: @EPAEcology

Dr Hugh Feeley is a freshwater ecologist who recently joined the environmental monitoring team at the EPA. Hugh has over ten years' experience studying and assessing Irish freshwaters and has a special interest in the ecology of stoneflies. Currently, he is involved in assessing the ecological quality of Ireland's freshwaters, and you may find him splashing about in a river or lake near you soon.

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Prevent the spread of Crayfish Plague i

An outbreak of Crayfish Plague has occurred in Ireland. This disease affects a White-clawed Crayfish and results in their complete elimination from rivers and does not affect humans or farm animals and does not infect other w

The disease is spread by spores in the water that can stick to boats, angling equip Once Crayfish Plague has been introduced into a river or lake, it cannot be contro of introduction to unaffected sites is essential. All water users are urged please t thoroughly dry your equipment before you use it here and once again afte

Follow the Check, Clean, Dry measures to PREVENT the spread of thi and protect the sport, river and lake you love.

CHECK boats, equipment, clothing and footware for plants and animals. Pay particular attention to areas that hold water or are damp and hard to inspect.

CLEAN everything thoroughly. Use hot water over 65°celsius where possible. (e.g. use of nearby power washers at service stations).

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DISINFECT: If complete drying is not possible. DISINFECT everything using an approved disinfectant such as Milton (follow product label), Virkon Aquatic (3mg/L), Proxitane (30mg/L) or an iodine-based product for 15 minutes. Items difficult to soak can be sprayed or wiped down with disinfectant. Engine coolant water or residual water in boats/ kayaks should be drained and where possible flushed out with disinfectant.

DO NOT use untreated equipment in these waters if it has been previously used in an infected area. Check *www.biodiversityireland.ie/crayfish-plague-2017* for list of infected sites and to report dead, dying or non-native crayfish.

White-clawed Crayfish is an endangered species and Ireland is home to what is probably the largest surviving population of the entire species.

STOP
Crayfish Plague

RY

DRY everything
48 hours. The
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or 3 weeks and
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An Roinn
Cultúir, Oidhreachta agus Gaeltachta
Department of
Culture, Heritage and the Gaeltacht

ARTICLES

Time to rewild? – a view from across the Irish Sea

Alastair Driver, Director of Rewilding Britain, gives his views on the potential for rewilding in the UK, including natural water retention measures that have multiple benefits for water quality, biodiversity and reducing flooding risk.

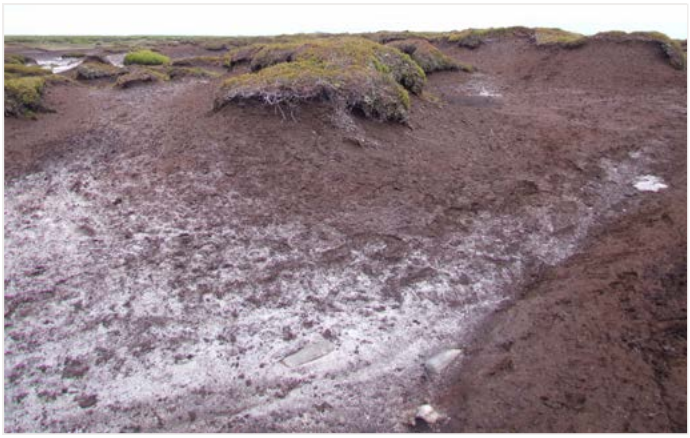
Rewilding in Ennerdale, United Kingdom.

UK politics used to be so boring. For me it was somewhere between shopping for clothes and watching paint dry. Not anymore. Now, thanks to the radical Brexit decision, we at least have a once-in-a-lifetime opportunity to change the most important set of rules affecting the natural environment in the UK - namely how we fund the management of our rural land and for what purposes. This is where "rewilding" has a key role to play.

We now have steadily growing evidence that localized restoration interventions deliver significant measurable benefits at a small-medium scale for flood risk management, water quality and biodiversity, etc, but I can still hear the sceptics saying *"yes but there's no evidence all this stuff works at scale".*

Well I for one am certain that it is largely case of multiplying up interventions across a larger area and joining them up – i.e. doing lots of small-medium sized things, a thousand times over. This is why rewilding now needs to be a key part of the rural debate, because it takes catchment restoration to another level, both in terms of scale and the extent of re-naturalisation.

My own working definition of rewilding, shamelessly constructed to fit in a tweet, is *"The large-scale restoration of naturally functioning ecosystems towards the point where nature can flourish unmanaged for the benefit of people and wildlife".*



Rewilding degraded peat (above), and the results of restoring it one year later (below) – Kinder Scout, United Kingdom.

However, rewilding is a process and various elements of that process apply across a wide spectrum of activity, with scale and impact generally increasing as you move along that spectrum, and everyone having a role to play. I am currently toying with the idea of promoting a grading system for rewilding, with my pocket handkerchief garden wildlife pond being at the bottom end of the spectrum at say Grade 4, and Grade 1 being the Holy Grail where it basically means "hands-off" across a very large area. In scale terms, now at least, this probably means blocks of 10,000 ha plus in England, Wales and Northern Ireland and 100,000 ha plus in Scotland. Rewilding of this scale should also involve the reintroduction of keystone species such as Beavers, Pine Martens, Lynx and Wild Boar, where necessary, to help achieve and sustain the naturally functioning ecosystems, and yes at the largest end of the scale it could even ultimately mean, in really extensive remote parts of Scotland, Wolves and Elk – but certainly not in my lifetime!

Making the journey with local landowners and communities on board

Right now, however, we have a long way to go before we have anywhere in the UK of that Grade 1 standard, so we should focus hard on the journey, not the destination, **and we must make that journey with local landowners and communities on board**. We cannot and should not attempt it without their support, for many obvious reasons which I don't have the space to summarise here, but which most EPA Catchment Newsletter readers will be all too aware of.

It's not for me to go preaching abroad when we haven't got our own act together in the UK, but if asked, my advice would be - don't wait for the UK to adopt this approach - get on and do what you can now. The environment is a long way down the Brexit pecking order and although we are hearing the right noises from the Secretary of State, Michael Gove, we are still some way from adopting a Payment for Ecosystem Services-based land management system.

Haweswater Rewilding Area, United Kingdom.

I would urge colleagues in Ireland to take every opportunity to prompt, enthuse, nag and inspire the delivery of multiple benefits through every organisation, project, plan and strategy you deal with, whether you are drafting the next round of agri-environment funding rules or designing a stream diversion for a road bypass. If we all do this, we will build a societal land management culture where joined-up thinking becomes the norm, moving our governments towards valuing rural land for the full range of societal benefits that it can provide, and not just for "food and birds". This will in turn lead to the acceptance that in some parts of the country, true "rewilding" genuinely is the best socio-economic option for local communities which will then help to keep them in remote rural areas.

Our time is now, but we need to act fast.

Alastair Driver, Director, Rewilding Britain

Twitter: @AliDriverUK

http://www.rewildingbritain.org.uk/

You can see a presentation Alastair recently gave to the EPA's Catchment Management Course here: https://www.slideshare.net/EPAIreland/alastair-drivers-drivers-for-better-catchment-management

You can read some evidence recently published by the UK Environment Agency on Natural Flood Management here: https://www.gov.uk/government/news/natural-flood-management-part-of-the-nations-flood-resilience

AranLIFE – working in the present, building for the future

AranLIFE Project Manager Patrick McGurn describes working with farmers to harness their local knowledge, and combining this with scientific expertise from project partners to improve the quality of priority habitats on The Aran Islands.

Farms on islands are made up of a number of small fields surrounded by stone walls which give shelter to livestock and protect the soil.

The Aran Islands have supported farming communities for over 4,000 years, who in turn have left behind a rich cultural legacy, including spectacular great forts on the Islands and a dense web of high field wall systems. Between these walls lie some of Irelands best dry grassland habitats including species rich calcareous grassland and Machair grasslands and of course the Limestone Pavement with its distinctive surface and features. These habitats contain a fantastic range of plants, some common species like Ox eye daisy (*Leucanthemum vulgare*) but some with very limited distribution in Ireland like Pyramidal Bugle (*Ajuga pyramidalis*) or Roseroot (*Sedum rosea*). Whilst only 40 km^2 in area, the Aran Islands are home to approximately 500 plant species. This is an amazing statistic considering that this equates to nearly half the total number of species within the whole island of Ireland and even more amazing when you consider that there are no bogs, mountains, rivers and woodlands on the islands that could contribute to this incredible species diversity.

In recognition of their ecological importance, all three of the Aran Islands are independently designated for protection under the EU Habitats Directive under the Natura 2000 network. Whilst designations are important in protecting such areas, it is the continuation of the sensitive farming practices that are vital to maintain them. The extensive farming system with its low fertiliser use and grazing tradition of winterage, conserves and enhances the species richness of the grassland allowing herbs such as Spring Gentian (*Gentiana verna*), Bloody Cranes-bill (*Geranium sanguineum*), Birds-foot-trefoil (*Lotus corniculatus*) and Lady's bedstraw (*Galium verum*) to flourish, filling the fields full of colour and providing food to grazing livestock and the associated wildlife that live off the different plant species.

The agriculture system practised produces these wonderful species rich grasslands that are dependent on continued grazing.

Water for grazing livestock is difficult to supply on the Aran Islands, so rain is collected through purpose built troughs.

These farming systems with associated high biodiversity are known as High Nature Value (HNV) farmland and are vital in maintaining Ireland and Europe's biodiversity. However these High Nature Value agricultural systems face difficulties. Abandonment or degradation of farmland, intensification of production, and socio-economic decline are long-standing threats for such extensive and nature-friendly farming systems. The Aran Islands face many of these issues - the highly fragmented farms, the low stocking rates, high labour and poor economic return. The economics of this farming system is resulting in change and increasing evidence of undergrazing and land abandonment on the islands which are a major concern for the priority semi-natural habitats present. A declining agriculture on the islands is worrying as agriculture has many benefits for the islands, not only in producing food and maintaining biodiversity but also in conserving the wonderful landscape with it stone walls historic monuments that 250,000 people a year come to see. Tourism and agriculture are very much linked.

Recognising the islands unique habitats and seeing the changes occurring has led to the development of a specific project to address some of the negative issues and try to put in place structures which deliver optimal benefit to the conservation of the farming heritage and environment of the Aran Islands. This project is called AranLIFE. The project's objective is simple, to reverse negative changes and improve the conservation status of 35% of the priority habitats by developing and demonstrating the best management practices to both maintain and bring sites to favourable condition. 75% of the project is funded by the EU LIFE unit whilst the remainder is funded by the Department of Culture, Heritage and the Gaeltacht, Teagasc, Department of Agriculture, Food and Marine, Fáilte Ireland, Heritage Council and Galway County Council. A project team, based on Inis Oírr, works with 67 farmers on the island who complete a range of works on the ground to improve habitat quality. Associated with this is an educational element aimed at all interested parties such as farmers, residents, tourists, schools, universities and local NGOs. AranLIFE has achieved this through the production of educational material, such as bird and plant guides, workshops, and through demonstration days and farm walks.

Since the start of the project work on the ground has been ongoing all with the aim of ensuring adequate grazing to the priority habitats. To date work has included:

- 24km of boreen (narrow roads) improved to facilitate field access
- 133 water retaining structures built or remodelled to supply water to the grazing animals
- 73ha of encroached scrub cleared from priority habitats
- implementation of optimal grazing plans on 1000 hectares of grassland with the grazing effectiveness measured through a simple scoring system

The project has also worked with Teagasc, IT Sligo and the local veterinary surgeon to look at the nutritional status of the grasslands and supplement accordingly using specific mineral supplement blocks. Measuring the effectiveness of the project forms an important part of the work and the project team are monitoring all the different actions over the course of the project.

AranLIFE is a short-term project working with farmers to improve the quality of priority habitats. However it is also a mechanism of gathering information that can direct policy to ensure future agri-environment programmes are best suited to the area. Restoring and preserving biodiversity, including in Natura 2000 areas and High Nature Value farming, is one of the priorities for European Rural Development. Projects like AranLIFE are the first steps in this process, taking immediate action and supplying the information for future projects.

Patrick McGurn, Project Manager, AranLIFE

www.aranlife.ie
Twitter: @AranLife

Results-based payments for farming: delivering high quality biodiversity and other public goods

Paying farmers to deliver better environmental outcomes is the focus of the Results-based Agri-environmental Pilot Scheme (RBAPS). Dolores Byrne tells us how farmers in Leitrim, the Shannon Callows and Northern Spain are piloting this approach.

Flower-rich, dry hay meadow in County Leitrim which is under threat because of enrichment from silage feeding. Under the results-based pilot, this meadow scored 8/10, with 2 marks deducted for supplementary feeding damage. This sends a clear signal to farmers as to what is right and wrong within their semi-natural grasslands. Photo: Dolores Byrne.

What if farmers got paid for the quality of wildflowers, birds and butterflies on farmland in the same way they get rewarded through markets for the quality of their livestock? That's the premise behind results-based agri-environment schemes where the level of payments to farmers are related to delivery of quality of the farmed environment.

Between 2014 and 2020, the Common Agricultural Policy will account for 38% of the overall European Union budget. Substantial supports are available through financing of agri-environment schemes to encourage farmers to maintain and improve the quality of public goods such as biodiversity, clean air, and water quality.

However, research shows mixed benefits from agri-environment schemes, and the status of biodiversity associated with farmland continues to decline. Maintaining extensive farming practices which sustain High Nature Value farmland and associated habitats and wildlife is essential to halt biodiversity declines.

With many emerging constraints on EU budgets, including Brexit, taxpayers want assurance that the monies paid out are being

Mosaic cropland of vines, olives and almond groves in the Mediterranean region of Navarra, Northern Spain. These areas provide habitat for a wide range of rare and protected wildlife. Photo: Dolores Byrne.

targeted to the right land in the right places - in order words, that farmers are paid according to the quality of their environmental and biodiversity outputs.

Clearly there is a need to create an environmental market place which adequately and fairly values and rewards farmers for the quality of public goods they produce.

The Results-based Agri-environmental Pilot Scheme (January 2015-June 2018) is exploring how the Burren model of paying farmers for the quality of biodiversity on their grasslands could work in three pilot locations of County Leitrim and the Shannon Callows (including parts of Counties Galway, Roscommon and Offaly) in Ireland, and the Navarra region of Spain.

The three pilot locations were chosen because they are set within High Nature Value farmland areas and offer contrasting farming methods, climate and physical challenges. Each region focuses on different outputs. In County Leitrim the focus is on semi-natural grasslands and habitat suitable for the rare Marsh Fritillary butterfly. Breeding wader habitat, ground nesting birds and flower-rich hay meadows are being tested along the Shannon Callows. The Navarra region of northern Spain is testing how results-based approach could work for the mosaic of vine, almond and olive cropland, a very important refuge for many rare and protected flora and fauna.

Different pressures are present on maintaining extensive farming in the three areas. In Leitrim, afforestation and abandonment are seen as the main land use changes, whereas in the Shannon Callows and Navarra, the push is for intensification. Results-based schemes are a farmer-led approach to farming and conservation, which sees farmers paid for both work undertaken and, most importantly, for the delivery of results for the environment.

How does a results-based scheme work in practice?

The project teams in each area have identified result indicators which are used to assess the quality of the farmland for the measure in which they are enrolled and to indicate general environmental condition. Indicators must be fair to the farmer and be within their control. They must also be reliable indicators of the quality of the target species or habitat which the scheme measure is aiming to enhance.

Taking semi-natural grasslands in County Leitrim as an example, the 'biodiversity health check' of a grassland is scored on scale from 0

Lapwing, one of the breeding wader species in the Shannon Callows experiencing population declines. Photo: Colm Fitzpatrick.

through 10. Indicators used to assess the quality of the grasslands include the number and cover of positive plant species which indicate low levels of grassland fertility and the cover of negative plant species which can indicate fertilisation and over grazing (e.g. abundant thistles, docks or ragwort). The assessment also includes indicators for current habitat condition such as extent of bracken, scrub and any damaging activities. The latter set of indicators acts as threat assessments, highlighting to the farmer practices which might not deliver high-quality species-rich grassland into the future.

"It's a fair way of doing things. You want to improve on the scores and want to know what you have to improve"– farmer in County Leitrim

Fields which score higher on the RBAPS scale are producing better quality habitat for plants and wildlife; fields that score lower are likely to be more intensively managed land which can support higher stocking rates. The higher the 'biodiversity health' of the field, the higher the score and consequently the greater the farmer is rewarded for their time, effort and management.

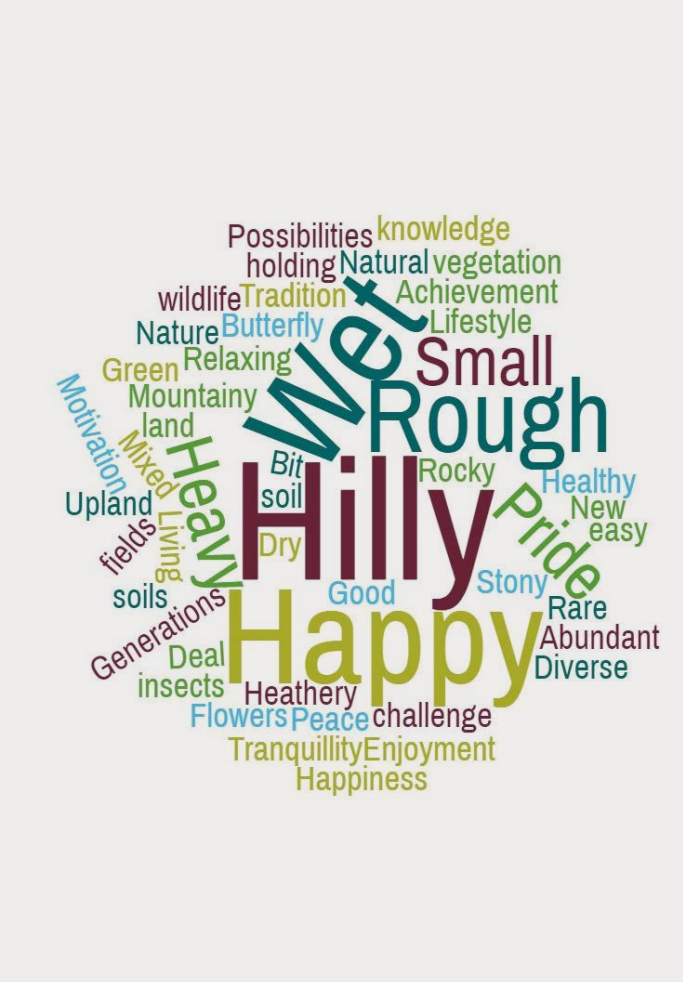
Paying for results

Payment levels are area based and are linked to the score obtained. Increasing payment is available in increments up to the maximum payment of score 10. Tiered payment levels provide financial incentives to the farmer to deliver highest quality environmental outcomes in their particular farm setting.

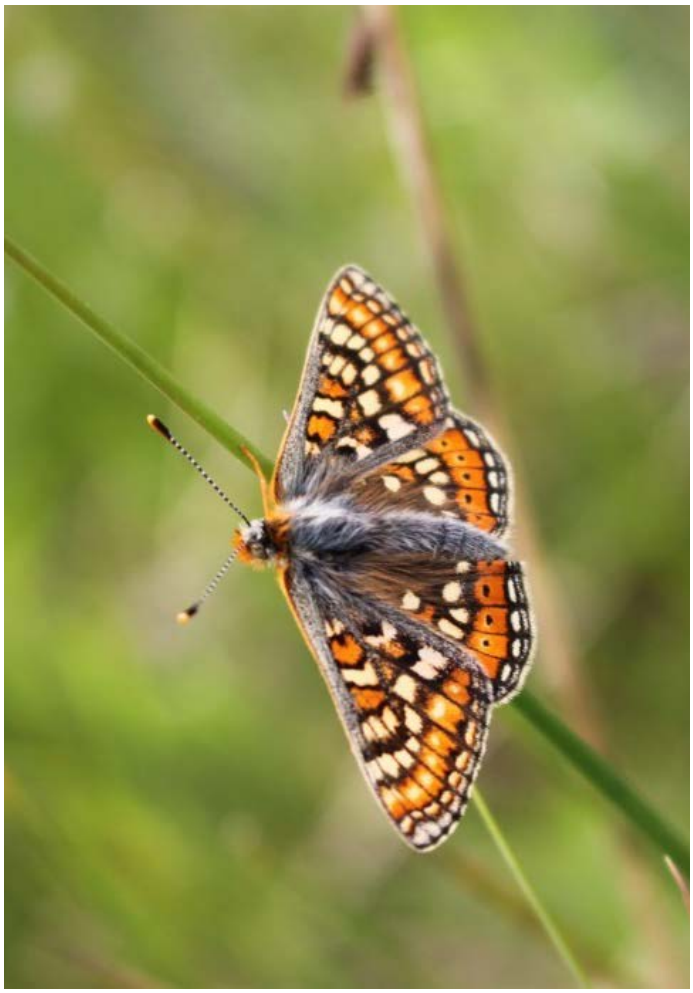
Results-based schemes are by their nature tailored to the region and are adapted to local conditions and circumstances. In the Shannon Callows, which is designated for nature conservation, some prescriptions (obligations) accompany the results-based element to maximise potential for breeding wader success. Payments are also available here for undertaking actions, such as creation of wet features such as ponds for breeding waders, which enhance the quality of farmland for these birds.

Are results-based schemes changing the way farmers view their marginal land?

It would appear to be the case with the farmers involved in the Ireland and Spain pilot. One farmer enrolled in the Marsh Fritillary



Word Cloud showing the words used by County Leitrim farmers to describe their farms after two years in the results-based pilot scheme. Word Cloud: Dolores Byrne.



Marsh Fritillary in a north Leitrim grassland.

measure in County Leitrim said that they wouldn't have noticed nature much before the scheme. Now they were stopping to look at the butterflies on their land, and even took photographs of the ones they found so that they could look them up later to see what type of butterfly was present.

"I know more about what is on the land now. You'd be more interested if you're getting paid for having the flowers on the land. I always thought they were weeds before this scheme" – farmer in County Leitrim

By putting management choices back in the hands of the farmer better environmental and biodiversity results can be produced through agri-environment measures targeted to individual farms that are more cost-effective for taxpayers.

Findings of the results-based pilot scheme will be presented to the European Commission in May 2018 and project partners are liaising with interested communities, non-governmental organisations and government bodies to bring attention to the benefits of results-based approaches for agri-environment schemes. Lessons learned from the results-based project are already being transferred into schemes on the ground, including as part of successful European Innovation Partnership projects which are being funded by the Department of Agriculture, Food and the Marine.

Dolores Byrne, Project Ecologist, IT Sligo

www.rbaps.eu

Project Co-ordinator: Derek McLoughlin derek@efncp.org

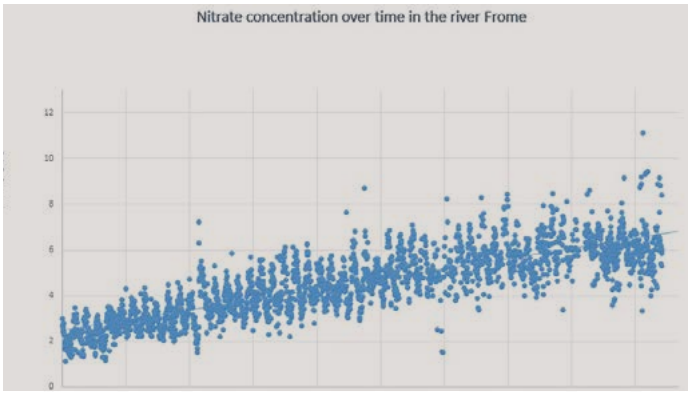
Funders: This project was funded by the European Commission with co-funding provided by project partners and with support from The Heritage Council, Teagasc and the Department of Agriculture, Food and the Marine.

Using Reverse Auctions to support delivery of catchment off-sets in Wessex, UK

Since June 2016, Wessex Water have been working with EnTrade, trialling a reverse auction platform to help deliver nitrogen offsets through catchment management. James Peacock outlines how this approach invites farmers and others to bid for funding for environmental improvements, to offset capital works that Wessex Water would otherwise have to build.

Poole Harbour is a high-profile site on the south coast of England, and has some of the highest levels of biodiversity in UK. It is an important bird habitat, protected as a RAMSAR wetlands site, a Site of Special Scientific Interest (SSSI), and as a Special Area of Conservation/Special Protection Area (SAC/SPA).

The last forty years have seen a marked increase in levels of nitrate flowing from the catchment in to the Harbour. The catchment is currently at risk from eutrophication from nitrate pollution.

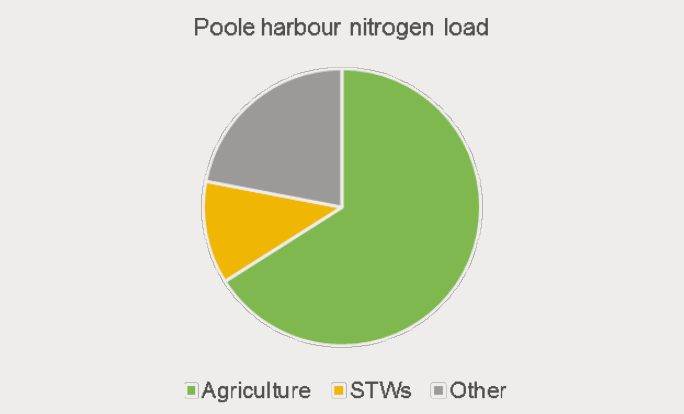


Levels of nitrates have been increasing in the Poole harbour catchment for 50 years.

Despite significant investment to reduce nutrient inputs from sewage treatment works in the catchment, further reductions are required to meet Water Framework Directive standards. In 2014, the UK regulators asked us to build a nitrate treatment works at our Dorchester sewage treatment works, to reduce our nitrate discharge by 40 tonnes. However, this work would cost around £6 million to install and £400,000 annually to operate. It would remove less than 2% of the total annual load to Poole Harbour from all sources.

The majority of nitrate losses in the catchment come from agriculture, and therefore this is where the best opportunities for nitrogen reduction are. There are various ways to achieve nitrogen reduction in agriculture, including cover crops, arable reversion, buffer strips and spreader calibration.

In the Poole Harbour catchment, we estimated that we could achieve a nitrate saving through a catchment management approach for 40% of the total cost of an asset-based approach, on a whole life cost basis. We decided to use a reverse auction as a way to set the price for measures to deliver this 40 tonne of nitrogen saving.



Sources of nitrogen in the Poole Harbour catchment – 66% is from agriculture.

Reverse auctions are not new. They work best for simple commodities, and have been popular in procurement for 30 years. They help to find the market price for a commodity, in our case ecosystem services. This means the price paid for services should be fair to buyers and sellers, and based on supply and demand in the market.

One way to deliver nitrogen savings is to grow cover crops over the winter period. Cover crops are sown in the autumn after a commercial crop, where the farmer would not grow his next commercial crop until the spring. The cover crops reduce leaching by taking up residual nitrogen held in the soil and by providing ground cover over the winter, when most leaching occurs.

Above left: Oil Radish – a type of cover crop grown over winter to reduce nitrogen leaching. Above right: Analysing samples for soil mineral nitrogen (SMN) to validate impact of environmental measures.

In our reverse auction, we rank bids based on cost per kg of nitrogen saved. We then contract with the most cost effective bids. We take the cost effectiveness from the cost entered by the farmer and the calculated effectiveness of his bid.

A number of factors affect how effective a cover crop is at reducing nitrogen leaching. Date of sowing and choice of cover crop are directly in the control of the grower, and therefore we use these factors to influence our estimate of effectiveness. The earlier a farmer sows a cover crop the greater the effectiveness, but the impact of sowing date will differ between crops.

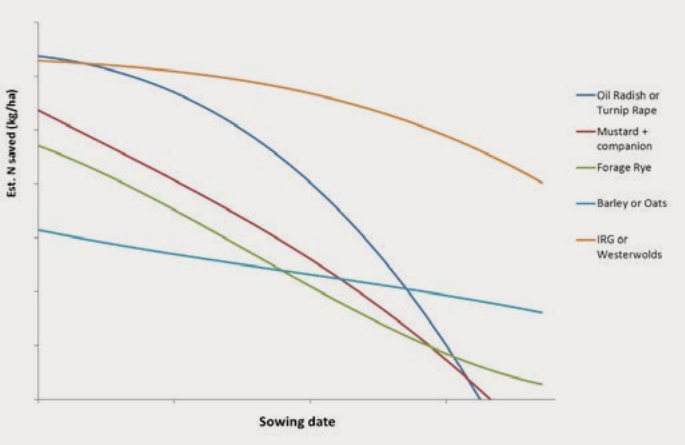


Chart showing how effectiveness of nitrogen saving varies by date and type of cover crop.

During an auction, a farmer selects the type of cover crop they will grow and the date they expect to grow it. The system then takes this date and calculates effectiveness (in kgN/ha) using the effectiveness curve for the selected cover crop, shown above.

EnTrade have now run six auctions with Wessex Water, United Utilities and Natural England. These auctions have included arable reversion, cover crops and buffer strips. In total, we have received bids for 150 tonnes of nitrogen reduction measures through the platform, from nearly 50 farmers.

In Poole Harbour, the auction approach has resulted in an overall cost per kg of nitrogen saved of £1.40 per kg N (£76 per hectare) for cover crops. This is 20% less than the overall average of all bids of £1.68 (£97 per hectare), showing the value of the auction process. It has also helped improve the reach of catchment management in the area, improving engagement with more farmers.

We use farmer-submitted photos and satellite imagery to ensure that farmers have put in the measures. We make the agreed payment once we were satisfied with the evidence. The planting of cover crops by farmers has had an over 90% success rate, and our sampling results have shown that the measures have been successful in delivering the required savings, very close to the estimated savings in the platform. We then feed this data back in to the platform to improve the calculations, and therefore the accuracy of the estimates.

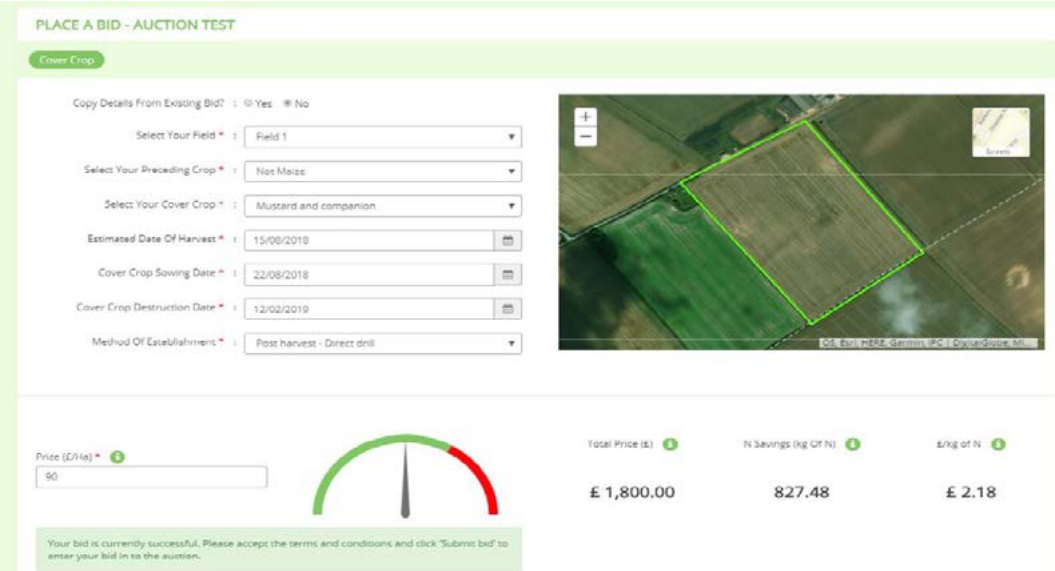
We found in our feedback surveys that 70% of farmers who use the system were positive about it for our first auction. This increased to 90% in the most recent auction. We are currently carrying out some work to find out about the eligible farmers who have not bid.

Having demonstrated that a reverse auction platform can work for nitrates, Entrade are now in the process of developing modules for other outcomes – this includes reducing phosphorus and pesticides in catchments and increasing uptake of biodiversity and natural flood management. Ultimately, we want to build a platform that can deliver and quantify multiple outcomes, to get the most out of spending in catchments. In future auctions, we will aim to quantify these additional natural capital benefits, which we can enhance by combining further funding from other sources – to achieve truly sustainable catchments.

James Peacock, Entrade Product Manager

Find out more:

https://www.wessexwater.co.uk/pooleharbour/
www.entrade.co.uk



Farmers can adjust their bid at any point throughout the auction, and once closed we can calculate the most cost-effective combination of bids to meet the given target.

Smart Farming case study – dairy farmer Andrew McHugh

The Smart Farming programme focuses on eight key areas that have the highest costs on farms, or offer the greatest savings to farmers. In this case study, Thomas Ryan tells us about a dairy farm owned by Andrew McHugh, who saved over €9,000. Andrew presented this case study to the Citizens Convention on Climate Change in 2017.

Andrew and his family are dairy farmers and live near Newtownforbes in County Longford. Andrew took part in the Smart Farming programme which helped him to identify cost savings on his farm of over €9,000.

Andrew is also on a pathway to reducing his climate impact by 20%, using the results of the Teagasc and Bord Bia Carbon Navigator decision support tool outlined in the Winter 2017 Catchments Newsletter. The following five areas were examined on Andrew's farm, to identify ways to reduce greenhouse gas emissions: grazing season length, herd breeding strategy, improved nitrogen efficiency, improved slurry management and better energy use.

Grazing season length

Using the Carbon Navigator decision support tool, Andrew can reduce his emissions by 0.8% by increasing the grazing season length by one week in March and November, as grazed grass in the early and late grazing season is a higher quality more digestible feed than grass silage, leading to reductions in the proportion of dietary energy lost as methane (CH_4). Also, the shorter housing season leads to reduced slurry methane and nitrous oxide (N_2O) emissions from storage and energy use from spreading.

Herd breeding strategy

The largest (-15%) reduction in greenhouse gas emissions identified on Andrew's farm when using the Carbon Navigator decision support tool was by increasing the genetic merit of his herd. Increasing genetic merit by using the Economic Breeding Index (EBI) has the capacity to reduce emissions through four mechanisms:

- Improving fertility reduces calving intervals and replacement rates, thus reduces enteric CH_4 emissions per unit of product
- Increasing milk yield per unit of grazed grass and improving milk composition increases the efficiency of production, which decreases emissions per unit of product
- Earlier and more compact calving increases the proportion of grazed grass in the diet and reduces culling and replacement rates
- Improved survival and health reduces deaths and disease incidences, reduces replacement rates and emissions

Andrew's current EBI figures have scope for improvement and thereby reducing greenhouse gas emissions. This is because dairy cows that are milking for three seasons or longer in Andrew's herd are currently trailing the national EBI average. Andrew's focus over the coming years will be to target his breeding strategy on improving the genetic metric of his herd by using the EBI index to breed for improved performance (yield and fertility).

Improved nitrogen efficiency

Andrew can reduce his greenhouse gas emissions by almost 3% by increasing nitrogen efficiency. Andrew will be focusing on the following areas:

- The increased use of clover in swards thereby reducing N usage
- Better soil fertility management
- Effective grazing management leading to high levels of grass production and utilisation
- Improvements in the timing and application of fertiliser nitrogen
- The application of the most appropriate N fertiliser type for the prevailing conditions (urea v CAN)

Improved slurry management

The Carbon Navigator has identified that by improving manure management Andrew can reduce greenhouse gas emissions associated with manure by almost 2%, through a transition from summer application to spring application of manure and the use of low-emission application methods.

Spring application reduces ammonia emissions (NH_3) following land spreading due to the more favourable weather conditions at that time of year. It also increases the fertiliser replacement of slurry. Therefore, the total fertiliser nitrogen input and associated emissions from manufacturing, spreading and storage are reduced.

Better energy management

While energy usage accounts for a relatively small amount of total system emissions on dairy farms, the Carbon Navigator has identified that Andrew can reduce his greenhouse gas emissions by almost 1%. Three key areas are identified as having significant potential to reduce energy related emissions:

- Effective pre-cooling in a Plate Heat Exchanger
- The use of Variable Speed Drive (VSD) Vacuum Pumps
- Presence of energy efficient water heating systems

Each of these three areas were relevant for Andrew, however the Smart Farming study drew Andrew's attention to the need to resize his plate heat exchanger.

Measure	Action	GHG Change
Grazing season length	Increased grazing season length in shoulders of the year	-0.8%
EBI	Scope to improve EBI by 55 points – breed for milk production and fertility	-15.0%
Nitrogen Efficiency	Reseeding and grassland management to allow greater kg solids output per hectare for similar inputs.	-2.9%
Slurry spreading timing	Spread slurry 70% in spring v's current 60%	-1.9%
Energy efficiency	Reduce energy consumption through increased plate cooler capacity	-0.8%
Total		-21.3%

Greenhouse gas emissions reductions identified on Andrew McHugh's farm by the Carbon Navigator.

Energy production, forestry and biodiversity

In addition to using the Carbon Navigator decision support tool Andrew would like move to an energy neutrality position on his farm, whereby he is using the shed roofs and manures for renewable energy production. The lack of necessary stimulus measures from the Department of Communications, Climate Action and Environment is holding back the potential for farm scale renewable energy production.

Andrew would also like to complement his existing dairy farming enterprise by developing an agro-forestry and biodiversity strategy for his farm, which would allow him plant certain parts of his farm. However, the compulsory re-planting obligation, restrictions on planting and administrative burdens around the forestry roads scheme all act as barriers to supporting the development of an agro-forestry strategy on Andrew's farm.

Farmers providing leadership

Smart Farming is one means by which the agriculture sector in Ireland, and particularly farmers themselves, are endeavouring to provide leadership in addressing climate change. The programme draws on the expertise of the sector and complements other knowledge transfer programmes such as Better Farms, PastureBase Ireland and Dairy Sustainability Ireland.

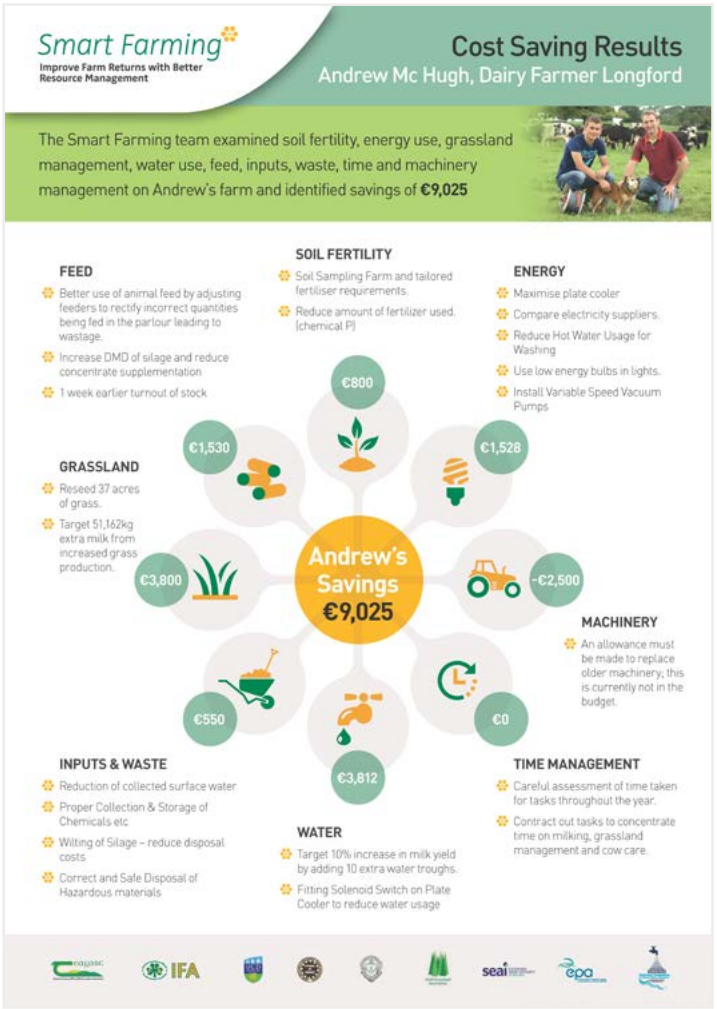
Are you ready to take the Smart Farming challenge?

Are you ready to take the Smart Farming challenge? We are currently recruiting farmers, who may be interested in taking part in 2018. Let's talk smartfarming@ifa.ie and 01-4260343

Thomas Ryan, IFA

Watch Andrew's presentation to the Citizen's Assembly on Climate Change:

www.smartfarming.ie/case-studies/andrew-mchugh/



Smart Farming cost savings identified on Andrew McHugh's farm.

ARTICLES

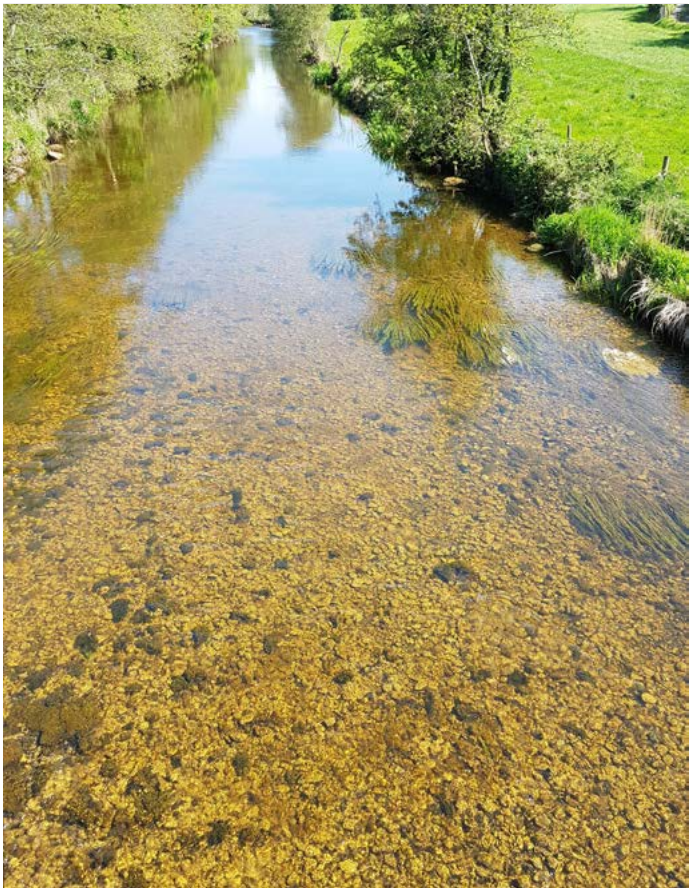
It's all about the algae

When people think about algae in rivers, pollution and eutrophication normally spring to mind. In this article originally published by the Royal Society of Biology in the UK, Martyn Kelly explains how initiatives such as the EU's Water Framework Directive can help us better understand the contribution of algae to our healthiest waterways.

Imagine for a moment that you are looking at a perfect stream. What do you see? Your answer will probably depend on where in the country you live, but it is unlikely to involve large, unsightly growths of algae.

Algae are in fact an important part of stream ecosystems, but we often only notice them when the natural balance is upset and they can proliferate.

Take a tentative step into any stream, even a crystal-clear one, and you will feel the stones that make up the bed of the stream are slippery to the touch. If you rub off a small part of this slippery surface and put it under a microscope, you'll see that it is teeming with algae.



A diverse and balanced community of benthic algae attached to stones in this high status lowland Irish river Photo: Bryan Kennedy, EPA.

This little-known group constitutes 75% of all the plant species recorded from the UK – and a large part of the evolutionary diversity of all photosynthetic organisms, too.

Until the turn of the millennium, applied scientists' interest in freshwater algae was mostly focused on the problems they caused. It was well understood that an excess of inorganic nutrients leads to accelerated growth of algae in lakes and reservoirs, and has consequences for water managers: clogged filters in water treatment works, taste and odour problems and, in particular, blooms of toxic blue-green algae (now known as cyanobacteria).

In 2000, however, the European Union's Water Framework Directive (WFD) was enacted, bringing with it a paradigm shift in how we evaluate the quality of water. Before the WFD, we evaluated water primarily in terms of an absence of undesirable properties. The WFD turned this logic around and brought in definitions of 'ecological status' that focused as much on the presence of positive attributes.

At the same time, it specified the groups of organisms that needed to be considered and one of these, for freshwaters, was the phytobenthos – the algae found attached to submerged surfaces.

Prolific growth, owing to excess nutrients, of an opportunistic alga in this eutrophic stream. Photo: Bryan Kennedy, EPA.

While we all had a reasonable idea of what algae to expect in an obviously polluted river, knowing what to expect at the opposite end of the water quality gradient was more of a challenge. There was plenty of anecdotal information available, but few rigorous studies of what is found where. This was key to all the methods developed for the WFD: not only are the expectations for a Pennine burn different to those of a chalk stream in Hampshire, but the implementation of the directive needs to be consistent between the different countries of Europe, too.

This means that a set of sites that are as close to natural as possible are needed in order to act as benchmarks against which all others can be judged. However, this is a real problem in the UK, with its long history of human alteration of the environment – and, indeed, in most other parts of Europe. What do we understand by 'natural'? Does it mean streams flowing through a landscape clothed in primordial forest or do we accept a measure of human alteration?

In practice, there needs to be enough of these benchmark streams to both cover the diversity of habitats and permit adequate replication of naturally variable systems. The criteria also need to work across national boundaries, so that 'good status' (the target of the WFD) means the same in Germany and Poland as it does in the UK.

Chaetophora sp. on a rock (above top) and under a microscope (above). Photos: Bryan Kennedy, EPA.

After much debate among ecologists from all over the EU, 'reference sites' were defined on the basis of low population density, low levels of urbanisation, intensive agriculture and industry in the catchment, plus a natural flow regime. Some (notably the late Brian Moss) regarded this as a dilution of the original high ideals of the WFD, but most recognised that this was a pragmatic solution to a complicated issue. That the UK still struggles to achieve the WFD targets for many lakes and rivers suggests that this compromise was small relative to the overall scale of the problem.

With the benchmark defined, the task facing regulators is simply to compare the algae from any stream or lake with what should be there. In other words, 'observed' versus 'expected', with the outcome termed the 'Ecological Quality Ratio'.

However, faced with more than 5,000 species of freshwater algae recorded from the UK and Ireland, how do you go about doing this? Practice around Europe varies, but most countries have focused on a single group, the diatoms, which would probably have been the most common type of alga in that imaginary sample from earlier.

Diatoms are microscopic algae whose yellow-brown colour betrays affinities with the brown seaweeds of our coastlines and whose most noteworthy feature is a beautifully sculpted silica cell wall (imagine the best crystal glass, but on a microscopic scale). Biologists working for water agencies in France have been using diatoms to assess water quality for a number of years, and the UK had picked up on the idea to help with implementation of an earlier directive on urban wastewater.

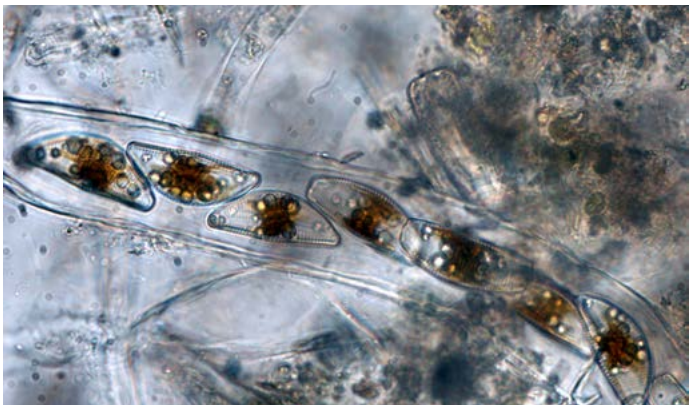
The Trophic Diatom Index provides an indication of the effect of nutrients (especially phosphorus) on stream ecology and, by calibrating these observed measurements against expected values from a subset of sites at 'reference condition', you have a simple measure of ecological status. A catchy acronym, DARLEQ (Diatoms for Assessing River and Lake Ecological Status) was devised and the UK's environment agencies could start the task of evaluating the condition of our water bodies.

DARLEQ and similar methods developed for the same purpose elsewhere in Europe were radical in that they present a view of the condition of algae in freshwaters that is not focused purely on negative properties. That, strangely, has presented those of us involved with the method with a substantial challenge that has little to do with science and much to do with public perceptions of the environment.

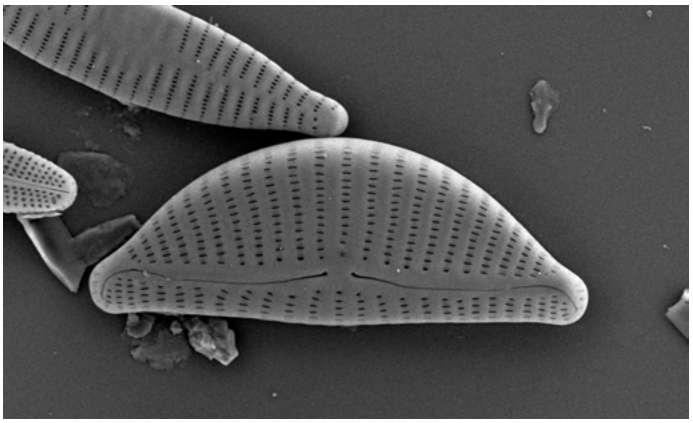
The problem is that when DARLEQ identifies a stretch of river as being less than 'good', the WFD specifies that steps need to be taken to restore good status. This often involves utility companies improving effluent quality – for example, by reducing the concentration of nutrients such as phosphorus, the costs of which are passed to their customers. They, in turn, are entitled to ask why. In many cases, the high standards that the WFD sets mean that the public may feel they are paying for improvements to a river that, to a lay person, already appears to be in reasonable condition.

Buried in the WFD is a clause that says improvements to good status are not necessary if the costs are "disproportionately

expensive" (article 4 paragraph 5) and I have met utility company staff who question whether an improvement in the type of diatoms present alone is enough to justify the expense of investing in better sewage treatment. The answer, of course, is that the diatoms should be an indicator of the health of all the microscopic life in the stream and that this, in turn, supports the more aesthetically appealing components of the ecology. This message, however, has been slow to permeate.



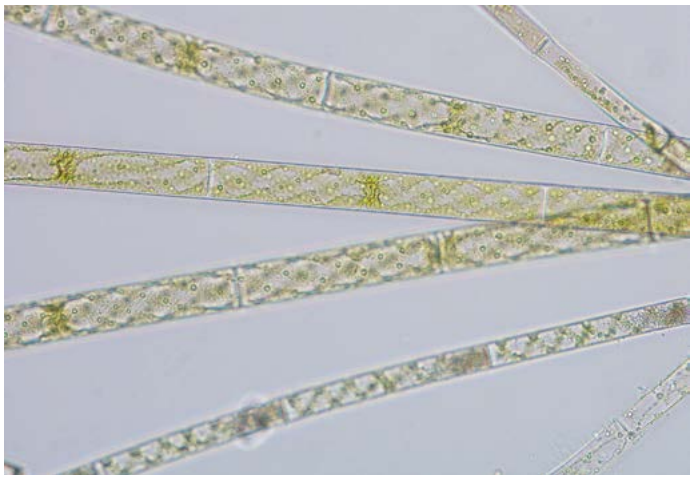
Cells of a cymbelloid diatom (a microscopic alga 0.04 mm length) when viewed with light (left). Photo: Bryan Kennedy, EPA.



Cells of a cymbelloid diatom (a microscopic alga 0.04 mm length) when viewed with scanning electron microscopy. Photo: Bryan Kennedy, EPA.

The need for results of ecological assessment methods to be understandable beyond a narrow group of specialists was one factor behind the development of a new approach: Rapid Assessment of PeriPhyton in Rivers (RAPPER). This is a quick survey method that focuses on those algal growths that can be seen with the naked eye.

Remembering my first lesson in the effect of freshwater pollution on invertebrates on an A level biology field course, I set out to devise an approach whose rudiments could be taught in an afternoon. Unsightly filamentous green algal growths that smother the beds of many of our lowland rivers are good indications that a stream's quality is compromised, but RAPPER also includes a list of algal genera that are characteristic of good status or better. Initial trials have yielded promising results and the Freshwater Biological Association is exploring the possibility of using RAPPER as a citizen science tool with the Riverfly Partnership.



Characteristic spiral chloroplast of the green algae Spirogyra viewed under a microscope. Photo: Bryan Kennedy, EPA.

In considering these developments, however, it is impossible to ignore the political backdrop: first, the austerity measures introduced across government departments since 2010 and, more recently, the spectre of Brexit.

Brexit may drive ecological assessment in interesting directions, although it is too early to make predictions with confidence. It could, for example, force our environmental regulators to rethink approaches, but it may also have some very negative outcomes.

The European Union (Withdrawal) Bill will see most existing EU law written into UK statutes, after which, over time, legislation will be revised and Parliament (and, where appropriate, the devolved assemblies) will be able to decide which elements of that law to keep, amend or repeal. When the time comes for the nuts and bolts of the WFD to come under examination, the statutory requirement to monitor inconspicuous components of ecosystems, such as diatoms, may well be quietly dropped.

This is partly because of the remorseless pressure within the public sector to drive down costs and the lack of awareness of their contribution to ecosystem services within the management hierarchy. However, it is also because scientists who study these organisms have paid little attention to explaining benefits in terms that mass audiences can understand.

The time has come to tell the public more about the role that these important members of ecology's 'back office staff' play in maintaining healthy ecosystems.

Martyn Kelly

Martyn Kelly is a freelance environmental consultant with an interest in the ecology of freshwater algae. He blogs at www.microscopesandmonsters.wordpress.com

This article originally appeared in the Royal Society of Biology's 'The Biologist' – special thanks to both the RSB and the author who have kindly allowed us to reproduce it here.

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