Issue 13: Summer 2020

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Catchments Newsletter

Integrated Catchment Management: sharing science and stories

Blue Dot Catchments: working to let life thrive in some of our wildest waters

Inside this issue

Main photo: The Failmore River from bridge southeast of Maumturk Mountains (Photo: Francis Deery). (PXX, Photo: XX)
Other Photos: Shore Crab (PXX, Photo: © Dave Wall), Yellow Bird's-foot Trefoil and Red Clover (PXX Photo: XX), Image 3 (PXX Photo: XX).

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Inside this issue

Summer 2020 Editorial

The last few months have seen transformational changes in our ways of working and living as we respond to the challenge of a global pandemic. The power of community and the willingness of people to act to help others has never been clearer. In the EPA Catchments Unit, we moved to remote working in a single afternoon on 12 March and have been doing so ever since. We're collaborating remotely with our partner organisations and the work continues.

Data from the National Biodiversity Data Centre has shown that the lockdown allowed more people to observe and connect with their local environment. The three months of the Covid-19 lockdown have seen a remarkable increase in records submitted by citizen scientists; with April experiencing a 54% increase in the monthly number of records submitted; May a remarkable 70% increase; and June with a 66% increase despite the poor spell of weather. It is clear that people turned to recording and engaging with biodiversity in response to the Covid-19 lockdown.

Communities have continued looking after their environment around the country. On page 10, you can read how the Local Authority Waters Programme has moved to online meetings which has allowed them to continue their work with communities and allowed people to attend during lockdown while acknowledging online meetings can find it hard to match 'active community engagement and networking - not forgetting the all-important cup of tea after a community meeting!'

Other stories give some ideas for what you can do and see in your local area - you can read about how you can get involved with shoreline citizen science (p.5), Nature on our Doorsteps (p.6) and find out more about a water-themed mural in Stoneybatter (p.8), and the 2020 Community Water Fund (p.12).

The community in Stoneybatter will also be drawing on the Community Water Development Fund to help install planters that gather rainwater from downpipes. This slows the flow of water to the Liffey and conserves water by using rain for pollinator-friendly plants – a great example of how to achieve multiple environmental benefits.

Accessibility of information and equity in decision-making leads to better involvement of communities in the management of our natural environment. On page 16 Gretta McCarron from An Fóram Uisce tells about the barriers to public involvement in decision making processes and governance of our waters, and what can be done to improve inclusion and equity.

The EPA hosted its first virtual water conference in June (see page 14). Over 1200 people attended from across local authorities, public bodies, academic institutes, environmental groups and members of the public. The topics discussed included the pressures on our water environment and the actions needed to protect and restore this essential resource. This year's event had almost triple the attendance of previous years – showing clearly that virtual conferences can have a wider reach.

You can read about the new EPA Water Maps and the facility to download chemistry data on catchments.ie (p.14), how we measure the flow and levels of rivers, lakes and groundwater across Ireland (p.18), a new Environmental Sensitivity Mapping tool (p.26), and INCASE — a research project piloting Natural Capital Accounting in 4 catchments (p.28).

The latest Red List shows two Irish stoneflies are threatened with extinction (p.20). To help preserve water quality and the species that depend on it, the Blue Dots Catchments Programme is now working to let life thrive in some of our wildest waters (p.22).

On page 25, we have a story about how the National Federation of Group Water Schemes have developed a biodiversity framework for their sites. These community-owned sites are spread out around the country providing drinking water for their members. The aim is make them havens for wildlife like bees and insects across Ireland – another great example of multiple benefits.

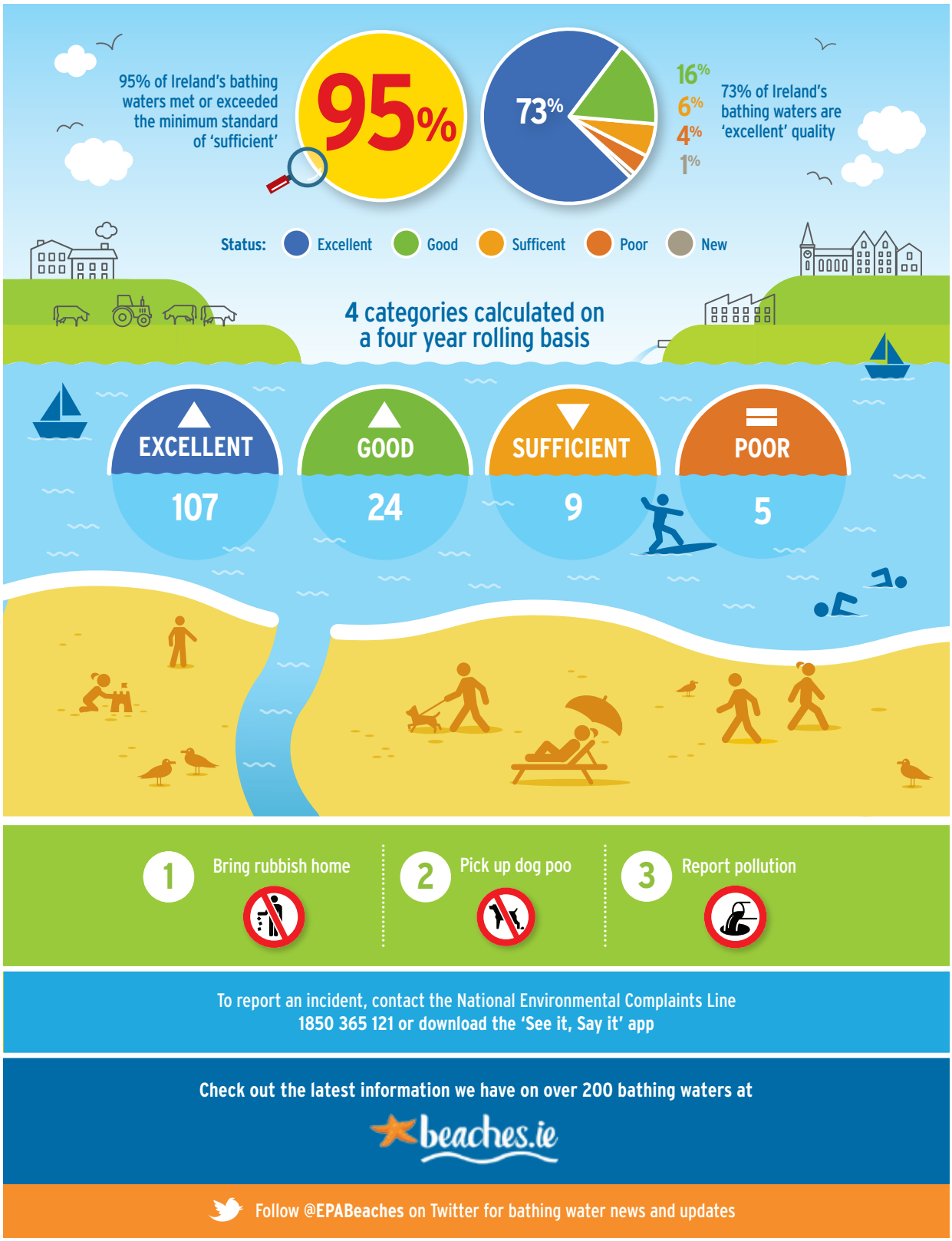
On page 31 you can read about The Living Bog project and how the restoration and rewetting of 12 of Ireland's unique raised bog SAC's in seven counties is impacting on water in these bogs – more multiple benefits for these bogs, their biodiversity and water. Finally, on page 34 we have a story from Italy on recent floods in Venice and how these are predicted to become more frequent as climate change impacts increase in future.

Scientific assessments are currently underway to update our understanding of the pressures impacting on our waters, and the reasons why water quality has declined. This will provide the evidence base to underpin the programme of measures in the third cycle River Basin Management Plan which will run from 2022 to 2027. The draft plan is due to be published at the end of 2020 for public consultation.

The second cycle has seen great engagement and collaboration across the water sector, public bodies and communities – we now need to focus on implementation and outcomes to halt the decline in water quality and restore our waterbodies to good condition, while making sure we maximise multiple benefits for biodiversity and climate as well. The third cycle River Basin Management Plan for 2022-2027 will be a key tool to drive this process, so we would encourage everyone to get involved.

Jenny Deakin and Paddy Morris, EPA Catchment Science and Management Unit

Bathing Water Quality in Ireland 2019



Common Starfish (Photo: © Dave Wall).

Citizen science: help Explore Your Shore and do a Rocky Shore Safari

Dave Wall from the National Biodiversity Data Centre tells us about the Rocky Shore Safari, a new survey that will help gather information on marine plants and animals on Ireland's rocky shores.

The National Biodiversity Data Centre has launched their Rocky Shore Safari which is a new survey under our Explore Your Shore! marine citizen science project.

Rocky Shore Safari is the fourth survey of our Explore Your Shore! citizen science project and is designed to collect information on the distribution of marine plants and animals in Ireland's rocky shore habitats.

Explore Your Shore! is empowering and supporting volunteer citizen scientists to survey and record intertidal and coastal marine biodiversity. The project is also seeking to build a network of active marine biodiversity recorders in Ireland. The records obtained will improve our knowledge of marine species distributions around the Irish coast.

Bladder Wrack Seaweed (Photo: © Dave Wall).

Explore Your Shore! is asking members of the public to get involved in our Rocky Shore Safari by spending one hour surveying their local rocky shore and submitting records of animals and plants to www.ExploreYourShore.ie

Explore Your Shore! is targeting coastal habitats and species using a suite of online surveys. As part of the project, online survey and identification workshops and resources will be available with full details posted on our project website at www.ExploreYourShore.ie

Shore Crab (Carcinus meanas) (Photo: © Dave Wall).

Biodiversity records collected will be used to map the current distribution of intertidal and coastal species in Ireland. Explore Your Shore! will also assess the use of marine plants and animals as bio-indicators of water quality and climate change. The project also seeks to map the distribution of invasive marine species such as wireweed, slipper limpet and Chinese mitten crab.

"Despite being an island nation, the importance of Ireland's intertidal biodiversity has not received the attention it deserves. Explore Your Shore! aims to get people more engaged in discovering Ireland's shoreline and the wonderful biodiversity it contains." - National Biodiversity Data Centre's Director, Dr Liam Lysaght.

Explore Your Shore! offers a suite of surveys to enable the public to get involved in marine citizen science biodiversity data recording. In 2019 we received 1400 records of marine species from around the Irish coast. The project wants to inspire people to get out and about on our coastline and discover the rich diversity of life on our shores. Participants can map and explore their records via the National Biodiversity Data Centre's Citizen Science Portal, as well as benefitting from the physical and mental wellbeing obtained by spending time by the sea.

Explore Your Shore! is partnered with a number of coastal biodiversity recording schemes such as Seasearch Ireland diving surveys, Coastwatch eco-audit surveys and Purse Search Ireland recording of shark, skate and ray egg cases.

Anyone who would like to participate in our Rocky Shore Safari or in any of our Explore Your Shore! Surveys should visit our website at www.ExploreYourShore.ie for further information, survey forms and other resources.

Learn More:

www.ExploreYourShore.ie
www.biodiversityireland.ie

Explore Your Shore! is funded by the Environmental Protection Agency to promote citizen science and awareness of water quality in Irish freshwater and coastal aquatic habitats.

Nature on our Doorsteps: Volume 1

Many of us of a certain generation who have an interest in nature and conservation most likely grew up searching hard for any information on the creatures and plants that lived around us at home.

Trips to the Library or to local book shops would of course have yielded information but this mostly addressed British birds, plants, trees and insects. In fact, growing up, we probably knew more about the exotically named butterflies on the chalk downs in Britain or about the lions and gazelles in the Serengeti National Park than we did about the snails, bumblebees, or 'weeds' in our own back gardens.

A recently published book, 'Nature on our Doorsteps' offers a little glimpse into some of these everyday features of the natural heritage in our own immediate environment, attempting to raise the profile of those things that are generally overlooked because they are seen as being 'ordinary'.

Following the seasons throughout the year, this book highlights a range of both well-known and less recognised insects, plants and invertebrates that can literally be found in our own back gardens, if we take the time to look.

At first glance, this Giant Pied Hoverfly could be mistaken for a bumblebee.

Yellow Bird's-foot Trefoil and Red Clover are loved by pollinators for their rich source of nectar.

This yellow Crab spider is well camouflaged while it glues leaves together to form a pouch for its eggs.

The book is a product of a partnership between South Dublin County Council's Heritage Officer, Rosaleen Dwyer, and the Echo Newspaper Group in Tallaght, Co. Dublin.

Since July 2017, The Echo has published weekly biodiversity columns as provided by the Council's Heritage Officer. The articles are short, approximately 200 words, and are accompanied by two photographs. They follow the seasonal changes that occur in the gardens, parks, roadside verges and public open spaces in South Dublin County, anywhere that most people are likely to encounter nature.

The only skill that is required is the ability to stop, stand, and look.

For many people, 'buzzing' things are to be shooed away or squashed before they sting. This leaves very little time to observe what their true identities are, how they behave, or how we might be benefiting from their activities. They may turn out to be a rare or a threatened bumblebee, or even a fascinating bumblebee mimic – a 'bumblebee in disguise'.

Who are nature's recyclers and nature's colonisers? What are witch's brooms? When is a berry not a berry? Why do some trees hang onto withered leaves over winter? What exactly is stem 'spittle'? How do plants survive the cold of winter? Why are cowslips the 'come-back kid'? Who are nature's air conditioners?

These are just some of the topics covered in Volume 1 of Nature on our Doorsteps. A second volume is expected later in 2020.

While being everyday examples of the natural diversity that is to be found around us, the subjects at the heart of these articles are the basic building blocks of the natural world. Protecting and enhancing these 'ordinary' building blocks is therefore key to protecting our own future as a species. The first step is getting to know and value what is around us.

Rosaleen Dwyer, Heritage Officer, South Dublin County Council

Learn more:

Nature on our Doorsteps Volume 1 is available from the County Library, Tallaght, Dublin.

The lovely water mural at L. Mulligan Grocers, who celebrated 10 years in business in July 2020.

Stoneybatter's new water mural – adding vibrancy to a vibrant place

Thomas Carolan from the Local Authority Waters Programme tells us how Stoneybatter's community became Ireland's first pollinator-friendly community, and how rainwater planters and a mural are helping the community get involved in treasuring their water...

Stoneybatter is a vibrant area in Dublin city centre.
The community in Stoneybatter are very engaged in environmental initiatives. Recently it was recognised by the All-Ireland Pollinator Plan as Ireland's first pollinator-friendly community. To get this recognition, 70 sites (so far) signed up to help pollinators in Stoneybatter:

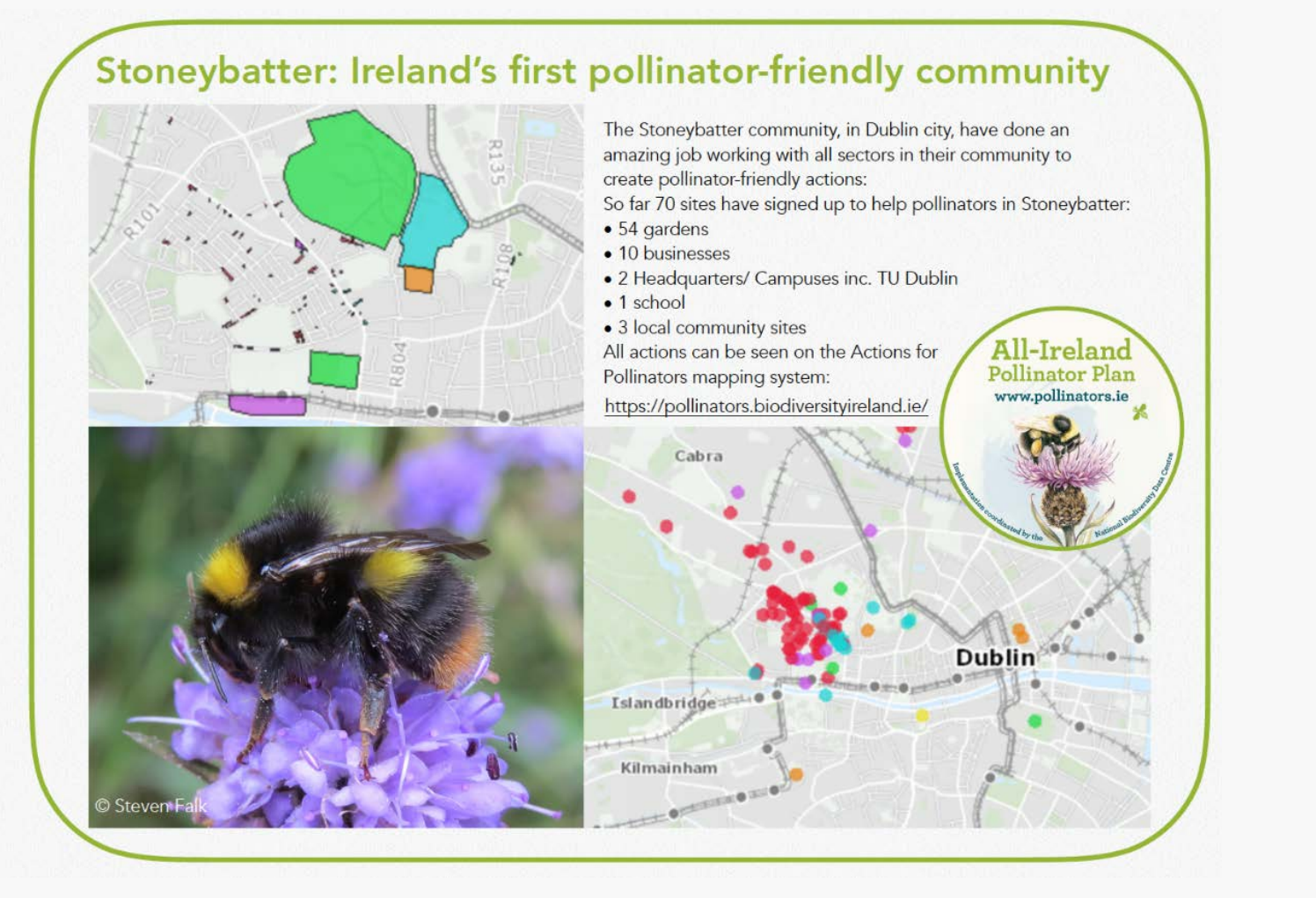
- 54 gardens
- 10 businesses
- 2 headquarters/ campuses including Technical University Dublin
- 1 school
- 3 local community sites

Rainwater Planters Project

As part of an effort to expand the community's environmental focus and address urban water issues, the LAWPRO Community Water Officer, Thomas Carolan is working with Bí Urban, who are a nature-based social enterprise based in Stoneybatter.

Bí Urban were successful in their application for funding to LAWPRO's Community Water Development Fund 2020. Their project aims to construct rainwater (down-pipe) planters in as many gardens in Stoneybatter as possible. These planters are connected to the downpipe of a house in a similar way to a water butt. The benefit of these planters is that they divert excess rainwater from the drainage network, which in periods of heavy rainfall can cause overflows into the Liffey directly affecting water quality.

The planters also help to conserve water by limiting demand on mains water for watering the plants in the planter boxes. Finally, the planters provide more pollinator-friendly plants throughout Stoneybatter, which benefits the overall environmental objectives for the community.



Water and water quality in Dublin

The rainwater planters project is one of several water-related initiatives that the Stoneybatter community and the Community Water Officer are planning in the area. This is because water and water quality do not always receive a lot of attention from communities in an urban setting. However, there is a growing awareness of the need to protect and conserve water as a resource in urban areas. The boil water notice that was called for 600,000 people in the greater Dublin area (including Stoneybatter) in 2019 highlighted this issue. As mentioned by Sean Laffey of Irish Water at the recent EPA 2020 Conference: "...we're having our second drought in three years..." and this puts significant pressure on water resources.

The Water Mural: Pride of Place

In this context Stoneybatter Pride of Place (POP) in collaboration with the Community Water Officer decided to fund a water-themed mural that would highlight these extremely important issues and draw attention to the water-related initiatives planned for Stoneybatter.

Seáneen Sullivan who is a member of Stoneybatter POP and the owner of L. Mulligan Grocery in the heart of Stoneybatter agreed to have the water mural adorn the gate of her iconic city centre establishment, arguably giving the mural the most prominent spot in the city centre village of Stoneybatter. The image and message were designed to be simple but effective, which was beautifully achieved by artist Holly Pereira.

Thomas Carolan, Community Water Officer, Local Authority Waters Programme

Learn more:

www.watersandcommunities.ie
www.pollinators.ie
www.biurban.ie

Ballymacraven river, County Clare (Photo: © Ruairí Ó Conchúir).

Going online to support communities working to enhance water quality and biodiversity

In these strange times, the work of the Local Authority Community Waters Officers has had to move online. Ruairí Ó Conchúir tells us how he has moved to Zoom training events for local communities – and that while this has allowed him to support communities during the pandemic, it can never be as effective as chatting face-to-face over a cup of tea...

What started out as one to one online support to individual community groups in late March 2020, at the very start of the COVID-19 lockdown, soon developed into a comprehensive training programme. The online Zoom based training was designed to support community groups in the Mid-West to engage with their local water bodies in terms of water quality, biodiversity, habitat enhancement work, biosecurity and the sharing of ideas on water related projects and ways in which local groups and individual champions can help build local community resilience.

In the period from mid-April to early July 2020 a total of 12 online training events for community groups were delivered. These free online training events were designed to support groups to gain a better understanding of the various interrelated issues at play within their local water bodies. Amongst other focus areas, the training included the following:

- **Otter Identification & Citizen Science Survey Work and Approaches** focused on otter and American mink identification, otter survey work, recording of data and possible otter habitat restoration works
- **Dragonfly and Damselfly Identification and Citizen Science Survey Work** focused on approaches and techniques to survey work, data capture and recording, habitat management and site-specific planning
- **How Our Rivers Work and How We Can Work With Our Rivers** focused on rivers as biodiversity corridors and practical measures communities can undertake to support their local river as part of their wider catchment
- **Control and Management of Alien Invasive Species** focused on the practical steps to take to control and manage invasive plant species along rivers
- **Waterbodies and the Work of Tidy Towns** focused on how groups can create a greater understanding of local water bodies, undertake practical measures to improve water quality, biodiversity planning, riparian management, and site-specific planning to lessen the impact of climate change

- **Wetlands - Helping Communities Reconnect with Nature** focused on the Shannon Town Community Wetlands Restoration Project and other community wetlands in Ireland helping communities reconnect with nature
- **Biosecurity, You and Your Local Water Body** focused on the ever-present threat of Crayfish Plague and invasive species and how communities can raise awareness of biosecurity risks and undertake preventative measures, including the Check-Clean-Dry protocol, to lessen the impacts on local rivers and recreational waters
- **Project Work, Funding and Project Planning** focused on how communities can access funding, plan projects, share tips and project ideas to enhance their local water bodies while building community resilience in the face of the current climate change crisis and biodiversity emergency

The online training was targeted at community and voluntary groups, Tidy Town groups, development associations, environmental NGOs, farmers and landowners throughout counties Clare, Limerick and Tipperary during the period of COVID-19 lockdown. The training was delivered by Ruairí Ó Conchúir, with joint training sessions delivered with Olive Carey of the Shannon Wetlands Project and with David Wall, of Dragonfly Ireland, on dragonfly identification, survey work and techniques.

In terms of uptake and engagement there was very considerable interest in the training with noteworthy support from LAWPRO HQ, various PPNs, local authorities and LEADER companies in the Mid-West. The need for technical and back-up support to go online is significant, especially if the training is being delivered as a one-person operation. Pre-registration is also a critical factor for GDPR reasons and to prevent Zoom-bombing. A hosting platform, where the trainings can be made more widely accessible, is also essential.

Irrespective of the massive changes that have occurred in how we communicate and engage online there is no substitute to face-to-face training and practical engagements with community groups. Holding online training events and meetings during the COVID-19 public health emergency offered a way to keep communities engaged. But moving forward to the reopening phase of Irish society it is important to acknowledge that such online and virtual events can be deeply disempowering. The virtual world is all very well for those who can go virtual, but it can also be extremely marginalising, especially within isolated rural communities and for those not in a position to go virtual for multiple reasons. Ultimately going online is very poor substitute for effective public consultation, real active community engagement and networking - not forgetting the all-important cup of tea after a community meeting!

Ruairí Ó Conchúir, Community Water Officer, Local Authority Waters Programme, covering the local authority areas of Clare, Limerick & Tipperary

Learn more:

www.watersandcommunites.ie

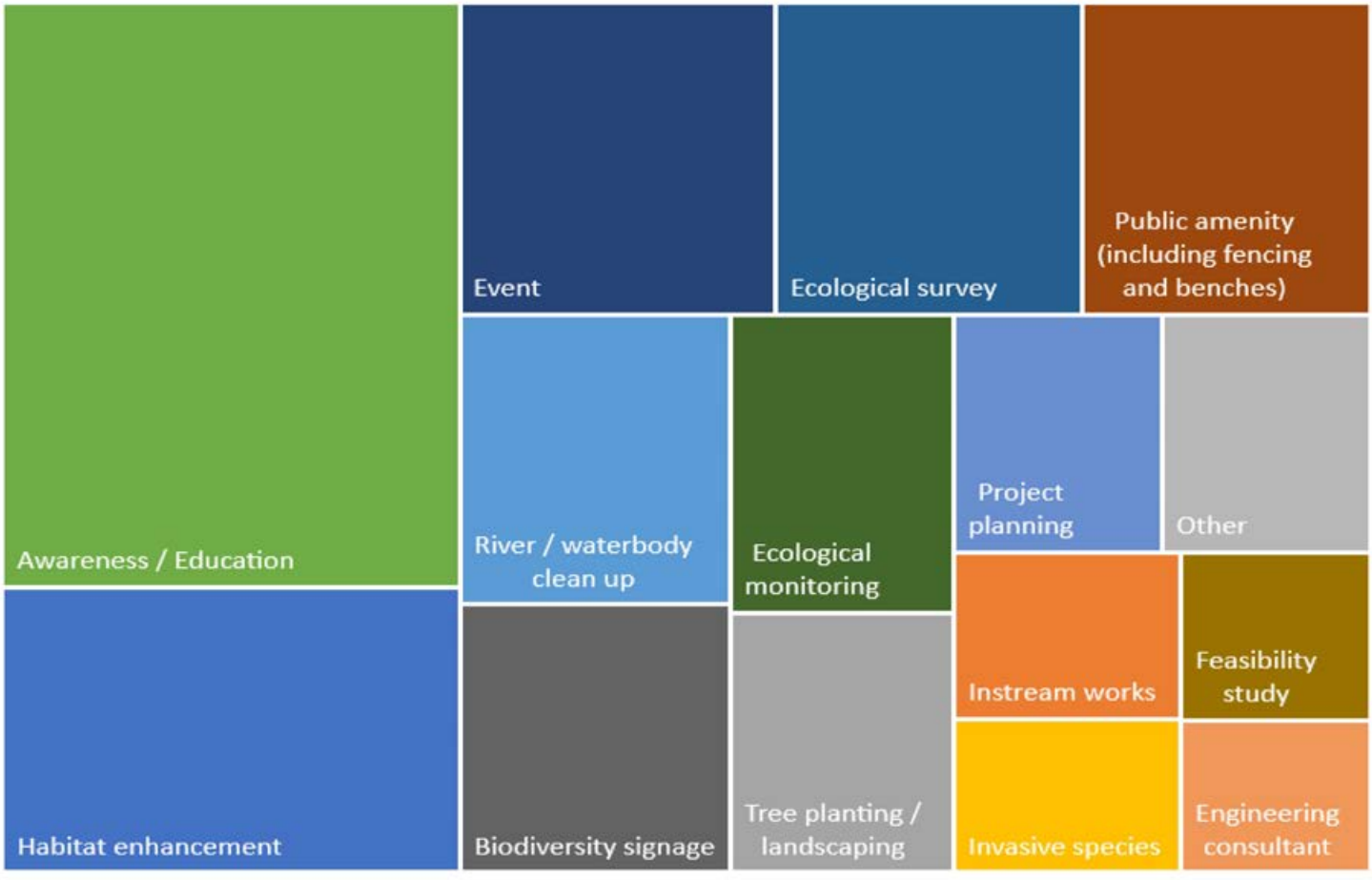
Owvane River, County Limerick (Photo: © Ruairí Ó Conchúir).

Community Water Development Fund 2020 open call

Sheevaun Thompson from the Local Authority Waters Programme tells us about the Community Water Development Fund. In 2020, this fund had 145 applications, and 118 of these were successful. The fund will award more than €200,000 this year, and the average award to community groups is €1,951.

The Local Authority Waters Programme (LAWPRO) launched the Community Water Development Fund for 2020 at the Catchment Partnerships and Rivers Trusts Conference held in the Hudson Bay Hotel, Athlone on the 30 November 2019.

The Fund is now in its third year of operation and was set up specifically to encourage greater community engagement in the area of water related projects and initiatives, delivering benefits locally whilst also helping to meet the objectives of the River Basin Management Plan for Ireland and the EU Water Framework Directive.



The Fund is open to all community and voluntary groups to assist in the protection and management of water quality, both locally and in the wider catchment. This can include the development of a catchment partnership or River/Lake Trust, and delivery of local projects to protect and improve water quality in a local waterbody. The Fund enables communities to get more involved in the management of their water environment, delivering multiple benefits for present and future generations. The Fund is administered by LAWPRO on behalf of the Department of Housing, Planning and Local Government.

For the 2020 Open Call, an online platform was developed on the website of the Local Authority Waters Programme at www.watersandcommunities.ie

This facilitated the analysis of data and proved to be a very important and useful tool in light of COVID-19 and the need for the remote assessment of grant applications.

As with previous years, there was massive interest in the Fund, with 145 applications received and over €660,000 in total project costs. A final sum of €230,247 was awarded with 118 applicants successfully receiving some level of grant aid. The average grant awarded was €1,951.

As an incentive to apply online, all applicants submitted through the online portal were included in a special draw for a prize grant of €500. This proved a great initiative and 109 of the 145 applications were submitted online. Congratulations to Ballybunnion TidyTowns, Co. Kerry who were the lucky winners of the €500 prize.

Types of projects considered for funding under the Community Water Development Fund included:

- Capital projects such as river restoration/habitat conservation/ natural flood mitigation measures, wetlands
- Projects that promote public awareness/education and events such as biodiversity days, events, citizen science, training workshops, surveys, signage, promotional leaflets, etc.
- Public amenity improvements such as waterbody clean up, removal of invasive species, fencing, bird watching facilities, etc.
- Feasibility studies, reports and plans

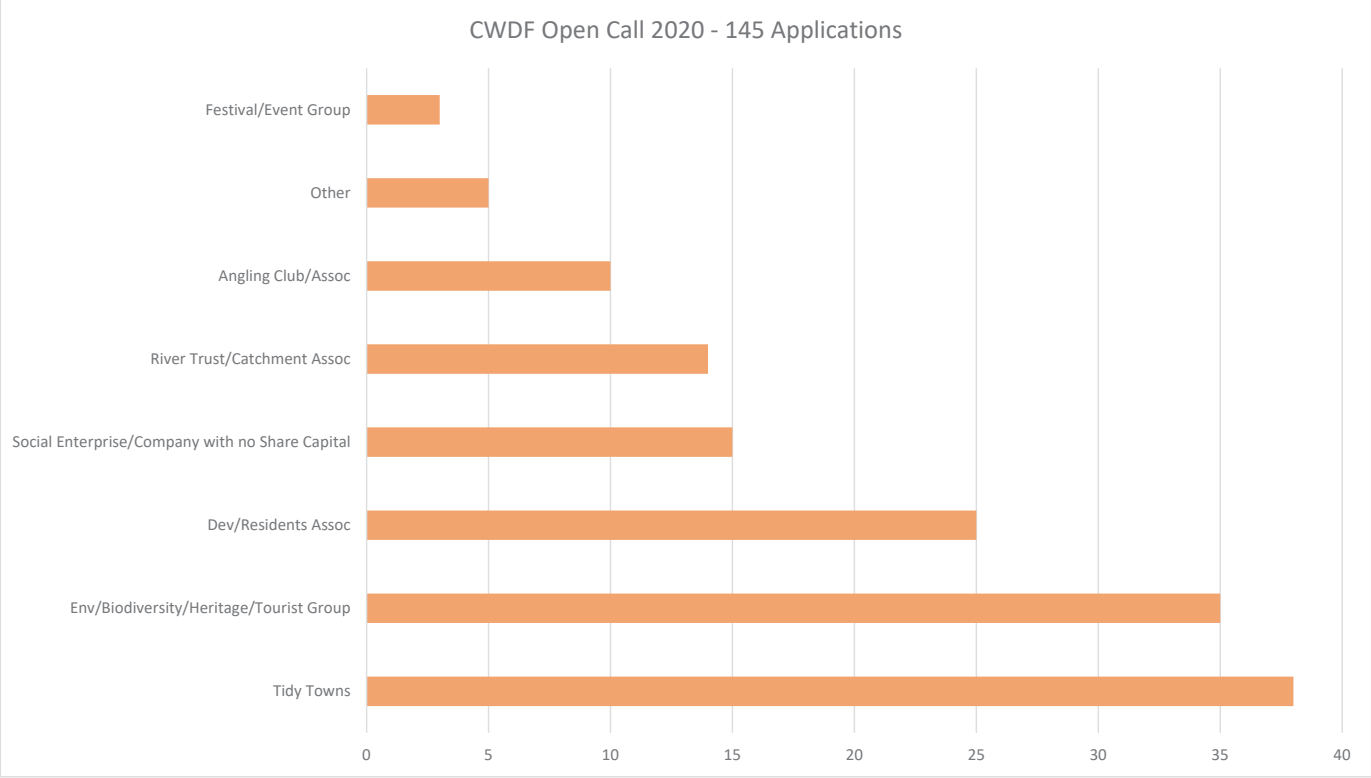
As in previous years, awareness and education remain the most popular type of project applied for under the Fund.

Applications received by group type shows that TidyTowns groups were the most active applicants. It is fantastic to see these groups showing such a keen interest in their local water bodies and biodiversity.

Sheevaun Thompson, Local Authority Waters Programme

Learn more:

Further details of grants awarded under the Community Water Development Fund 2020 are available on www.watersandcommunities.ie



EPA Water Conference 2020: Restoring our Waters

On 17 and 18 June 2020 the EPA held its National Water Event as an online conference. This year's theme was 'Restoring our waters' and was free to attend. It was the EPA's largest water event ever, with over 1250 people attending online. Videos and the slide decks from all speakers are now available on catchments.ie

We've also added some written questions and answers – some of the presenters have answered additional questions they did not have time to answer on the day; special thanks to the presenters who volunteered and took the time to do this.

This word cloud was made form words submitted by the more than 1200 people who attended this conference.

To everyone who joined us: thanks for attending; thanks for your probing questions; thanks for your passion; thanks for caring about our waters. We can achieve more working together.

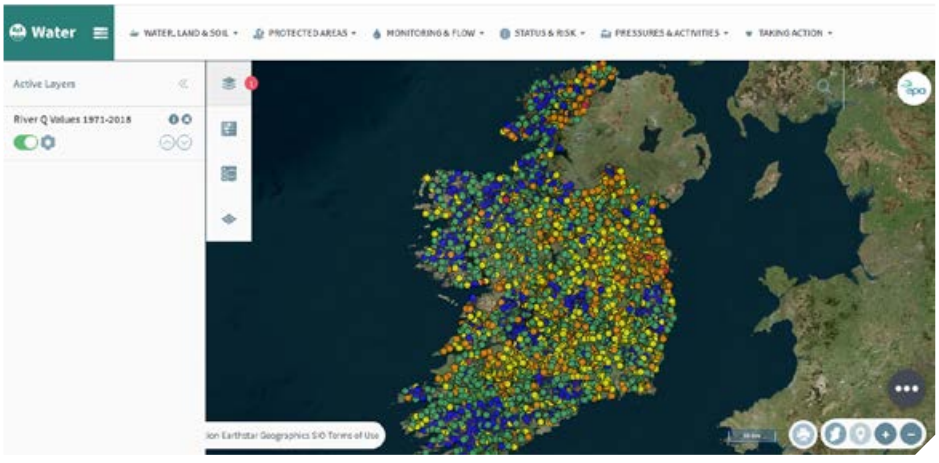
Special thanks to all our presenters and the team who worked behind the scenes to make sure this year's conference happened.

Learn more:

www.catchments.ie/2020-epa-water-conference-watch-online-now/

Catchments.ie – upgraded with new Water Map and chemistry downloads

Catchments.ie shares science and stories about water and integrated catchment management in Ireland. Paddy Morris from the EPA Catchments Unit tells us about some recent upgrades to the map section, and how you can now download chemistry data for every water body and subcatchment in Ireland...



The EPA Water Maps - this layer shows all ecological sampling results of River Q Values from 1971 to 2018, one of the longest time series of this type in Europe.

We've upgraded the catchments.ie maps and have added many new features and layers. The maps have lots of new tools, a vastly improved search function, and you can switch to satellite imagery for your map. We've also changed the categories for our layers and added several new ones. You can access the new Water Map at https://gis.epa.ie/EPAMaps/Water or by using the link on www.catchments.ie

Water Map layers and categories

For Version 2.0 of the Maps, we have added new layers and changed the categories which will hopefully make them both more useful and easier to use. Any layer can be switched on by using the

menu at the top of the map.

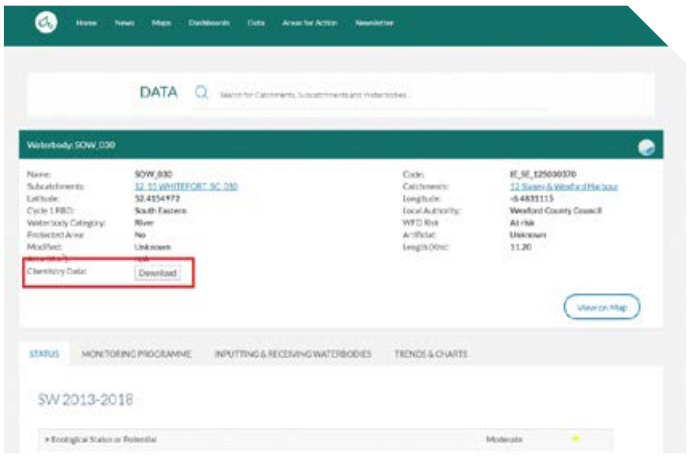
The new categories and layers are:

- **Water, Land and Soil**
  - Water: includes water features like catchments, subcatchments, river sub-basins and water bodies, along with river flow and river network layers
  - Geography: counties, local authority areas and settlements
  - Hydrogeology: GSI bedrock and gravel aquifers, GSI Vulnerability
  - Soil: Subsoils and susceptibility maps for nitrate and phosphate
- **Protected Areas**
  - Drinking Water, Recreational Waters (designated Bathing Waters for swimming), Shellfish, Salmonid, Conservation Areas (SACs, SPAs)
- **Monitoring and Flow**
  - Q Values – river ecology monitoring results from 1971 to present
  - Flows and Levels – both monitored and modelled, with links to all active hydrometric monitoring gauges
  - National Monitoring Stations
- **Status and Risk**
  - Bathing Water Quality – this is updated during the bathing season which runs form 1 June to 15 September and includes links to www.beaches.ie which has information on water quality, tides, accessibility and weather for all designated Bathing Waters
  - Water Framework Directive Status 2013-2018
  - Water Framework Directive Risk 2010-2015
  - Water Framework Directive Status 2010-2015
  - High Status Objective water bodies
- **Pressures and Activities**
  - Significant Pressures for river, lake, transitional and coastal water bodies
  - Pollution Impact Potential Maps
  - EPA Licensed Activities – Urban Waste Water, waste and industrial facilities
- **Taking Action**
  - Stories – these are all stories from catchments.ie, showing how local communities and public bodies are working to protect and restore water quality in Ireland
  - Areas for Action Plan – this shows the Priority Areas for Action that are being focused on by the Local authority Waters Programme during implementation of Ireland's national River Basin Management Plan 2018-2021. Further details on all Areas for Action are available at www.catchments.ie/data/#/areaforaction

Chemistry downloads for every water body and subcatchment

The latest update to catchments.ie has made chemistry data downloadable. These downloads are available for every subcatchment and water body we have these records for. Making these data open means that the public can easily access the results of all the hard work done on their behalf by the EPA, our local authorities and other public bodies to monitor and assess Ireland's waters.

While these downloads may not be for the more casual user, we hope that some people will find these chemistry downloads useful.



You can see information on any of the 4,829 water bodies and download the chemistry data by clicking the link highlighted red above.

Where to find these chemistry data downloads

These chemistry downloads can be found on our Data pages. You'll need to search for the subcatchment or water body you want this data for.

If you do anything interesting with these downloads, feel free to email us and let us know: catchments@epa.ie

Paddy Morris, EPA Catchment Science and Management Unit

Learn more:

Water Map: www.catchments.ie/catchments-ie-changes-new-water-map

Chemistry downloads: https://www.catchments.ie/catchments-ie-changes-chemistry-data-downloads

Public involvement in governing our waters

Gretta McCarron from An Fóram Usice tells us about the barriers to public involvement in decision making processes and governance of our waters, and what can be done to improve inclusion and equity.

Integrated Catchment Management (ICM) and other integrated water resource management frameworks include public engagement as a central pillar for their delivery. This, more inclusive, 'bottom-up' approach seeks to foster greater participatory involvement of stakeholders and builds bridges between governments and citizens. There is also specific legal requirement for public engagement in the EU Water Framework Directive (WFD). Public participation in water resources management is also included in the Dublin Principles (1992), and public participation in decision making is a core pillar of the Aarhus Convention (1998).

Public engagement in water management seeks to protect and improve the quality and availability of water resources through inclusive and equitable decision-making processes. As such, it is considered critical for the successful management of Ireland's water resources through the River Basin Management Planning process; the achievement of the objectives of the WFD; and ultimately, securing healthy rivers, lakes, coasts, and groundwaters. A new and evolved form of inclusive and equitable engagement is essential in the preparing, reviewing, and implementing of Ireland's third River Basin Management Plan, including in the setting out of Significant Water Management Issues.

Effective public engagement

Effective public engagement is not only about 'raising awareness', addressing 'a knowledge deficit', or encouraging behaviour change; it also includes a commitment that the public, broadly defined, is involved in decision-making processes and outcomes. This level of participation is not only statutorily required, but can also lead to more just, equitable, and sustainable decision-making.

The approach needs to allow time to develop ideas, options, and priorities with communities and stakeholders; it needs to embrace the idea of social transformation with the accompanying potential for dissent and critique of the status quo.

Effective public engagement facilitates multiple viewpoints and interests, and recognises inequity and diverse expertise in the design, delivery, and outcomes of decision-making around water resources. It has three pillars:

1. It recognises the historic inequities between different sectors of society that shape social, political, and ecological conditions
2. It values different forms of knowledge and expertise by rejecting hierarchical and 'additive' approaches to public input throughout the decision-making process
3. It is simultaneously global and local, meaning that public engagement initiatives cannot be one-size-fits-all or limited to decision-making and action at a pre-determined scale, e.g. local/ catchment only

Figure 1: Equality versus equity.

Equity, inequity & the imbalance of power

One of the central tenets of effective public engagement is equity, or more specifically, inequity. Inequity is the idea that there are differences in the power, resources, and authority that individuals and groups have; and that these differences stem from combinations of historic, social, political, and ecological processes. These differences mean that members of the public and stakeholder groups do not begin from the same starting point, and do not have the same ability to participate, nor the same power to impact on decision-making processes and effect change. Consideration of equity should shape how public engagement is designed and delivered by addressing these inequities (Figure 1).

Offering 'a place at the table' or an open space for views to be shared misses the critique of equity – not everyone is equally able to participate or be heard. By approaching communities and societies as stakeholders who do not start from the same vantage point, and by acknowledging and openly addressing historical relationships and key power dynamics, issues of inequity can be addressed.

Imbalance of expertise

Participatory approaches which incorporate community input frequently position local or lay knowledge as a useful complement, or 'add-on', to scientific knowledge. Often it is restricted to moments within the management process where scientific experts deem local input helpful and/or beneficial in securing compliance with regulation.

Research shows that where local expertise and knowledge has not been integrated in governance and management meaningfully and consistently, low levels of trust and collaboration have been found. In contrast, meaningful engagement and communication have been associated with higher levels of trust, adoption of implementation strategies, and meeting environmental targets. Ideally therefore, water management should not be 'led' by experts, but instead, incorporate scientific experts as one kind of expertise among many, allowing effective public engagement to seek the co-production of knowledge through multiple forms of expertise.

Scale

Water is at once global and local, influenced by international and national environmental and economic policies and trade, global climate change, and local social relations and practices. In this context, the question of scale (what counts as local) is all-important because it defines what is relevant and irrelevant, and what measures are available or unavailable for addressing the problem at hand. It is important to note that focusing on the local does not resolve long-standing challenges regarding how to govern water resources across various boundaries (catchment, river basin, towns, counties, etc.). Nor does it resolve the issue of the different (often more removed) scales and levels at which much oversight, decision-making, and accountability is located.

Recommendations for effective engagement

Based on commissioned research and review of the literature, An Fóram Uisce provides the following recommendations regarding the design and facilitation of effective public engagement in water management in Ireland:

1. *Introduce and support public participation processes which incorporate the three key principles of effective public engagement:*
   - address inequity and power imbalances between different individuals and stakeholder groups
   - incorporate various forms of knowledge/expertise to recognise the value of lay knowledge as well as scientific expertise
   - address issues of scale e.g. how pressures and processes that operate at national levels circumscribe local decision-making regarding water management
2. *Conduct an evaluation of current engagement initiatives based on the above principles. This should also include an assessment of wider water governance for compliance with good governance principles:*
   - accountability, transparency, equity, inclusiveness, responsiveness, effectiveness, and efficiency. This is because such governance is necessary to support public engagement
3. *Include communities and individuals in procedures and decision-making around water resources from the beginning. This recognises the value of their knowledge early in the catchment management process*
   - It also elicits concerns, connections, and expertise early on and, vitally, it builds trust

As noted by Simon Rafferty in his article in this newsletter 'public engagement has the potential to build capacity and empower communities by improving awareness, confidence and knowledge and skills for local and national policy making'.

Public participation is the first step in the Integrated Catchment Management process and An Fóram recommends that the above considerations are included as an integral part of planning for and development of the third River Basin Management Plan so that the final plan will be co-created with communities across Ireland.

Gretta McCarron, Communications and Education Lead, The Water Forum / An Fóram Uisce

Learn more:

www.thewaterforum.ie

Twitter: @anforamuisce

The members of An Fóram Uisce.

This article is based on The Water Forum I An Fóram Uisce commissioned research on Public Engagement in Water Governance, completed by Patrick Bresnihan and Arielle Hesse of Trinity College Dublin https://www.thewaterforum.ie/app/uploads/2020/03/Water-Forum_Public-Participation_Bresnihan-and-Hesse_2019.pdf and An Fóram's Information Brief for the Department of Housing, Planning and Local Government (DHPLG) https://www.thewaterforum.ie/app/uploads/2020/03/Water-Forum_Briefing-Note_Public-Engagement-1.pdf

1.The Dublin Statement on Water and Sustainable Development. http://www.un-documents.net/h2o-dub.html
2. Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters. https://ec.europa.eu/environment/aarhus/
3. Bosch, D., Pease, J., Wolfe, M. L., Zobel, C., Osorio, J., Cobb, T. D., & Evanylo, G. (2012). Community DECISIONS: Stakeholder focused watershed planning. Journal of Environmental Management, 112, 226–232 https://www.sciencedirect.com/science/article/pii/S0301479712003957?via%3Dihub;
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ARTICLES

Go with the flow, keep it on the level: measuring water quantity in Ireland's rivers, lakes and groundwaters

Measuring flow in a river.

The EPA recently launched a monthly hydrometric bulletin which will provide a national summary of river flow, lake and groundwater levels across Ireland. Conor Quinlan tells us about the work of the EPA Hydrometrics and Groundwater team and how their data underpins assessments of change...

The EPA Hydrometric and Groundwater section operate a network of over 350 surface water and groundwater water level and flow monitoring stations across Ireland. These stations produce time series data for river and spring flows and lake and groundwater levels which provides a nationally representative sample of water flow and level conditions. These data sets are used to calibrate models and applications for water resource management and assessment, to ensure flows are sufficient to support healthy aquatic ecology, climate change impact and adaptation, and to support the licencing and enforcement work of the EPA.

If we use the human body as an analogy for monitoring and assessing the health of our aquatic ecosystems, physio-chemical (i.e. water quality) test results are like blood test results, while hydrometric information including river flows, spring flows, groundwater levels, and lake levels correspond to the heart rate and blood pressure readings of a person.

Like a medical assessment, both water quality (blood test results) and hydrometric information (pulse and blood pressure) are required to accurately assess and diagnose issues in our aquatic ecosystems.

Flow and level data are a vital component required to achieve integrated catchment management. Water quality results must be combined with flow information for us to calculate what volume or load of contaminant is present, the spatial extent of contamination, the speed at which it moves though a system and where it ends up. Flow and level information is also vital for us to sustainably manage abstractions and discharges from and to our surface waters and groundwaters.

Representative long-term flow and level records are also vitally important to enable us to identify climate driven changes in our aquatic ecosystems and to ensure that climate adaptation planning is evidence-based and proportionate. Climate predictions and hydrological models derived from them are estimates of future

A remote-control boat: this is used to measure flow and to map the river channel profile.

conditions in our catchments. Like all models, these predictions are unlikely to be entirely accurate in many locations. It is therefore vital that we maintain monitoring networks to obtain high-quality records of actual measured changes in hydrological flow and level conditions across Ireland in the coming years and decades. These observations will be used to assess and re-calibrate climate models and to provide an evidence-base for the sustainable future management of our waterbodies.

Flow and level information is used together with abstraction and discharge data to assess and manage the water resources in our waterways on a truly cumulative basis. This integrated approach is key both to enable us to achieve the environmental objectives for our waterways and to utilise and protect our combined surface water and groundwater resource in an uncertain future where both increased flooding and more frequent droughts are predicted to occur.

Flow and level data are available for download via the EPA HydroNet web portal. River flow percentile estimates for catchments where there is no hydrometric monitoring station can be viewed on EPA Water Maps in the 'River flow estimates – HydroTool' layer. The National Register of Hydrometric Stations in Ireland is available for download from the EPA website.

The EPA has also launched hydrometric bulletins which will provide a monthly national summary of river flow, lake and groundwater levels across Ireland.

Conor Quinlan, EPA Hydrometrics and Groundwater Section

Learn more:

Monthly Hydrometric bulletins: www.epa.ie/pubs/reports/water/flows/hydrometricbulletins/

Hydronet: www.epa.ie/hydronet/

EPA Water Map: www.catchments.ie

The EPA Hydrometrics and Groundwater team.

Brachyptera risi nymph.

Irish stoneflies: two threatened with extinction

A recent evaluation of Irish stonefly has seen two stonefly species added to the Red List of species threatened with extinction, and one species declared extinct in Ireland. Hugh Feeley tells us more these fascinating species and how climate change and water pollution are causing them problems.

Stoneflies are an extremely important component of the natural biodiversity of Irish freshwaters. Although small and inconspicuous insects that spend most of their lives amongst the stony habitat of our streams, rivers and lakes they can constitute a significant proportion of the invertebrate biomass and are an important part of the diet of fish in aquatic food-chains as well as nutrient flows and recycling in riverine systems.

As adults they don't live for long (days to weeks) but are food sources for birds and bats, and amongst fishermen, stoneflies are well-known and have attracted common and local names.

Examples include Brachyptera risi which is known as the February Red and Protonemura meyeri which is the Early Brown or Winter Brown. Stoneflies of the family Leuctridae are commonly known as needle-flies, the two Irish species of Perlidae are known as Large Stonefly, while Isoperla grammatica (Poda) is known variously as a Yellow Sally or Old Joan.

The status of Irish stoneflies, known scientifically as Plecoptera, was recently evaluated against the Red List criteria produced by the International Union for the Conservation of Nature (IUCN). This is the first time the threat status of the Irish stoneflies has been assessed and it highlights some worrying trends.

The evaluation was based on just over 12,000 records for the island of Ireland, covering all 20 species. Results identified two species deemed under threat of extinction on the island of Ireland: Protonemura praecox, was assessed as Critically Endangered (which is the highest level of threat) and Capnia atra as Vulnerable.

A third species, Perlodes mortoni, was unfortunately deemed Regionally Extinct in Ireland as it has not been recorded for over 100 years. This species was last recorded in 1901 along the River Glyde in Castlebellingham, Co Louth. The remaining 17 species are assessed as Least Concern, meaning they are considered not under threat.

Perlodes mortoni (Photo: Paul Kennedy).

The threat status assigned to the two threatened species quite likely reflects increasing average temperatures associated with climate change. Protonemura praecox has not been seen in Ireland since 1991 and there is concern for its remaining populations, while Capnia atra is a glacial relict species confined to a small number of sites in the west. Ireland is at the most southerly extent of this species European distribution and as temperatures rise it is quite probable that we will lose this cold-water specialist. Other species, such as Diura bicaudata, which have populations predominantly confined to higher altitudes may become threatened in the near future as temperatures continue to rise.

Indeed, the threats that climate change, but also the continuing organic pollution, habitat change, and sedimentation, as highlighted by the latest EPA water quality in Ireland report, pose to the stoneflies (and other aquatic species) in Ireland should not be underestimated, with most species highly susceptible to one or more of these pressures.

Habitat destruction and changes to the natural flow and physical environment of lakes and rivers are likely to have had a significant influence on the present distribution of the Irish stoneflies and the impact of these pose continuing and significant threats. In some respects, this assessment of stoneflies is the coughing 'canary in the coal mine' and unless action is taken on climate change and water pollution more and more species found in our rivers and lakes will begin to disappear across the island.

The Red List was produced by National Parks and Wildlife Service (Department of Culture, Heritage and the Gaeltacht) and Northern Ireland Environment Agency, with acknowledged information and data provided by the Environmental Protection Agency and University College Dublin.

Hugh Feeley, EPA Ecological Monitoring and Assessment Unit

Learn more:

www.npws.ie

The headwaters of the Skerdagh River, Mayo, where 16 species of stonefly have been recorded.

The Failmore River from bridge southeast of Maumturk Mountains (Photo: Francis Deery).

Blue Dot Catchments – working to let life thrive in some of our wildest waters

Cormac McConigley from the Local Authority Waters Programme tells us about work on the Blue Dots programme. This programme is trying to prevent any further decline and restore high status waters around Ireland and recently brought together people to work on a vison and plan for how to do this...

The River Basin Management Plan 2018-2021 sets out the targets and measures Ireland will implement to achieve the objectives of the Water Framework Directive. One of the key measures to address the decline in high status water bodies was the setting up of the Blue Dot Catchments Programme to specifically target the maintenance and restoration of high status objective water bodies. The programme is directed by a Blue Dot National Steering Group which had its inaugural meeting in January 2019 and adopted a work programme in September 2019.

High status water bodies are our waters with the highest quality nationally. The Water Framework Directive classifies water bodies into one of five classes – High, Good, Moderate, Poor and Bad status. To achieve High ecological status, a water body largely reflects undisturbed conditions with only minor pressures and are often used as a benchmark for where our water quality should be.

These waters often support biodiversity which has been lost or has suffered significant declines elsewhere in our landscape and therefore they are important for many our species such as e.g. salmon, the freshwater pearl mussel, slender naiad. In October 2019, an overview of the Blue Dot Catchments Programme was presented in the Catchments Newsletter. It was highlighted that Ireland has suffered a significant decline in our pristine or high status water bodies. High status sites have declined from 31.5% (1987-1990) to 17.6% (2013-2015) an almost 50% loss (Fanning et al., 2017). The most recent assessment of our river waters bodies from 2016-2018 has indicated that the decline has continued and is

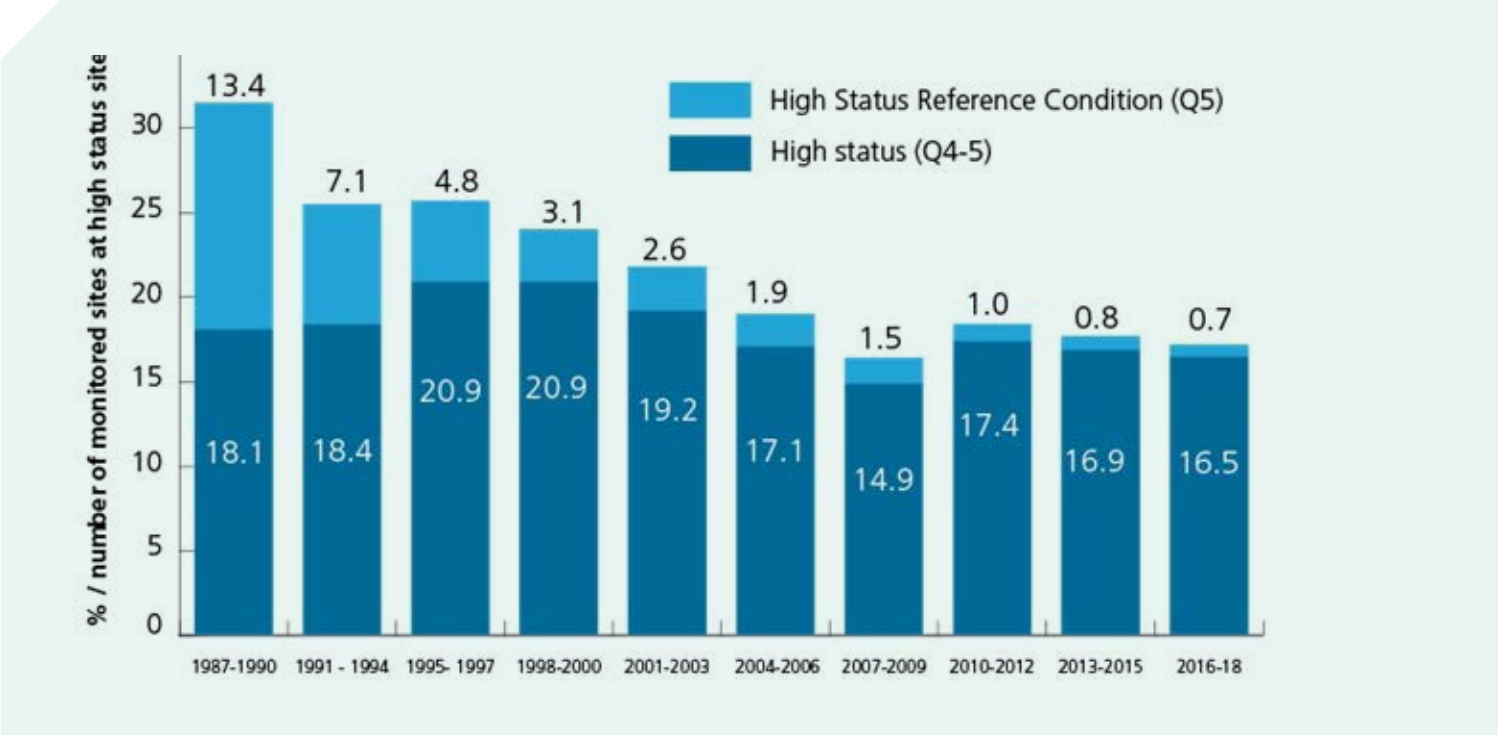


Figure 1: The decline in the percentage of highest quality biological (macroinvertebrates)river sites in Ireland, 1987-2018.

now at 17.2% of all sites. In particular the loss of our highest quality river sites which are identified as Q5 sites by the Environmental Protection Agency, have reduced from 13.5% (or approx. 500 sites) of all sites in 1987-1990 to only 0.7% (or 20 sites) in 2016-2018.

The overarching aim of the Blue Dot Catchments Programme is to protect or improve Irelands highest quality waters. To achieve this the programme requires the cooperation of local and public authorities, communities living and working with blue dot catchments, and all those who support them such as Catchment Groups, River Trusts, Tidy towns and others. This is particularly important to inform the development of a communications and engagement plan that can be used to engage with the communities that live in the catchments of Blue Dot waters.

The first step in preparing to engage with communities was to hold a Visioning Workshop where national stakeholders could come together and discuss a vision and branding for the programme and begin putting a framework for a communication and engagement strategy together. The workshop was held on 5th March 2020 in Tullamore and was attended by over 40 participants representing 22 organisations. A selection of organisations with expertise in water quality protection including local and public authorities, environmental NGOs, community group representatives and academics with research backgrounds on high status water bodies were invited to attend.

Several introductory presentations were provided to set the scene. Attendees were then divided into 6 working groups via a pre-prepared selection process which ensured that a mix of organisations, NGOs, catchment groups, academics and LAWPRO staff were at each table. The discussion at each table was facilitated by a LAWPRO Community Water Officer (CWO).

A flipchart was provided to each table so that thoughts, ideas, drawings etc could be documented, while notes on discussions were also taken by LAWPRO staff. The flipchart work and notes were collated at the end of the workshop and used to prepare this workshop outcomes report.

Each table was asked to discuss and present ideas for the following four items:

1. A vision statement for Ireland's Blue Dot Catchments Programme
2. Branding for Blue Dot waters
3. How the Blue Dot Catchments Programme might best communicate and engage with communities that live in areas with Blue Dot waters
4. Review the Blue Dot Catchments Programme 11 objectives

Under each topic discussed, the ideas gathered will be used to further inform the Programme in the coming months.

A Vision

The workshop participants identified that the vision for the programme and Blue Dot waters would need to encourage people to view Blue Dot waters as valuable resources that should be cherished. The presence of a Blue Dot Water should be a source of pride to the communities that live in the catchment. It should be recognised that it is the practices of people in those communities that have allowed Blue Dots to persist where they have. These waters are unique habitats with special biodiversity, sitting within landscapes which offer multiple other positive benefits that should be highlighted and valued.

Many potential vision statements were drafted at the workshop. Across all the statements produced the most commonly used words were extracted to form the word cloud in Figure 2. This represents the main themes that the final vison will aim to incorporate. The most commonly identified terms were Protect, Restore, Community, Health, Climate, Integrated and Value. These words will form the basis of the final vision statement.

Figure 2: Word cloud of the most common words used in vision statements.

Developing an identity for the programme

The majority of workshop attendees agreed that the programme would need to develop a logo and accompanying strap line. Many ideas for both were put forward on the day as well as ideas on what a logo would need to represent. Several participants drew potential logos that could be used by the programme or form the basis for a logo to be designed by the steering group or others. Some common themes were for the logo to be blue, whether in the shape of a flowing river, as a dot, as the letter Q for quality, or a water drop. It was noted that there would be value in the logo being similar to the LAWPRO logo with its catchments theme. It was also broadly agreed that the logo would need to have some origin story behind it which communities could engage with. Work is progressing on finalising the visions statement and logo, after which a formal launch will take place.

Engaging Communities

As highlighted above, engaging communities is essential to the success of the programme. Workshop participants drew on their experiences to identify what has worked in the past and what has been less successful. In particular, the experience of the Community Water Officers working in the Local Authority Waters Programme is an invaluable resource for the programme to draw from. LAWPRO's work with communities means they have gained significant understanding in recent years of what communities would like or need, and what supports they may also require.

The participants identified that the key to successful engagement is to begin early and to "press the flesh". Successful engagement of this type must include workshops held in the community where thoughts and ideas can be gathered at the start. It is important that communities are asked what they want. How do they currently feel about their local waters? Do they know that they have a Blue Dot waterbody in the area? How valuable is this knowledge to the community? What actions are seen as possible to protect this valuable resource they have?

It was also highlighted that communities need a way to feed back into the programme about their local waters. They should be co-designers of any management that is to take place and be fully aware of what is happening.

Public engagement around water bodies has improved over the years with LAWPRO leading the way to greater community involvement around water quality. The Blue Dot Catchments Programme will aim to build on this and foster greater community involvement for the protection of our most valuable waters.

Next Steps

The visioning workshop provided potential vision statements, logos, straplines and ideas about what the brand would need to represent. These outputs will now be used by a specialist to develop a brand for the programme and to inform a bespoke communications and engagement plan for Blue Dot waters.

An objective of the programme is to establish pilot projects for community engagement and action. This objective is also outlined in the River Basin Management Plan and the South-West was identified as the region where engagement should be piloted. The initial programme proposed the development of a three-strand "education, signage and action" pilot programme in conjunction with the South West Water and Environment Committee Chair to commence bottom up engagement with communities in Blue Dot areas and to provide an opportunity for learning what actions may be effective in other parts of the country. The Blue Dot Steering Group will develop ideas and proposals for the pilot in the coming months, and it will be informed by the proposed engagement plan.

Cormac McConigley, Blue Dot Scientist and Bernadette White, Catchment Manager – Western Region & Blue Dot Catchments Programme Manager

National Federation of Group Water Schemes - Biodiversity Framework

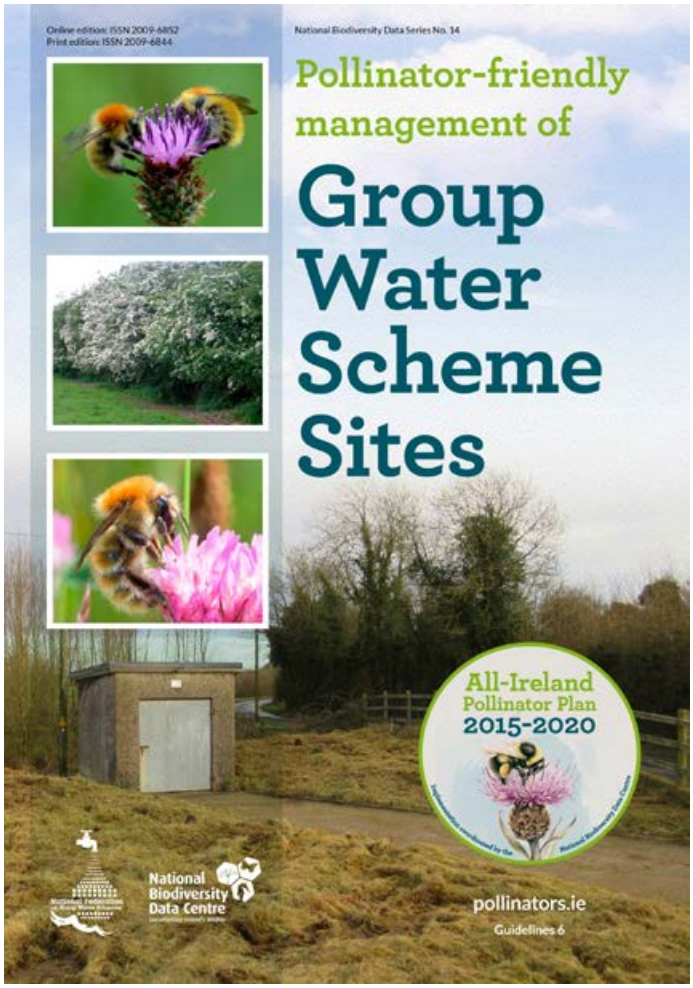
Group Water Schemes are community owned rural groups supplying drinking water to their local members. Adrian Smyth tells us how the National Federation of Group Water Schemes have developed a biodiversity framework for their sites. These sites are spread out around the country and could be havens for wildlife like bees and insects all across Ireland.

A wholesome and safe water supply is best assured where it is abstracted from a healthy environment. Aside from the intrinsic value of a healthy environment, there is a direct correlation between the environmental health of a source catchment and the cost of producing drinking water. Key measures of an environmentally healthy source catchment include the ecosystems and biodiversity that it supports.

Following a pilot project conducted by Ashill Group Water Scheme in 2018, the NFGWS signed up to the All-Ireland Pollinator Plan, recognising that the implementation of biodiversity enhancement measures on group water schemes could have a positive impact on water quality, ecosystem regeneration and on community engagement with their local group water scheme. As part of this pilot, the National Biodiversity Data Centre, in collaboration with the NFGWS, developed a comprehensive guide to assist with the implementation of biodiversity-friendly measures around group water scheme pumphouses/sites. Launched at the Rural Water Conference in 2019, this guide observes that:

Group water scheme sites are secure sites that are not grazed. If they were managed in a pollinator-friendly way, it would create an entire network of safe places for bees and other insects across the landscape. The positive impact this could have is enormous.

The aim of the newly released NFGWS biodiversity enhancement framework document is to build on the existing resources currently in place for Group Water Schemes and to provide a generic framework for the overall enhancement of biodiversity in and around group water scheme sites. It takes account of and builds on the progress made in the area of water resources management and source protection in recent years, the availability of new



information and maps and lessons learned. The objectives are to:

- provide a high-level vision and structure for biodiversity enhancement on Group Water Schemes
- integrate and link biodiversity enhancement to drinking water source protection
- integrate and link biodiversity enhancement to wider community education goals
- environmentally proofing capital projects to ensure their impact in minimised
- link with and expand on the NFGWS Strategy for Source Protection on Group Water Schemes (NFGWS, 2012a) and the NFGWS Quality Assurance (HACCP) system (NFGWS, 2012b)
- provide a focused narrative that will be used in public consultation and collaboration

Adrian Smyth, National Federation of Group Water Schemes

Learn more:

www.nfgws.ie/biodiversity

Environmental sensitivity mapping: supporting assessments and planning decisions in Ireland

The Strategic Environmental Assessment (SEA) Directive requires the assessment of potential environmental impacts resulting from the implementation of plans (e.g. river basin management plans, county development plans) and programmes (e.g. for waste management). The overall goal of SEA is to support sustainable development by incorporating environmental considerations into decision-making.

This is commonly done by determining the vulnerability or sensitivity of the areas likely to be affected by the plan/programme. Informed by this, recommendations are made to avoid or mitigate any potential significant environmental effects. Environmental sensitivity describes the susceptibility of natural resources (e.g. habitats, water bodies) to human-induced changes such as land-use modifications that may cause their degradation. Analysing a region's characteristics that make it susceptible to change provides a valuable starting-point in plan-making, helping to direct developments to the most appropriate location.

Figure 1. Strategic Environmental Assessment (SEA) thematic groupings of data on the left menu, and bedrock aquifer map showing detailed attribute information through a pop-up query window.

The growing availability of spatial data and technological developments are resulting in a greater uptake of online GIS-based decision support tools in planning and decision-making. Building on these advancements, a team of researchers led by UCD School of Geography, in collaboration with the All-island Research Observatory (AIRO) at Maynooth University, have developed an Environmental Sensitivity Mapping (ESM) web-tool to support SEA and planning decisions in Ireland.

The ESM web-tool centralises access to well over 100 environmental datasets grouped by SEA themes, including water, allowing planners to rapidly and efficiently examine environmental considerations within their plan area. It also includes a bespoke and innovative analytical widget that enables creating plan-specific environmental sensitivity maps, without the need for specific GIS skills or expertise. Users can select a range of datasets from each SEA theme to include in the analysis (Figure 1), as relevant to the plan/programme under assessment. These datasets can be weighted to determine their relative importance and, in this way, capture stakeholder concerns/opinion (for example, on the importance of protecting nutrient sensitive water bodies), facilitating public consultation requirements in SEA. The final output provides an environmental sensitivity index map for the selected area (Figure 2) – which can help anticipate potential land-use conflicts to inform planning decisions.

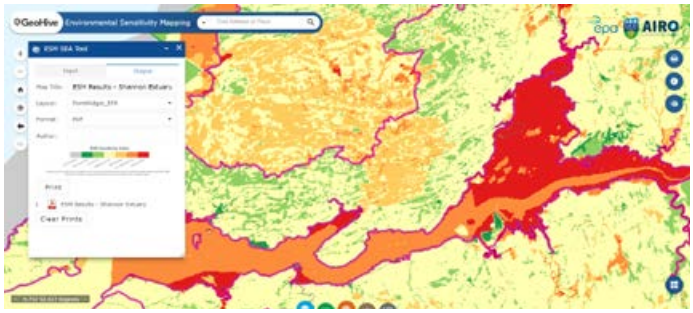


Figure 2. Sample Environmental Sensitivity Map (ESM) for the Shannon Estuary. The ESM widget allows creating sensitivity maps at a water management unit level. This particular map has been created using the environmental variables shown in the map layout below (Figure 3).

The ESM web-tool is a publicly available, robust and innovative solution that can lead to more effective environmental assessments and, in turn, better plan-making in Ireland. It has already informed the National Planning Framework and the Regional Spatial and Economic Strategies, as well as various other applications at local level.

Ainhoa González

Learn more:

For more information on the web-tool, project background and informative video on GIS and SEA, visit www.enviromap.ie - see Start Mapping to access the web-tool.

Acknowledgements: The ESM web-tool is a collaborative public sector data project between UCD School of Geography (concept and design) and AIRO (analytics and mapping). The research was funded and supported by the Environmental Protection Agency and the web-tool is hosted by the Ordnance Survey Ireland on their GeoHive, the State Geospatial DataHub.

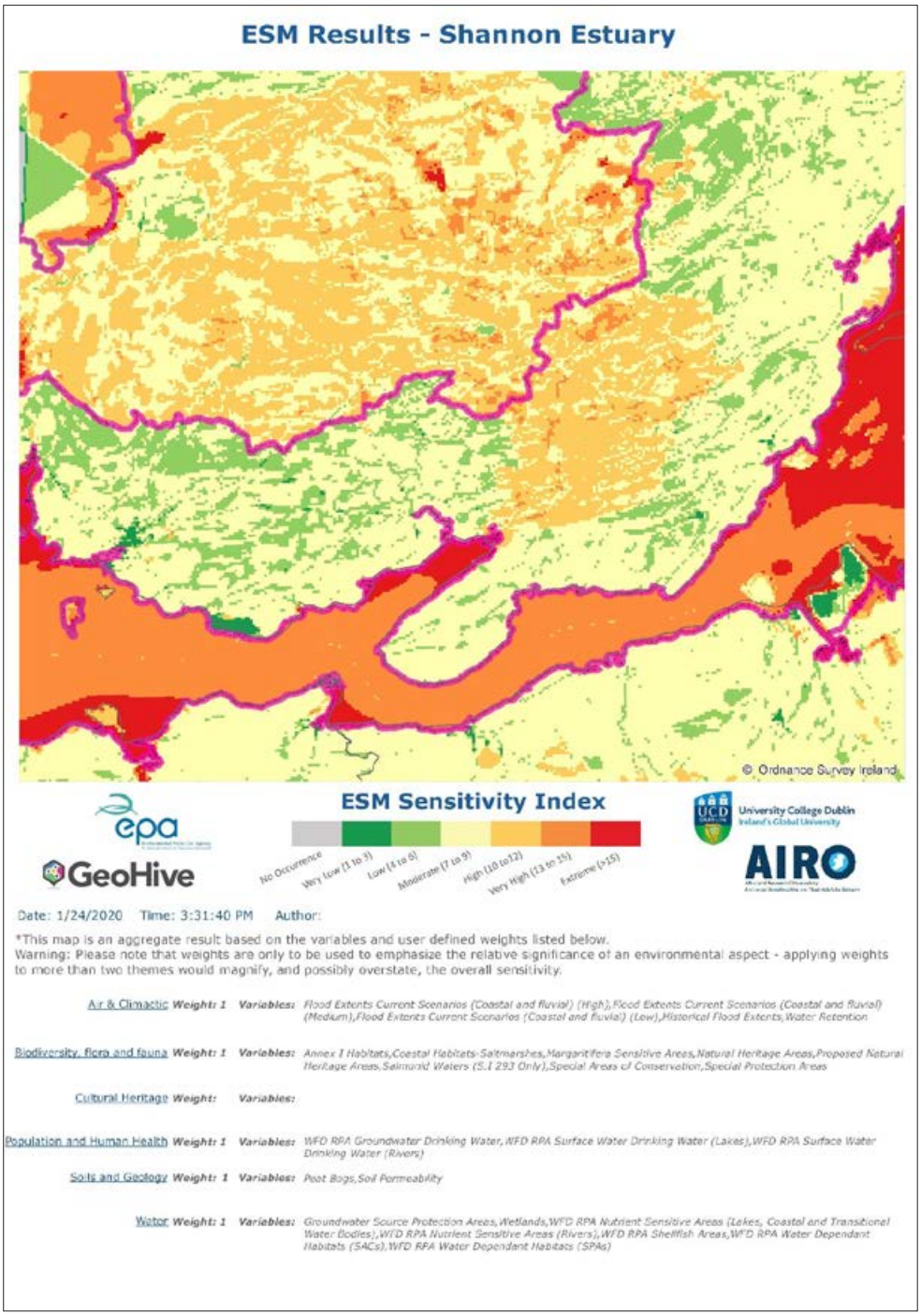


Figure 3: Sample Environmental Sensitivity Map (ESM) layout illustrating the environmental criteria brought into the sensitivity analysis. These criteria are to be contextualised to the issues of the plan/programme under assessment for a meaningful analysis.

ESM Webtool
Bringing environmental assessment to your fingertips

UCD DUBLIN

AIRO

epa Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

osi Ordnance Survey Ireland

You can watch a video highlighting how the ESM tool works on www.enviromap.ie

Calopteryx Virgo demoiselle beside the Figile River, County Offaly – the Figile is one of the four pilot catchments that has been chosen for this project. Photo: EPA Ecologists)

Irish Natural Capital Accounting for Sustainable Environments (INCASE)

Catherine Farrell is a researcher with INCASE, an EPA-funded research project that is piloting environmental accounts for four catchments in Ireland. Catherine tells us about the use of natural capital accounting in Ireland, the policy drivers, the role of the United Nations System of Environmental-Economic Accounting (SEEA) in this, and a little about the four catchments chosen for this pilot...

"The biodiversity convention's member states have to publish biodiversity action plans — but these are often statements of a country's ambitions, rather than records of its achievements. For the next set of goals this has to change, and fortunately there seems to be a way forward. This is the UN System of Environmental Economic Accounting (SEEA), a mechanism for reporting environmental data, and it needs to become the global standard for environmental reporting" - Nature Editorial, 18 February 2020

Can natural capital accounting be used in Ireland?

The natural world we live in underpins human existence. It can be thought of as our stock of natural capital that yields flows of goods and services. These goods and services include the basic requirements of daily living – food, water, clean air, etc. Ensuring those services continue to flow for this generation and future generations is one of the fundamental aspects of sustainable development and the keystone of social and economic welfare.

In the Irish context, the EPA State of the Environment Report (EPA State of the Environment Report 2016) highlights the need to integrate natural capital accounting (NCA, often referred to as Green or Environmental Accounting) into our measures of prosperity, so that we can track and measure our performance alongside related issues such as wellbeing and environmental health.

NCA can be used to identify trends in the quality of the environment, inform trade-offs, identify co-benefits, establish critical links between natural and other capitals (such as built and social capital) as well as identifying knowledge gaps. Such an approach will help us to understand and, combined with the use of other appropriate tools, address the dominant pressures and their impacts - climate change, growth in human population, continued degradation of nature - on Ireland's environment.

The INCASE (Irish Natural Capital Accounting for Sustainable Environments) research project aims to apply NCA at a pilot (catchment) scale in Ireland. Significant pressures on At Risk water bodies are well-defined at catchment level by the EPA, with agriculture identified as the most significant pressure in the River Basin Management Plans 2018-2021. In the meantime, EPA reports in December 2019 indicate that water quality in Ireland continues to decline. Addressing the causes or drivers of these pressures can help to identify solutions to reverse negative trends.

Developing natural capital accounts at catchment scale will inform how the accounts (asset extent, condition, supply and use of services, benefits, etc) can be built using Irish data sources and provide valuable lessons on how best to scale up to the national level. INCASE will explore how NCA can be used to identify solutions either through investing in and renewing degraded natural capital stocks and flows (improving water quality, restoring ecosystems, etc) and/or changing management practices and incentive schemes (for example developing Payment for Ecosystem Services).

What are the policy drivers for Natural Capital Accounting?

As with many aspects of humanity, it is the policy instruments at government level (local, regional and international) that dictate where we focus our energy and resources, and this is the same for how and why we must begin taking nature into account. Or put another way, this is why we are developing natural capital accounting (NCA) as a tool to integrate decision making and make better decisions around our use of nature to achieve sustainable development.

Firstly, let us consider how we have fared by not taking nature into account in decision-making. By ignoring nature, widespread ecological degradation continues which in turn leads to local and global critical levels of biodiversity loss. Biodiversity underpins natural capital, and degradation of natural capital has led to global pressures such as climate change. We are now faced with ongoing and repeated calls for transformative changes in human behaviour to prevent further degradation beyond critical thresholds, as highlighted in the IPBES 2019 and IPCC 2019 reports. Changing behaviour is difficult and this is where the policy comes in - to help focus our energy around making those changes.

In response to these pressures, UN policy at international level is calling for wise use of nature. This requires us to develop NCA systems whereby we can track changes in the extent and condition of stocks of natural systems, understand and measure how the services we need, and use are flowing, and what we must do to ensure that flow continues. The call at UN level call is echoed by the new European Green Deal, published at the end of 2019, the recent EU Biodiversity Strategy 2030: Bringing nature back into our lives as well as the 2020 targets for natural capital accounting set in Ireland's National Biodiversity Plan 2017-2021 and the call for an integrated approach to land-use as set out in the Irish Climate Action Plan, published in 2019.

NCA will be mandatory in coming years and building the best approach and fit for the local, Irish context is essential. The INCASE Project forms part of the network of EU and global projects working towards refinement and further development of NCA methods. As part of this network, Ireland will be well-placed to contribute to and lead in terms of the refinement of the process at national and EU levels.

The role of the System of Environmental Economic Accounting (SEEA) method globally and the steps to its preliminary application in Ireland

Caragh River, County Kerry – the Caragh is one of the four pilot catchments that has been chosen for this project (Photo: EPA Ecologists).

The main method of NCA adopted globally, is the System of Environmental-Economic Accounting or SEEA method. This is an emerging statistical system that brings together economic and environmental information into a common framework to measure the contribution of the environment to the economy, and the impact of the economy on the environment.

The SEEA contains an internationally agreed set of standard concepts, definitions, classifications, accounting rules and tables to produce internationally comparable statistics. The SEEA has three components –

- The SEEA Central Framework (2012), which was adopted by the UN Statistical Commission as the first international standard for environmental-economic accounting in 2012
- The SEEA Experimental Ecosystem Accounting, which offers a synthesis of current knowledge in ecosystem accounting
- The SEEA Applications and Extensions, which illustrates to compilers and users of SEEA Central Framework based accounts how the information can be used in decision making, policy review and formulation, analysis and research

Presently more than 80 countries worldwide have adopted the SEEA approach, with the SEEA-CF (Central Framework) in mainstream use and SEEA-EEA (Experimental Ecosystem Accounting) gathering wider use as the method is refined and becomes normalised.

In the EU, NCA has been well-developed in the UK and the Netherlands in the period 2010-2020, with work progressing under the EU KIP-INCA, MAES and MAIA (Mapping and Assessment for Integrated ecosystem Accounting) projects. INCASE will link in with this network of EU projects to assist in developing clear and relevant approaches across the EU.

Ireland has taken preliminary steps. The INCASE Project will build on the work carried out on aspects of NCA and related topics to

date in Ireland, bringing it together under the NCA framework, using the SEEA methodology. This will help to develop the best way forward for NCA in Ireland, and therefore avoid ad hoc staggered steps which may otherwise be unproductive. The SEEA-EEA will be extended to account for ecosystems, geosystems and atmospheric systems, testing the approach in four catchments before scaling up to national level. Essentially INCASE will serve to trouble shoot the approach at pilot scale while also determining the most effective and efficient way to classify assets, measure condition, identify flows of services and identify benefits and beneficiaries.

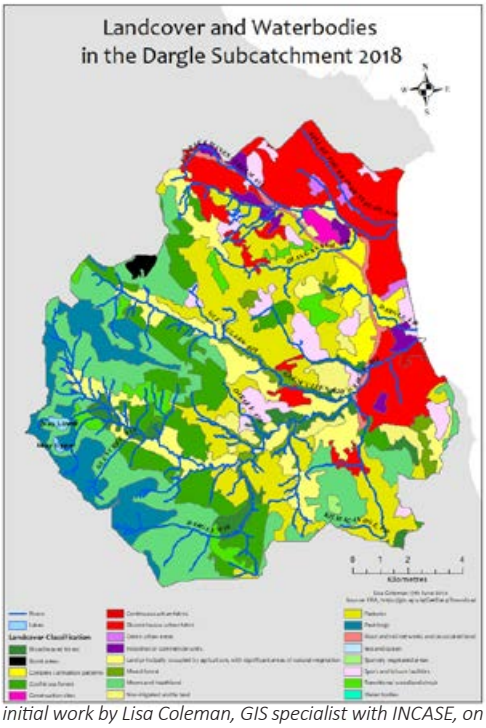
The work to date by the INCASE Project Team has established that developing natural capital accounts at catchment and national scale is feasible. Critical steps include a review and assessment of the wide array and quality of data available in terms of outlining the basic requirements for NCA in Ireland and potential data gaps. Establishing the process steps to gather, collate, assess and align these data in a standardised way is a key output of INCASE. Determining how available data can be used for various accounts will follow from the data review.

The outputs will inform national scale application and has already created a discussion platform around challenges in terms of high-level concepts about NCA: how can it align with (replace?) GDP to develop truer reflections of prosperity, how to progress on valuation, the efficacy of the approach in general and basic aspects such as data share and data quality.

How will INCASE use the System of Environmental Economic Accounting to aid assessment, reporting and improvement of water quality in our catchments?

While Natural Capital Accounting has a range of potential uses and applications, the central focus of INCASE is to inform how NCA (specifically the SEEA approach), can assist with reporting and/or working towards water protection and management in the context of implementation of the Water Framework Directive River Basin Management Plan (RBMP) for Ireland in the period 2022-2027.

INCASE will link the NCA approach with the Integrated Catchment Management (ICM) approach already in use in RBMPs. ICM was originally developed as the approach in Ireland for water management as awareness grew of the connectedness of our natural environment (water, habitats, soils, GHG emissions) and of the co-benefits of considering all natural systems (eco-, geo-, atmospheric systems) together as a broader interconnected system. Thus, highlighting that catchments are landscape units where these systems align. Linking NCA with ICM, thereby broadens the perspective of ICM as used and promoted by the EPA Catchments Unit, bringing focus to the dependencies between land use planning and environmental management in general. Working with key stakeholders like the CSO and NPWS, INCASE will explore how the stocks and flows in each catchment relate to society.



Some of the initial work by Lisa Coleman, GIS specialist with INCASE, on the Dargle Catchment.

The work is pioneering, and over the course of the next couple of years we will streamline the process of applying the SEEA framework, so that it can be extended nationally. Key outcomes will be identifying critical data sets and standardising the approach in the Irish context.

Four catchment areas have been selected for INCASE, representing a range of conditions and characteristics.

- The Caragh sub-catchment in West Kerry is predominantly a peatland catchment with considerable data already gathered by the KerryLIFE and PMP projects
- The Dargle in Wicklow has similar features, but it is also an extension of our capital city Dublin with an expanding urban population in a coastal context
- The Bride in Cork is a pastoral farming catchment with another EIP ongoing – the BRIDE regenerative farming project
- In complete contrast, the Figile River (two sub-catchments combined at the headwaters of the River Barrow) in the industrial peatland landscape of East Offaly has a number of challenges in relation to peatland management and water quality

Catherine Farrell, INCASE Project

Learn more:

www.incaseproject.com

The INCASE Team: we are a multi-disciplinary team with specialists in ecology, freshwater biology, economics, statistics, accounting and agriculture - Professor Jane Stout, Trinity College Dublin; Prof Cathal O'Donoghue, NUI Galway; Mark Eigenraam, Ideea Group; Assoc. Prof Stephen Kinsella, University of Limerick; Assoc. Prof Mary Kelly-Quinn, University College Dublin; Orlaith Delargy, IFNC; Carl Obst, IDEEA Group; Dr Catherine Farrell, Trinity College Dublin; Lisa Coleman, University College Dublin.

What is in the Bog Water?

The Living Bog is a project working so that 12 of Ireland's unique raised bog SAC's in seven counties will be brought back to life between 2016 – 2020. Restoration work on these Natura 2000 sites will improve over 2,600 hectares of threatened raised bog habitat – the equivalent of over 7,000 Croke Parks and 18% of the national high bog area. John Cody, Project Hydrologist, The Living Bog Project, National Parks and Wildlife Service, tells us about work they have been doing studying the water in these bogs...

Whilst on the road, in classrooms and communities, The Living Bog is often asked about the colour of water coming from, or near a bog, and if it's safe to drink that water. The yellowish-brown colour of bog water is a familiar sight to anyone from the midlands (or indeed the uplands), and some of our rivers are sometimes coloured. What causes the colour? Dissolved Organic Matter, or DOM.

This article explains what causes the colour and the associated impacts on water quality and hopefully answers some of the many questions out there about water from the bog, and stresses how important it is to keep that water on the bog.

Water discharged from the bogs contains Dissolved Organic Matter (DOM). DOM is principally composed of natural acids and proteins produced by the specialist peat forming plant species unique to bog ecosystems. It is the organic forms of carbon, nitrogen and phosphates contained in DOM that are responsible for the characteristic yellow brown colour of bog water. The natural organic compounds that compose DOM are stable in the bog environments, which typically have low levels of dissolved oxygen.

The Dissolved Organic Carbon (DOC), Dissolved Organic Nitrogen (DON), and Dissolved Organic Phosphorous (DOP) compounds are not immediately available as plant nutrients and hence DOM is not considered as a water pollutant in its own right.

Ecologically, DOM provides a substrate for bacteria and once in a receiving water course can also acts as a natural sunscreen, reducing the depth that UV light penetrates through the water column, protecting communities of decomposers (bacteria and protozoans) that responsible for a streams capacity to attenuate pollutants.

Bogs in their natural state are a carbon sink. Peat forming plants like sphagnum mosses remove carbon from the atmosphere. This carbon is stored in the bog as peat where water logging inhibits natural decay processes.

Draining the bog transforms the bog from a carbon sink to a carbon source.

Carbon is lost from the peat via two pathways, as direct atmospheric exchange through soil respiration and as DOM in discharge from the drainage ditches - or channels cut into the bog

to dry it out for peat extraction. A drained bog will act as a carbon source until the bog is re-wetted (or no peat remains).

The carbon flux associated with DOM can exceed direct atmospheric exchange by orders of magnitude and accounts for the majority of the carbon flux from a ditched bog. Up to 90% of the carbon lost from degraded bogs is exported via drainage discharge.

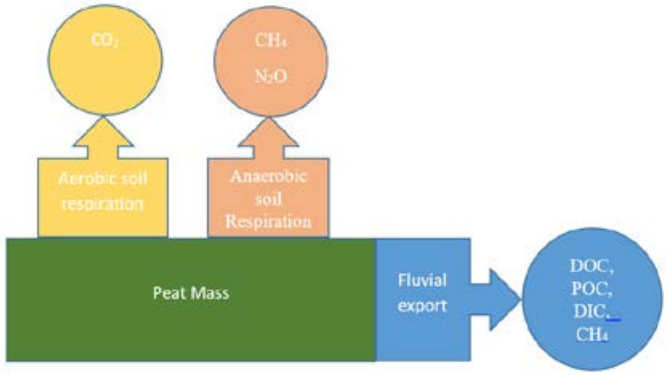


Figure 1: Pathways of Carbon losses from degraded Peatlands.

Once discharged into a receiving water course with comparatively high levels of dissolved oxygen the organic carbon, nitrogen and phosphorous compounds that make up DOM are broken are broken down by decomposers. These processes result in the production of carbon dioxide, and inorganic forms of nitrates and phosphates. The carbon dioxide released in this way is considered a fugitive emission in current studies of bogs in relation to climate change and is a major cause of uncertainty in estimates of the climate change potential of degraded bogs.

The nitrates and phosphates that are released as by-products from the digestion of DOM by decomposers are considered as water pollutants by the EPA. This is not due to potential impacts on human or animal health, but because they contribute to a process known as Eutrophication, which has a negative impact on the ecology of the water course. Consequently, production bogs have been identified as a significant pressure on 8% of Irish rivers at risk of not meeting their environmental quality objectives under the Water Framework Directive.

There is evidence that ammonium (a natural by-product of decay processes) is present at elevated levels downstream of production bog sites. Ammonium is a recognised water pollutant as it is toxic to some fish species at low concentrations, there is no direct risk to human health posed by ammonium in drinking water.

Nitrates in water are implicated as a cause of methemolobinemia (blue-baby syndrome), which is caused by nitrogen combining with oxygen in the blood stream in preference to iron. Epidemiological evidence suggests that this represents a health hazard in babies less than 2 months of age. The other significant water pollutants from production sites are fine peat sediments.

These sediments are composed of Particulate Organic Carbon (POC) suspended in the discharge from the drains. POC is not known to cause a risk to human or animal health, but can have significant impacts on stream ecology. As POC's settle out of suspension it can blanket stream beds, negatively impacting benthic species such as the fresh water pearl mussel.

A typical peat production site in the Irish midlands.

The Living Bog project is sampling water quality from selected restoration sites on a monthly basis. For example the concentration of Nitrate at the discharge point on Killyconny Bog, Co Cavan on 23/09/2019 was less than 1.67 mg/L, which is an order of magnitude lower than existing Maximum Allowable Concentration (MAC) of 50 mg/L set by the Drinking Water Directive. This concentration would be reduced significantly by dilution on entering the receiving water course.

DOC had a concentration of 45.1 mg/L and TOC 46.7 mg/L. Particulate Organic Matter (POC) present in a concentration of 1.6 mg/L. There are no published MAC's for these parameters, so the project will seek to compare the concentrations from restored sites with the data the EPA has available on production sites over the course of the next 12 months, in order to determine how drain blocking impacts on water quality ecosystem services.

The Living Bog has installed a number of flow measuring structures on selected raised bog project sites. These are used to monitor the discharge and the water quality from the bog. View on YouTube: www.youtube.com/watch?v=p062FiXesFE

Tri-halo methanes (THM's) are formed by a reaction between chlorine and organic compounds (principally DOM). THM's are thought to be carcinogens as there is epidemiological evidence that prolonged exposure to THM's leads to elevated rates of some stomach cancers. As DOM is dissolved in the bog water it cannot be removed from water via filtration or coagulation /flocculation, which are the traditional primary stages in water treatment. Hence treating water with high levels of DOM is expensive. Consequently water sources that have high levels of DOM or are highly coloured have been avoided by water supply utilities to avoid the costs of associated with treatment.

Traditionally water entering a pipeline from a water treatment plant is dosed with chlorine. This acts as a disinfectant and is an effective treatment of the main pathogens that cause serious diarrhoeal diseases such as dysentery. It is considered an essential part of the treatment process as the chlorine dose provides a residual disinfection effect as water passes through the transmission pipeline, ensuring potable quality at the consumers tap.

THM's are not formed in concentrations that would impact human health under natural conditions. They are part of a wider group of compounds collectively known as Chlorine by-products (CBP's). There are maximum acceptable concentration limits set by the EC Drinking Water Directive for THM's and CBP's, and compliance monitoring is undertaken routinely by the EPA. Hence the occurrence of DOM in a peatland catchment is only likely to represent a risk to human health if there is a water abstraction point downstream of the bog. This is unlikely as water utilities would not abstract surface water from a source with high DOM concentrations, it would be cheaper to pump it from a borehole. Drinking bog water without treatment will would likely cause acute diarrheal disease.

From the above it can be concluded that restoring the bogs will have the following net benefits to the ecological status of the receiving water courses:

- Reduce the amount of sediments entering the receiving water course
- Reduce the amount of ammonium being directly discharged into the water course
- The impacts in relation to DOC are less clear. From first principles increasing the residence time of water on the bog surface will increase DOM concentrations, as will increased coverage of Sphagnum moss, as the natural amino acids produced by the sphagnum is a major constituent of DOM and a contributing factor to the low pH typical of healthy bogs. However, there are no negative health impacts associated with the DOM and it is not considered a pollutant. In fact, the increased concentrations of DOM could well be considered an important ecosystem service function of bog restoration. The production of ammonium resulting in microbial breakdown of DOM is unlikely to cause toxicity to fish as this process will be naturally regulated. The project will monitor the impacts of drain blocking on DOC concentrations using FDOM sensors installed in hydraulic measuring structures

Blocking drains on the bogs will have a net positive impact on water quality. As the ecological status of the bog improves, so too will the ecological status of the receiving water course.

John Cody, Project Hydrologist, The Living Bog Project, National Parks and Wildlife Service

Learn more:

The Living Bog Project: www.raisedbogs.ie

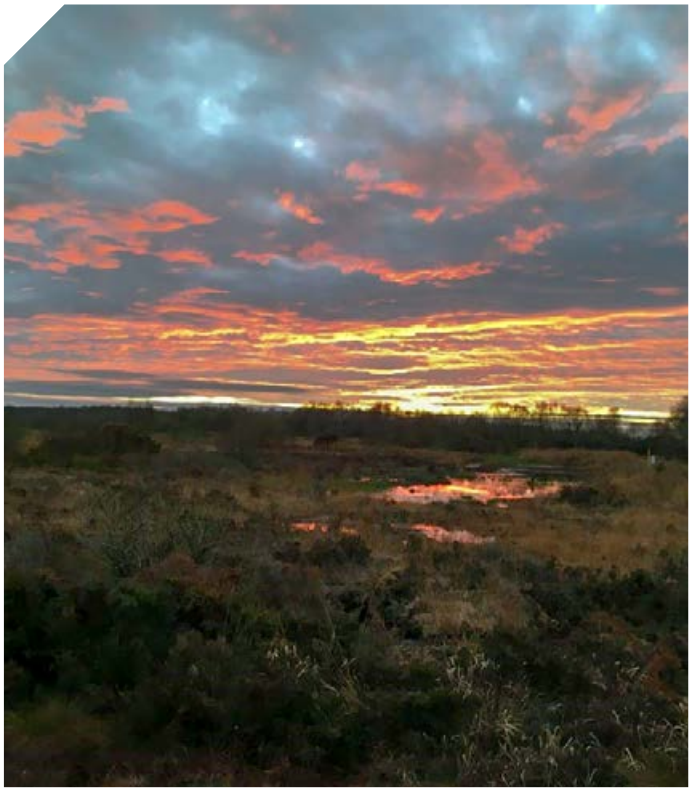
EPA Catchment Unit, Significant Pressures: Peat www.catchments.ie/significant-pressures-peat/

Local Authority Waters Programme
www.watersandcommunities.ie/

KerryLIFE Project: Sustainable land use management for the conservation of the freshwater pearl mussel www.kerrylife.ie

'An overview of dissolved organic carbon in groundwater and implications for drinking water safety' by Dr Shane Regan, Paul Hynds & Ray Flynn.

https://www.researchgate.net/publication/316351764_An_overview_of_dissolved_organic_carbon_in_groundwater_and_implications_for_drinking_water_safety



Sunset on Ardagullion Bog SAC, Co Longford, December 2019, one year after restoration works. (Photo: John Cody, Hydrologist, The Living Bog).

Venice from the International Space Station (Photo: Flight Engineer Thomas Pesquet, ESA).

The flood of Venice

Davide Gallazzi tells us about the flooding of Venice in November 2019. This flood was triggered by a combination of factors including rain, hightides and subsidence - all of which are predicted to be exacerbated in future by the impacts of climate change...

During November 2019, Venice was affected by a number of exceptionally high tides ("acqua alta") which on the 12th reached a height of 187cm above sea level. This was the second highest tide on record, after the event of November 1966 (the same days as the Flood of Florence[1]) when the height recorded was of 196cm (Note: tide height measurements since 1872 are referred to the topographical landmark at Punta della Salute which was chosen due to its proximity to St. Mark's Square. Due to the sea level rise and ground sinking, this landmark is nowadays ca. 36cm below sea level). An analysis of the historical data for tides at Venice allows to calculate a return period for the recent event of 160 years, while the 1966 event would have a return period of 1000 years.

Meteorological Causes

Venice and in general all of the northern shores of the Adriatic Sea are prone to flooding due to high tides, and particularly so during the Autumn. This is in part due to meteorological and astronomical causes, like full moon, tidal cycle, atmospheric pressure and its local variations, which can trigger gradient currents capable of moving significant volumes of water, heavy rainfall and particularly the presence of a strong "Scirocco" (a wind blowing from SE) which on one hand obstructs the discharge of surface water into the sea, while on the other hand pushes sea water towards the northern shore.

All of these factors contributed to the event of the 12 November. In the specific, available data indicate that in the general area of Venice rainfall in the period 1-19 November 2019 was of 101mm (with particularly heavy rain on 3, 8-h, 12-13 November), 74% in excess of the average rainfall, atmospheric pressure on the 12 November was characterised by a low of 983mb centred in the area, with strong and persistent Scirocco with gusts of 90-120km/h.

1 www.catchments.ie/the-flood-of-florence/

Last but not least, the low-lying nature of the lagoon of Venice makes the city particularly sensible to global sea level rising. Comparison between data from Venice, Genoa and Trieste indicate a long-term trend of 1.4mm/year of sea level rise in the period 1890-2016, but with a rate of 3.68mm/year for the period 1994-2016.

Geological Causes

The lagoon of Venice formed around 7,000 years ago when ice-thawing after the last glaciation lead to sea inundation of the northern part of the Adriatic Sea. Consequently, the lagoon is underlain by approximately 1,000m of fluvio-glacial sediments, which are sinking due to compaction. It appears though that in historic centre of Venice this geological cause is less important than it was generally thought. Data collected since the beginning of satellite monitoring ca. 20 years ago indicate that this area is relatively stable if not even raising, possibly due to tectonic uplifting. Ground sinking rate has been measured reaching a maximum of 3-5mm/year near the Northern and Southern borders of the lagoon, and a rate of 1-3mm/year at the sand bars near the open sea.

Moreover, sea level rising in the lagoon of Venice is in part due to local human activities, and in particular the massive extraction of groundwater for industrial purposes, especially in the near-by refinery complex of Porto Marghera to the north west, which alone caused a sinking of ca. 12cm in the period 1930-1970. On this aspect, it is interesting to note that a positive consequence of the 1966 flood was a stronger attention to the dynamics of the lagoon which led to cessation of industrial groundwater extraction since 1970, at least in the area close to the actual historical settlement of the city. Groundwater extraction continues, even if at a lesser scale, in the northern part of the lagoon contributing to the general subsidence of the area.

Historical Causes

It curious to notice that Venice could be partially responsible for its own troubles. In fact, while in other parts of Italy (southern Tuscany and Latium regions) lagoons and coastal marsh areas were reclaimed through the centuries, the lagoon in Venice was preserved as such by a decision of the leaders of the Venice Republic (810-1797 CE) as it was considered to be an extremely valuable protection against the risk of an invasion via land, a factor so important as to over-weigh the associated malaria and lack of agricultural land near the city. To protect the lagoon, the course of all the local rivers was repeatedly modified to prevent infilling by sediments. The body overseeing such aspect, il "Magistrato delle Acque" (Water Commission) had a main role in the administrative machine of the Venice Republic, and as such its activities were completely independent and strongly protected from any political or administrative interference.

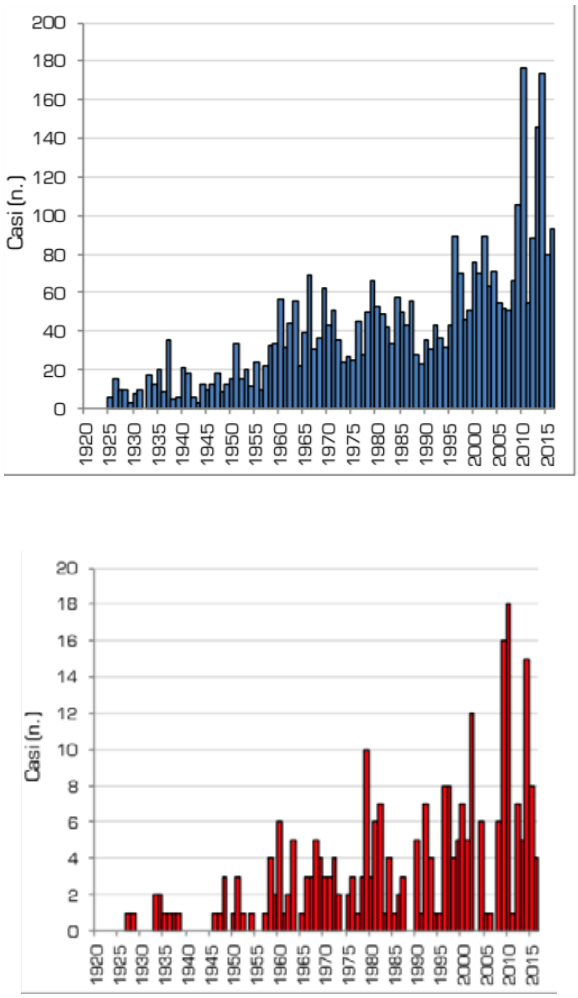


Figure 1: Projected increasing yearly frequency of medium-high tides (i.e. 80-109cm a.s.l, top) and high tides (i.e. at least +110cm, bottom).

Future Scenarios

A recent study of the area predicts that sea level rise (whatever the cause) even in the case of a moderate scenario (the so called: IPCC A1B), would bring the average sea-water level between 17cm and 53cm higher by 2100. This figure may sound small, but it should be noticed that when the tide reaches +80cm St. Mark's Square (the lowest point in the city) starts to flood; when the tide reaches +110cm circa 12% of the city gets flooded, and with tides of +130cm flooding affects approximately 70% of the whole city. Therefore, tides higher than 110cm may repeat between 20 and 250 times per year. Another study examining a worst case scenario, forecasted a natural subsidence of 3.3mm/year, with a consequent average sea level rise between 60cm and 82cm by 2100. Hence, acqua alta could reach over 2.50m, turning the exceptional circumstances of these days into a day-to-day occurrence. These dramatic predictions are to an extent anticipated by the increasing yearly frequency of medium-high tides (i.e. 80-109cm a.s.l, Figure 1, top) and high tides (i.e. at least +110cm, Figure 1, bottom), as shown above.

Davide Gallazzi, North West Environmental

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