IFM Specialist Conference
2016

Farming and Fisheries

Rheged Centre.
Penrith, England
10th – 12th May 2016

Delegate Pack
Tuesday May 10th 09.30 – 17.15

8.45 – 09.30 Registration and refreshments

### Session 1. Setting the Scene

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<td>Jonathan Grey, Wild Trout Trust</td>
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<td>Alice Richards, National Farmers Union</td>
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### Session 2. Ecological Impacts of Sediment

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<td>Ross Cherrington, Westcountry Rivers Trust</td>
<td>Unregulated maize and fodder beet management in the SW and their impacts on soil loss</td>
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<td>12.10</td>
<td>Peter Brunner, DHV</td>
<td>Troubled Waters: Investigating Ecological Impacts of Sediments in UK Lakes</td>
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<td>12.30</td>
<td>Mary-Kelly Quinn, Dublin</td>
<td>Potential impact of cattle access on the ecological quality of rivers: some observations from Ireland</td>
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<td>Caitlin Moran, Dales Rivers Trust</td>
<td>The effect of agricultural grazing on Invertebrate communities in streams</td>
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<td>13.10</td>
<td>John Quinton, Lancaster University</td>
<td>Keeping soil on the land and out of the rivers = better crops and a cleaner environment</td>
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### Session 3. Diffuse Pollution and its Impacts

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<td>14.40</td>
<td><strong>Kate Mathers,</strong> Loughborough University</td>
<td>How do signal crayfish influence fine sediment dynamics and what are the implications for macroinvertebrate communities?</td>
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<td>15.00</td>
<td><strong>Mark Walsingham,</strong> National Trust</td>
<td>Restoration of Redmire Pool and the Wye and Garron catchments.</td>
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<td>15.20</td>
<td><strong>Simon Evans,</strong> Wye and Usk Foundation</td>
<td>Correcting land abuse in the Wye for the benefit of farmers and fish</td>
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<td>15.40</td>
<td><strong>Ian Winfield,</strong> Centre for Ecology and Hydrology</td>
<td>An historic brown trout fishery and a new environmental governance: nutrient management at Loweswater, UK</td>
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<td><strong>16.45 – 17.30 Open Discussion</strong></td>
<td><strong>Moderator: TBC</strong></td>
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19:15. Conference Dinner at the Stoney Beck Inn, Penrith

*This is a three course dinner with wine cooked by the excellent team at the Stoney Beck Inn which has a coveted AA rosette.*

*Sourcing local, seasonal food is important at the Inn and this is reflected in their food. As much of the food as possible comes from Cumbria with many of the vegetables and herbs coming from the Inn’s own gardens.*

*The road miles and carbon footprint is kept to a minimum at all times.*
### Session 4. Working Together

**Session Chair:** Simon Evans. Wye and Usk Foundation

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<tr>
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<td>Chris Stoate, Game and Wildlife Conservation Trust</td>
<td>The Water Friendly Farming project – a landscape scale experiment to investigate mutual benefits to farming and water</td>
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<td>10.00</td>
<td>Jonah Tosney, Norfolk Rivers Trust</td>
<td>The WaterLife Project in Norfolk</td>
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<td>10.20</td>
<td>Peter Dennis, Apem Ltd</td>
<td>The River Worfe Restoration Initiative: saving a fragmented and threatened native brown trout population in Shropshire by catchment interventions</td>
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<td>10.40</td>
<td>Peter Turner, Environment Agency</td>
<td>There’s a change in the Aire – How Upper Aire farmers are outstanding in their field.</td>
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### Session 5. Working Together II

**Session Chair:** Peter Turner. Environment Agency

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<tr>
<td>11.45</td>
<td>Rob Thomas, Natural Resources Wales</td>
<td>Recognising which agricultural practices are causes and sources of diffuse water pollution, raising awareness and looking for sustainable solutions</td>
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<tr>
<td>12.05</td>
<td>Dan Turner, Dales Rivers Trust</td>
<td>Finding multi beneficial solutions to restore a SSSI River in Yorkshire.</td>
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<tr>
<td>12.25</td>
<td>Chris Turner, CSF Eden</td>
<td>Catchment Sensitive Farming in the Eden</td>
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<td>12.45</td>
<td>Phil Lyth, Yorkshire Farming and Wildlife Partnership</td>
<td>The Good, the Bad, and the Ugly – Experiences of Working with Farmers &amp; Landowners to Improve the Water Environment</td>
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**Session 6. Finding a Solution**

Session Chair: **Paul Coulson** IFM

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<tr>
<td>14.20</td>
<td>Leela O'Dea, Frog Environmental</td>
<td>Water Lynx™ block technology improves Nautilus Pond™ wetland design</td>
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<tr>
<td>14.40</td>
<td>Tea Basic, Bournemouth University</td>
<td>Impacts of gravel jetting on spawning substrates of lithophilic fish species</td>
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<td>15.00</td>
<td>Marta Assunção, Cefas</td>
<td>Using a modelling approach to assess present and future land use pressures on salmonid populations: a case study in the River Tamar catchment</td>
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<td>15.20</td>
<td>Simon Evans, Wye and Usk Foundation</td>
<td>The Wye and Usk Angling Passport Scheme. Giving something back to the landowners.</td>
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<td>16.00</td>
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<td>Conference Close</td>
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**Thursday May 12th 9.00 – 13.30 Field Trip**

The field trip will leave from the Rheged Centre and will be visiting the Eden Demonstration Test Catchment Project (http://www.edendtc.org.uk/). This is a partnership project lead by Lancaster University that includes the Eden Rivers Trusts, Durham and Newcastle University, CEH Lancaster and Newton Rigg College.

The River Eden Demonstration Test Catchment (EdenDTC) is a Defra funded research project. The aim of the project is to assess if it is possible to cost effectively mitigate diffuse pollution from agriculture whilst maintaining agricultural productivity. EdenDTC is part of a wider research platform including similar projects in the Hampshire Avon and the River Wensum.
Abstracts

Tuesday May 10th

Session 1. Setting the Scene

The view from across the Pond. Working with landowners on a grand scale

John Zablocki.

Nature Conservancy, USA

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Through the 20th century, conservation biology in the United States has undergone a significant evolution in terms of scale of focus and practice. The broad trend has been a shift away from local “fortress conservation”, in whatever form that may take (e.g., designation of wilderness areas, national parks, and acquisition of private nature reserves) to a more systems-based approach to conservation planning across both protected and working lands. The motivations for this transition emerged from changing paradigms in our understanding of ecology (e.g., a greater appreciation for stochasticity, ecosystem resilience, and meta-population dynamics), as well as from the growing recognition of the need to manage stressors (e.g., livestock grazing, wildfire, habitat fragmentation) at the scale they operate on. But while the science and conservation planning tools have made a great leap forward, the science can only ever take us so far before we run into the messy world of society, politics, and economy.

So how do we achieve conservation on a large scale? This talk explores these dynamics by examining efforts to restore riparian habitats and recover the Lahontan Cutthroat Trout (LCT) in the Great Basin of the Western United States. The LCT is a native fish species federally-listed under the Endangered Species Act in the US. The fish’s native range spans a vast area, encompassing a wide array of different socio-ecological settings and corresponding threats that pose challenges to the fish’s recovery (e.g., mining, invasive species, grazing, urban development, climate change, etc).

From this case study, the talk focuses on things that often get edited out of conservation planning, yet often end up being the very cornerstones of success. These include the need to cultivate strange bedfellows, the need to focus on language/communication, the need to consciously re-frame issues, and the need to create opportunities for interactions/networks to build between stakeholders. By focusing on what has worked, as well as what has not, the talk seeks to offer a perspective on how we can help close the gap between what our science tells us we need to do and what we actually end up doing.
An overview of the impacts of land management on UK rivers

Jonathan Grey,
Wild Trout Trust

E-mail address of the corresponding author: jgrey@wildtrout.org

Sediment ingress and accrual currently occupies the number two spot on the European Union Water Framework Directive list of ‘reasons for failure’ to achieve good ecological status or potential. There is plenty of scientific evidence from historical and ongoing research regarding the impact of fine sediments on aquatic flora and fauna. I will give an objective overview of some of the land management issues that constitute sources of sediments to aquatic ecosystems, using observations from the Wild Trout Trust Conservation Officers (with input from other river practitioners) from around the UK, and recap on some of the most significant impacts upon fisheries.

Farming the Solution: How farmers in the North West are preventing pollution and alleviating flooding

Alice Richards,
National Farmers Union.

E-mail address of the corresponding author: Alice.Richards@nfu.org.uk

The winter storms of 2015/16 have once again brought the focus on to farming, not in terms of how it has been impacted, but what can it do to make a difference. However, until the land is restored and farm businesses can resume farmers will not be able to look ahead and make the necessary changes.

The majority of farming sectors have had a difficult year, especially livestock, with low market values and delayed payments from BPS and Environmental Stewardship. Storms and floods are never welcome; however it couldn’t have come at a worse time for Cumbria farmers. The cost of recovering from the winter events will push many farm businesses to the limit.

We conducted a survey in December to ascertain what level of damage had been sustained across farmland, and how farm businesses had been affected. Flood water on its own is problem enough, but it’s also what it leaves behind and what it takes away that is often more of an issue. Large deposits of gravel and silt have been dumped on fields, as well as large mature tree trunks. Fences and walls have been flattened, and large amounts of river bank have been eroded. Farmers have lost a lot of this year’s fodder, both in terms of bales being washed away and the damage sustained to grassland which will affect this year’s growth. Normal farm routines have been disrupted due to loss of communications, access and machinery. Many farms in Cumbria rely on diversifying in order to bring in extra income; however these
too have also been impacted by the floods, both in the short and long term.

As part of our work within the Cumbria Flood Partnership we recently held a number of farmer workshops across the three priority catchments; Eden, Derwent and Kent. We wanted to find out from farmers within each of those catchments what they thought the issues and solutions were. April not being a great time of year to get farmers out to meetings, we still managed to get 40 farmers out across the seven workshops we were able to hold within the short timescale. We listened as they explained how their part of the catchment had been affected by the floods and how this had impacted on their businesses. We talked through the possible solutions for mitigating against flooding including maintenance, infrastructure and natural techniques. They also highlighted some of the great work that they’ve already been doing, including diffuse pollution measures.

The main suggestion that came through each of the workshops is that it’s very much the right option in the right place. What suits one part of the catchment isn’t necessarily right for other parts. This is also true of how the farmers wanted to work in the future; the engagement needs to be at the right scale because each area within a catchment is different from the other. Farmers want to be part of the solution, and they want to feel that their ideas and experience is listened to and believed, and for organisations to work together with them in order to deliver what’s required.

**Session 2. Ecological Impacts of Sediment**

_Unregulated maize and fodder beet management in the SW and their impacts on soil loss_

**Ross Cherrington**

Westcountry Rivers Trust

E-mail address of the corresponding author: Ross@wrt.org.uk

The South West like much of the Western side of the country has a landscape of steep hills, and numerous watercourses from the smallest ditches and streams to the Rivers Tamar and Exe. It also has areas of the highest concentration of dairy cows in the whole country, and combine this with expansion of bio-gas plants, high rainfalls and heavy soils and the management of maize and fodder beet is seriously impacting on the watercourses. There are few regulations stopping the growth of these crops anywhere within a farms system except for the Environmental Impact Assessment, protecting natural and semi-natural vegetation but if a field has been cultivated or sprayed in the last 15 years then there is nothing to stop it being ploughed up.

There have been some measures to educate farming on the inherent dangers of growing these crops and these include the Code of Good Agricultural Practice, Soil Protection Review, innumerable CSF S4P workshops and articles in the press, BUT too many don’t seem to care whether they keep their soils or not. In one study an estimated 50% of all suspended sediments within 2 Westcountry rivers could be attributed to maize growing.
It is estimated that there are 74,000ha of maize grown in the SW, up from 8000ha nationally since 1973. Researchers estimate that during the storms in the winter of 2013/14, every ten-hectare block of damaged land under maize stubble produced the equivalent of 15 Olympic swimming pools (375 million litres) of additional runoff.

I expect that every farm advisor from the Rivers Trust movement has a library of horror stories from a variety of winter harvested crops and with agriculture coming under severe financial pressure, these are likely to continue, as the farm business tries to save money. Until I am informed otherwise, with proof, then I doubt there have been many if any prosecutions for soil loss from a farm in the SW. and with the Environment Agency shedding many of their experienced Environment Officers, who know and understand their catchments, then this is unlikely to increase.

There could be however a way of introducing some protection to soils. The new Good Agricultural and Environmental Condition requirement GAEC 5 does allow the Rural Payment Agency to remove a percentage of farms Basic Payment if it can be proved that 1ha of land shows sign of erosion. However recent inspections have shown the RPA inspectors to have a woeful lack of training and interpretation, passing fields where there is not only an obvious
1ha of soil loss but impacting off farm increasing the severity of the penalty. The siltation of the Somerset levels clamour for dredging has missed the obvious that the drains filled with agricultural soils washed of inappropriate land management. Cross Compliance missed a trick in the last round of updates; a few simple rules could quickly reduce soil loss.

1. All maize stubble to be rough cultivated within 24 hours of harvest, unless under sown
2. Bare soils after fodder beet should be rough cultivated if erosion is seen or expected
3. If rough cultivation of maize stubbles would make the erosion risk worse, then maize should not be grown
4. No grass re-seed after maize if harvested after September

Maize area under cultivation has been going down in the SW as the number of dairy farms reduces and the cost of growing the crop increases, but The proliferation of Bio-gas plants has seen maize become more cost effective as the crop becomes double subsidised through the BPS and FITs. A biogas plant with a capacity of one megawatt, requires 20,000-25,000 tonnes [of maize] a year, accounting for 450-500 hectares of land. This has increased competition for land and increased rents, close to the plants so in localised areas maize or fodder beet is being grown for animal feed on land that is marginal at best

**Troubled Waters: Investigating Ecological Impacts of Sediments in UK Lakes**

**Peter Brunner**

Royal Haskoning DHV

E-mail address of the corresponding author: peter.brunner@rhdhv.com

**The importance of lakes**

Lakes are much more than remote bodies of water; they are important natural features that provide a wide range of vital ecosystems. They provide important habitats for a wide range of aquatic plants, invertebrates, fish, birds and mammals, and play an important role in the regulation and storage of water. Many lakes are also important recreational resources, and are actively managed for the benefit of a diverse range of user groups.

**Lakes under pressure**

The UK’s sensitive lake ecosystems are under many environmental pressures as a result of human activities such as agriculture, forestry, urbanisation, water supply and treatment.

There are many pressures affecting UK lakes, but of these three are particularly prevalent. The first of these is the increase in sediment supply from contributing catchments, which increases turbidity, encourages sedimentation on the lake bed and results in the gradual infilling of the lake. The second involves an increase in the supply of nutrients (e.g. nitrates and phosphates from agriculture and treated sewage discharges) and a decrease in levels of dissolved oxygen, which together change the trophic level of the lake and encourage algal blooms and vegetation growth.
Finally, there can be an increase in contaminants such as metals, pesticides, hydrocarbons and other substances derived from road runoff and urban areas. These contaminants may be dissolved in the water column, or may be associated with lake sediments.

As a result of these catchment pressures, many lakes that were formerly clear and deep and supported a diverse range of submerged and floating vegetation, diatoms, macroinvertebrates and fish have become degraded. These lakes typically have poor quality, turbid water, have become shallower, have low concentrations of dissolved oxygen and high concentrations of nutrients and other contaminants. They are therefore no longer able to support their natural ecology and instead have a much less diverse assemblage of aquatic flora and fauna. Restoration is therefore needed to improve the condition of these lakes and enhance their resilience to future changes.

**Drivers for lake restoration**

There are two main drivers aimed at improving the UK’s sensitive lake habitats; the Water Framework Directive (WFD), and the UK Government’s conservation targets.

The WFD requires all EU Member States to protect and, where possible, enhance the condition of all bodies of water, including lakes. Where lakes do not meet the required standards, the relevant authority must take steps to ensure that these targets are met by the end of future River Basin Management Cycles (2021 or 2027).

The UK Government’s “Biodiversity 2020” strategy includes a commitment to provide better habitats for wildlife. It makes a commitment that 90% of priority habitats will be in Favourable or Recovering condition, and at least 50% of the total area of designated habitats (including Sites of Special Scientific Interest) is in Favourable condition by 2020.

A large amount of work across the entire water environment is required to achieve the twin targets of the WFD and Biodiversity 2020. Our recent work on lake restoration for public bodies such as the Environment Agency and Natural England forms part of their combined focus to achieve these targets.

**Investigating the issues that affect lakes**

Royal HaskoningDHV’s Catchment Management team is currently working with the Environment Agency, Natural England and Natural Resources Wales to identify why lakes are failing to reach the WFD’s required standards and, in the case of designated habitats, are not yet at Favourable condition. We have successfully applied a range of techniques to characterise the issues that affect lakes and help develop management solutions to improve their environmental quality. One solution involves detailed water and sediment quality monitoring at lake inflows and in the wider catchment to identify sources of sediment and contaminants. We have also implemented bathymetric surveys to identify sediment depths and areas of accumulation and ecological surveys to characterise the plant and invertebrate communities that the lakes support.

**Improving lake habitats**

Our investigations have identified a range of techniques that can be used to restore lake habitats and achieve the goals of the WFD and Biodiversity 2020 strategy. These range from physical interventions that are effective in the short term, to changes to management practices in the lakes and contributing catchments that are more effective over longer timescales.
In many lake systems, we have found that the physical removal of accumulated sediment and contaminants is the most appropriate method to deliver immediate improvements to lake habitats. Although this can be expensive, sediment removal is often the only way to restore depth and habitat.

**The future**

Poor quality lake habitats will, for a long time, remain an issue that needs to be addressed. But combining direct interventions to restore degraded habitats with management planning, so that these are not required again, will ensure that these valuable ecosystems are protected and preserved in the future.

**This Presentation**

This paper presents and highlights the above aspects in regards to the restoration of UK lakes for three recent case studies associated with Stover Lake in Devon, Bosherston Lakes in Wales and Aqualate Mere in West Midlands. These particular lake studies were undertaken in order help develop management solutions to improve their environmental quality, deliver the UK Government’s Biodiversity 2020 objectives and achieve compliance with the Water Framework Directive.

**Potential impact of cattle access on the ecological quality of rivers: some observations from Ireland**

Mary-Kelly Quinn

University College Dublin

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Mary Kelly-Quinn¹ & Elizabeth Conroy¹, Turner², J., Rymaszewicz³, O’Sullivan³, J. J. & Lawlor⁴, D., Bruen³, M.

¹School of Biology and Environmental Science, University College Dublin
²School of Geography and UCD Earth Institute, University College Dublin, Belfield, Dublin 4, Ireland
³UCD Dooge Centre for Water Resources Research, School of Civil Engineering, UCD Earth Institute, University College Dublin, Belfield, Dublin 4, Ireland
⁴Centre for Agroecology, Water and Resilience, Coventry University, UK

Unrestricted cattle access to rivers and streams represent a potentially significant localised pressure on rivers. The effects of cattle access on macroinvertebrate communities were investigated in four rivers of high/good (Barrow, Clodiagh, Douglas and Glenlahan Rivers) and four rivers (Boycetown, D’arcy, Dee and Erkina Rivers) of moderate water quality status which drain, low gradient, calcareous grassland catchments in Ireland. This study was undertaken as part of the SILTFLUX research project (http://77.74.50.157/silflux/). Two of the sites had potentially higher cattle access disturbances, the Dee where cattle crossed the river twice daily and the Boycetown where cattle were overwintered adjacent to the access point. Macroinvertebrate sampling was conducted upstream and downstream of each cattle access point in spring (April/May) and autumn (September/October) 2013 in two aquatic habitats: stream mid-channels and margins. Six replicate Surber samples were taken within the mid-channel and
margins at each sampling location together with estimates of re-suspendable sediment from the stream bed and % deposited fine sediment cover. Macroinvertebrates in mid-channel habitats rather than channel margins were most sensitive to the added pressure of cattle access points. Site specific impacts were evident which appeared to be influenced by water quality status and season. Overall, downstream changes in macroinvertebrates in rivers of high/good water quality status (Barrow, Clodiagh, Douglas and Glenlahan) were more frequently observed in autumn than spring. In three of the four high/good water quality status rivers autumn samples revealed changes in community structure and functional feeding groups. Significant changes in at least two univariate metrics (total richness and EPT richness together with taxon, E and EPT abundance) were observed in both seasons for all four high/good status rivers. Two (Boycetown and Dee) of the four moderate water status rivers showed significant changes in a number of metrics driven in the main by downstream increases in collectors/gatherers, shredders and burrowing taxa. These two moderate water status rivers had, as mentioned previously, high or prolonged livestock activity. In view of these findings, the potential for some of these sites to achieve the objectives of the EU Water Framework Directive may be compromised. The results presented also highlight the need for additional research to further define the site specific factors and livestock management practices, under different discharge conditions, that increase the risk of impact on aquatic ecology due to these cattle-river interactions. This is being addressed in a follow-up project (COSAINT) (http://www.teagasc.ie/environment/cosaaint/).

* Funding for this research was provided by the Environment Protection Agency, Ireland under the EPA STRIVE Programme (SILTFLUX 2010-W-LS-4).


The effect of agricultural grazing on Invertebrate communities in streams

Caitlin Moran

Dales Rivers Trust

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The effects of agricultural land use on stream physical habitat and water quality are well documented. Intensive farming can result in increased nutrients in stream water, sedimentation and changes to bank-side vegetation.

Some invertebrate species cannot tolerate these conditions and so agricultural land use is likely to result in altered invertebrate communities.
This study aimed to identify the level of agricultural intensity at which invertebrate communities began to change in response to the altered conditions. Further, it assessed whether altered invertebrate communities behaved and fed differently. Because invertebrates have a key role in stream ecosystems, and are an important food source for fish and avian predators, any changes could have consequences for wider ecosystem and food web properties.

The number of invertebrate species and the identity of these species did not change until stream has 4 mg/L nitrate and 8 % of the stream bed was covered with sediment. Further increases beyond these thresholds resulted in a decline in the number of invertebrate species and a change in the identity of dominant species, from caddisfly larvae, mayfly nymphs, stonefly nymphs and riffle beetles to worms, diptera larvae, leeches and freshwater woodlice (Asellidae).

Below the thresholds the community was composed of species with very diverse traits; moving, feeding and respiring in a variety of different ways. Above the threshold the community became increasingly similar, all having the same characteristics. Previous research has demonstrated that communities that are very similar have a reduced capacity to perform functions such as decomposition and to withstand flood or drought events.

The amount of algae present in the stream increased with agricultural intensity due to higher nutrient concentrations, but the number of species that feed on algae declined. Instead filter feeding invertebrates dominated, likely making use of manure as a food source. This suggests a positive feedback for algal blooms in agricultural streams and warrants further investigation.

Studying the carbon isotopes in body tissues of invertebrates can reveal the food source for the invertebrate. There was indication that methane was entering the food web in streams with high agricultural intensity. Bacteria use methane in conditions where oxygen is not available. This could be where sediment deposits are smothering, or where algal blooms have caused eutrophication. Having a very different energy source will have implications for the growth rate and nutritional value of invertebrates for their predators.

Predatory invertebrates did not significantly change their diet with increasing agricultural intensity: they preferentially consumed species that were present across the whole intensity gradient including chironomids and simuliids. Because there were fewer invertebrate species, however, food webs were simplified.

In conclusion, there is a threshold point at which agricultural land use causes alterations to the invertebrate community. This altered community behaves and interacts differently producing changes throughout the ecosystem. Further research into how general this threshold is and how it varies across different regions is needed.

Keeping soil on the land and out of the rivers = better crops and a cleaner environment

John Quinton
Session 3. Diffuse Pollution and it’s Impacts

How do signal crayfish influence fine sediment dynamics and what are the implications for macroinvertebrate communities?

Kate Mathers

Loughborough University

E-mail address of the corresponding author: K.Mathers@lboro.ac.uk

Kate L. Mathers1, Richard Chadd2, Chris Extence2, Jake Reeds, Stephen, P. Rice1, Paul, J. Wood1

1 Centre for Hydrological and Ecosystem Science, Department of Geography, Loughborough University, LE11 3TU, UK
2 Environment Agency, UK

The negative effects of increased sedimentation on lotic ecosystems and their associated biota are well documented. Moreover, it is widely acknowledged that sediment characteristics are one of the primary determinants in the distribution of instream macroinvertebrates. However, little attention has been given to how biota may interact with sediment dynamics and how these modifications may influence the structure and functioning of aquatic ecosystems. In particular, by ‘engineering’ the erosion, redistribution and accumulation of fine sediments, some animals may gain environmental advantages which promote their fitness and survival.

Signal crayfish (*Pacifastacus leniusculus*), one of the most widespread invasive species in Europe, are considered to be keystone organisms in both lotic and lentic habitats due to their size, large biomass and functional role. Recent research has demonstrated that their rapid expansion within UK waterbodies has significant and longstanding consequences for the ecological integrity of the aquatic ecosystems they colonise. Results suggest that
Macroinvertebrate community composition display distinct changes compared to pre-invasion and control rivers and that these changes were driven primarily by a reduction in less mobile taxa such as Hirudinea (leech) and Gastropoda / Bivalvia (snail) species. However, the implications of signal crayfish activity may extend beyond the biotic system into the channel geomorphology and water chemistry of the rivers that they inhabit. Specifically, their direct ecological implications (e.g. predation and monopolisation of resources) may be augmented by indirect effects via their impact on fine sediment dynamics.

Signal crayfish may affect fine sediment dynamics at all stages of the cycle, from the erosion, transportation and mobilisation, through to the deposition, ingress and storage of fines in the river bed. Signal crayfish are typically a non-burrowing species in their native habitat range, however within the UK extensive burrow networks have been observed in river banks, potentially increasing the delivery of fines to river channels. Observations at 13 sites on six rivers in Central England indicates that burrow construction contributes between 0.25 and 0.50 t km⁻¹ yr⁻¹ of fine sediment to rivers which would otherwise not enter the river system.

Crayfish activities (i.e. foraging, fighting and burrowing activities) also have a direct effect on the mobilisation of fine sediments during flow conditions which would otherwise be insufficient to initiate mobilisation. A 12 month record of suspended sediment concentrations indicated that night time crayfish activity was typically associated with increased sediment fluxes. Crayfish bioturbation contributed at least 32% (474 kg) to monthly baseflow suspended sediment loads; this biotic surcharge added between 5.1 and 16.1 t (0.21 to 0.66 t km⁻² yr⁻¹) to the annual sediment yield.

It is also possible that signal crayfish may affect the ingress of fine sediment into the riverbed, and that this may alter predator-prey interactions. Experiments indicate that crayfish have the potential to significantly enhance fine sediment infiltration rates into clean gravel frameworks. Under experimental conditions, crayfish presence resulted in approximately 10% more fine sand infiltrating into the substrate when compared to control conditions. Many potential prey taxa (e.g. Gammarus pulex) display predator avoidance strategies that rely on vertical movement into the river bed. Fine sediment under appropriate loadings and grain sizes therefore disconnects surface and sub-surface habitats, leaving prey taxa more susceptible to predation. Importantly prey availability may play a key role in the influence that crayfish zoogeomorphic activity has on ingress rates, with reductions in prey availability increasing foraging behaviour, which resulted in greater ingress rates. As invading species become more established and prey resources are depleted, the effect of invasive taxa on fine sediment dynamics could potentially become more prominent.

The results of this research demonstrate that fine sediment pressures and the interaction with instream biota are not simple one way outcomes, but complex and interlinked processes. Biota themselves interact with the physical environment, and these interactions may affect and have important feedbacks within the ecosystem.

Restoration of Redmire Pool and the Wye and Garron catchments.
Correcting land abuse in the Wye for the benefit of farmers and fish

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The Wye and Usk Foundation is charity that has been working for 21 years to improve the fish stocks in these two famous rivers. For the past 30 years the area that salmonids could spawn successfully has been steadily reducing as a result of intensification of agriculture and unsustainable farming practices leading to massive soil loss. Suspended sediment levels in excess of 100g/l in tributaries and 25g/l in the main stem of the lower Wye have been recorded. 200,000t of soil left one sub-catchment in one 6 day spate in November 2012!

Since 2009 WUF has been working within the farming community to correct this and other water quality and quantity issues. In the process we have had to understand why top soil is being lost, where it is coming from and gain the confidence of even the most hard-nosed farmers and empower them to change and adapt practices for their benefit and those of the rivers. In our Catchment Restoration Fund WHIP 2 project we worked systematically on a waterbody by waterbody basis, engaging over 400 farmers, writing 323 whole farm plans which covered over 36,000ha of Herefordshire. We have seen suspended sediment concentrations reduce by 44% and phosphate by 10.6% in the catchments we have worked in compared to control streams and an increase in farm incomes and yields. Within the project the farming community contributed £571,000 towards improved infrastructure. Crucially we have developed an economic argument why farmers should look after their soils and farming across Herefordshire is changing for the better.

The river’s ecology has responded with successful salmonid spawning being recorded in the lower and middle main stem of the Wye for the first time since the early 1990’s and previously salmonid free or severely limited streams are now containing self-sustaining salmon and trout populations.

The presentation will detail how WUF gained the understanding that has allowed us to target action and advice, what advice we gave, and how the farmers have changed practices to protect their soils and increase their incomes. It will also detail the monitoring results, what has worked, what hasn’t and what still needs to be done.
An historic brown trout fishery and a new environmental governance: nutrient management at Loweswater, UK

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The lake of Loweswater in north-west England, UK, has a renowned history as a brown trout (Salmo trutta) recreational fishery. However, it has also undergone relatively recent nutrient enrichment with frequent blooms of blue-green algae (cyanobacteria). Recreational fishing has become less frequent and characterised by low catches. Conventional responses to this eutrophication, i.e. scientific monitoring and regulatory interventions from 2001 onwards, had little apparent impact and prompted concern within the local community and regulatory institutions. Following initiatives from local farmers in 2002 and interdisciplinary research funded by the Rural Economy and Land Use Programme, the Loweswater Care Project was created in 2007. This was a new social mechanism which supported, constructively criticised and broadened research in open and transparent debate and worked closely with community members (including farmers) to identify and, where possible, to implement potential solutions. This innovative structure led to the establishment of the Loweswater Care Programme (now part of the West Cumbria Rivers Trust), supported by Defra’s Catchment Restoration Fund from 2012 onwards, which enabled practical action to reduce phosphorus inputs by working with farmers, to reduce algal populations directly, and to continue environmental monitoring (including fish) through a combination of sampling by professional and citizen scientists.

Wednesday May 11th

Session 4. Working Together
The Water Friendly Farming project – a landscape scale experiment to investigate mutual benefits to farming and water

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Numerous management practices have been developed to reduce the impact of farming on water in order to benefit drinking water supply, fisheries and other freshwater ecology. Although the efficacy of these individual measures is well understood, the collective benefits of such measures, if applied together at the landscape scale, remain inadequately researched. Farming and fisheries are often considered as in conflict. We are adopting a landscape scale experimental approach to explore the potential benefits to water of such an integrated approach to catchment management, and the synergies between farming and fisheries objectives.

The Water Friendly Farming project is a BACI (Before, After, Control, Impact) experiment in Leicestershire, comprising three headwater catchments of the river Welland, each of about 1,000ha, and of similar farming system, soil and topography. The Eye Brook is at Moderate Water Framework Directive status but is also the upper Welland tributary with the highest density of wild brown trout, while the Stonton Brook tributary is Poor WFD status with an impoverished fish community. Three years of baseline data on flow, sediment, nutrients, pesticides, fish and invertebrates have been collected at the base of each catchment and a range of management practices is now being introduced across two of them. We quantify the seasonal loss of soil, nutrients and pesticides and explore with farmers the potential to modify management practices to benefit both crop performance and water quality. In doing so, we present important new scientific evidence and develop our understanding of practical opportunities and constraints.

Sediment concentrations are broadly related to rainfall, with more frequent high concentrations in 2012 associated with exceptional rainfall in that year. Sediment concentrations have been more seasonal and consistent across the three catchments in subsequent years. The estimated total load exported to water ranges from 149 - 269 tonnes of soil per year from each headwater catchment. This represents 0.19 – 0.25t/yr per hectare, or 0.44 - 0.55t/yr per hectare of arable land. The phosphorus concentration was very variable in 2012. In subsequent years, phosphorus concentration increased in the summer and early autumn period in response to discharges from rural sewage treatment works and were consistently above WFD thresholds and concentrations known to cause eutrophication. Concentrations of monitored
pesticides reflected those reported by water companies in many other agricultural areas and exceeded the 0.1µg/l limit for drinking water supply.

These results are representative of a large part of lowland England but provide a more detailed and comprehensive insight into a range of issues than is available elsewhere. They highlight the impact of the rural community as a whole on water quality and aquatic ecology, and the challenges that this poses for mitigation.

They also highlight the synergies between agricultural and water quality objectives. Sediment loss represents a loss of soil from agricultural land but also reflects poorly functioning soils in upper catchments, largely associated with compaction and low soil organic matter which inhibit crop growth as well as being associated with surface runoff and erosion. Such conditions also encourage blackgrass (a highly competitive arable weed with limited means of control), the use of herbicides as part of the control strategy, and the movement of these herbicides to water. Current work focusses on supporting farmers to manage soils better to achieve multiple public and private benefits.

The WaterLife Project in Norfolk

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The River Worfe Restoration Initiative: saving a fragmented and threatened native brown trout population in Shropshire by catchment interventions

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APEM was commissioned by Severn Rivers Trust (SRT) to undertake a series of surveys in the River Worfe catchment, a tributary of the River Severn in Shropshire. The Worfe has historically been influenced by a wide variety of pressures from surrounding land uses and development and these are causing the watercourse to fail Water Framework Directive (WFD) objectives. The catchment was selected as a priority catchment that has significant
capacity for improvement using funds made available to SRT via the Catchment Restoration Funding initiative.

In 2013-14 APEM undertook a series of ground and aerial surveys of the entire Worfe catchment to assess the current condition of the river and the pressures imposed on the watercourse by surrounding land practices. A component of this work was to accurately map the prevalence and quality of fish habitat in the catchment, whilst undertaking quantitative fish population surveys in order to establish the extent of brown trout populations in the catchment. In addition, a team of specialists identified barriers to fish migration in the catchment, with subsequent site visits identifying potential fish passageway measures at each.

The walkover survey identified nearly 200 sources of aquatic pollution ranging from chronic sediment ingress from arable fields to misconnected domestic applications in urban areas. Meanwhile the findings of the ecological surveys identified a fragmented and vulnerable brown trout population, which appeared to be lacking recruitment as a result of denuded juvenile nursery habitats and limited foraging opportunities throughout the catchment.

In 2014 APEM undertook 40 farm visits in the Worfe catchment to discuss high priority issues. The contribution of the land owners and farmers in the area to date has been excellent and a number of proposals have been put forward to the SRT and the Environment Agency. These aim to mitigate future diffuse pollution issues on Wesley Brook and a significant number have been implemented with demonstrable improvements in aquatic habitats expected.

There’s a change in the Aire – How Upper Aire farmers are outstanding in their field.

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The vast majority of the Upper Aire catchment, covering an area from Malham to Keighley, is adversely affected by the impacts of diffuse pollution which has been attributed to land management practices. The sediment entering the watercourses is having a detrimental impact on brown trout numbers to the extent that under the EU’s Water Framework Directive, 16 of
the 17 water bodies in the catchment are failing, mostly due to the numbers of trout present.

Since 2011 the Environment Agency has been working with the Yorkshire Farming and Wildlife Partnership and the Yorkshire Wildlife Trust on influencing and educating landowners about land management techniques which can reduce the amount of sediment getting into beck, streams and rivers.

We have also undertaken a large number of habitat improvement and creation projects, from the fencing of watercourses to reduce poaching to creating new Biodiversity Action Plan wet woodland sites.

The first improvements made by the project were in Gargrave, completed in 2011. These works were done as a demonstration for what the project could deliver and the site was chosen because the issues were so acute. The land was managed by a landowner who was keen to support the project and this site has since been used as part of our education events because of the amazing results.

Our strategy for choosing further sites was based on the fact that a small number of people own or manage a large amount of land in the area. We focused on sites which not only delivered quick wins, but which would engage these influential landowners, who had the ability to significantly magnify the impact of the project.

The project has delivered – and continues to deliver – multiple benefits in addition to improving water quality, such as increased biodiversity and natural flood management. Some of the other project aims are:

- Reduce diffuse agricultural pollution, particularly sediment, with an aim to improve the status of failing WFD elements in the Upper Aire Catchment – leading to better water quality and habitat in the watercourses. Our surveys found that spawning gravels in the Upper Aire Catchment are badly affected by sediment
- Raise awareness with landowners of the sources of diffuse pollution – we have deliberately targeted key influencers within the community in order to amplify the project’s profile and reputation
- Manage invasive non-native plants – allowing native species to re-establish and provide better habitat

- Increase the amount of wet woodland BAP habitat in the area – this will have triple benefits:
  - Additional trees slow the flow of floodwater over land, and also stop sediment washing off the land into watercourses
  - The tree root systems provide habitat for invertebrates and trout
  - Trees along the riverbanks provide shade, resulting in cooler water

Five years on and the project is still growing, with new partners regularly joining. We hope that we have created a project which will become self-sufficient leading to an eventual end to Environment Agency financial support.
Session 5. Working Together II

Recognising which agricultural practices are causes and sources of diffuse water pollution, raising awareness and looking for sustainable solutions

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Raising Awareness of Diffuse Water Pollution in the Agricultural Sector. A plethora of best practice guidance for soil management and preventing pollution, has been produced for the sector for over 30 years. Visual evidence from farm inspections indicate that take up of the advice is generally low. Why is this? There are likely to be many reasons, including how the guidance material was collated within the UK, for what and how it was made available. Farming in the typical UK climate of high rainfall can be challenging and undoubtedly practitioners can become acclimatised to their surroundings of farm wastes, mud and run-off. Livestock and land managers need to better understand the causes and sources of pollution and its impact if they are to modify practices and attain cost effective and sustained improvement.

In January 2013, it was calculated that at least 35% of the EU Water Framework Directive waterbodies in Wales were failing to meet the required Good Status because of diffuse water pollution. With some 79% of the land-use in Wales being agriculture, it is no surprise that two of the eight priority areas identified in the NRW document “Diffuse Water Pollution in Wales; Issues, Solutions and Engagement for Action” (http://naturalresources.wales/water/quality/diffuse-water-pollution-action-plan/?lang=en) involve tackling the causes and sources from agriculture.

In drafting actions to tackle the problems, we were mindful of the main findings in the 2010 UK National Audit Office’s (NAO) report on the Environment Agency’s efforts to tackle diffuse water pollution in England. The NAO focussed on three key issues, one of which was; Raising Awareness, for which they reported: “Despite the Agency’s efforts to persuade the farming sector to recognise their responsibilities for diffuse water pollution, the sector’s awareness of the problem remains low”.


Natural Resources Wales’ (NRW) agriculture leads had internal discussion on increasing the awareness and improving the adoption of best practices within the agricultural sector and then raised the matter with numerous external partners at the 2014 Royal Welsh Show. There was a consensus view that NRW should try and increase awareness via the various agricultural courses within further and higher education in Wales. There has already been a significant amount of related effort over many years, particularly by the legacy body Environment Agency Wales, thus we wanted to pilot different approaches to raising awareness of pollution risks in everyday farming practices with the aim of getting the subject embedded into course curriculums.

A pilot lecture highlighting the costs to the farm business of failing to separate clean and dirty water and managing soils correctly was successfully trialled to higher education students at Aberystwyth University in December 2014. Rob Thomas, an Adviser on Diffuse Water Pollution within NRW’s head office team; Evidence, Knowledge & Advice, subsequently worked with staff from Grwp Llandrillo Menai (https://www.gllm.ac.uk/about/) to take the messages to further education level students in North Wales.

The £20M Learning Village opened in 2012 at the Glynllifon Estate, ~5 miles west of Caernarfon, Gwynedd. It focusses on various aspects of farming and countryside management.

Preliminary work involved compiling a questionnaire that covered various risks from common farming practices. Some 120 students and staff at the Glynllifon College gave responses that helped to highlight what the existing awareness of impacts and risks was. The results were used to build a lecture with the presentation material focussed on areas of low awareness, of which,
understanding the impact of soil erosion and general contaminated water accumulating on farmyards, feeding areas and tracks were key. The lecture material contained diverse information on: clean water as a natural resource and its importance to good human health and the wellbeing of farm livestock; conversely, the adverse effect on both the environment and the farm business of not keeping clean rainwater away from farm wastes, which, on average in Wales, can lead to a loss of some 30% of the slurry storage capacity over the winter months; saving mains water costs by storing and utilising roof water: preventing environmental impacts and saving costs by storing and using agricultural fuels, oils and artificial fertiliser in a careful and planned manner.

Advice from the college programme manager was to limit the lecture to one hour and KISS # (!) The lecture was duly given to a succession of three groups of students studying agricultural machinery, livestock and land management and general environmental management studies. The lecture was intended as a pilot and the majority of the messages were conveyed through a number of pictorial examples of good and poor practices and this was particularly well received by students and tutors. With some further fine tuning, the intention now is to work closely with NRW’s Education Dept. with an aim of being able to offer a consistent lecture on the causes and sources of agricultural pollution to colleges across Wales on a regular basis.
Finding multi beneficial solutions to restore a SSSI River in Yorkshire.

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Catchment Sensitive Farming in the Eden

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The Good, the Bad, and the Ugly – Experiences of Working with Farmers & Landowners to Improve the Water Environment

Phil Lyth
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Phil has been advising Yorkshire farmers for the past 30 years, having formerly worked in the land drainage industry. He joined FWAG (Farming and Wildlife Advisory Group) in Yorkshire in 1986, and after 25 years, he and his colleagues formed Yorkshire Farming and Wildlife Partnership to carry on the work formerly undertaken by FWAG in the County.

The presentation will build on this experience of working with farmers, and on a range of water-related Projects from Whole Farm Conservation Plans and Moorland Grip Blocking, to Catchment-based initiatives throughout Yorkshire, most recently on the Upper Aire Habitat and Land Management Improvement Project since 2011.

The issues of sediment, diffuse pollution, riparian habitat and natural flood management are all intimately linked. For example, a lack of good riparian habitat generally increases the risk of sedimentation through erosion and close connection with runoff from farmland, and this in turn increases the likelihood of diffuse pollution and phosphate enrichment of surface waters. Buffer strips, riparian and wider catchment woodland can all help to attenuate runoff and reduce flood peaks.
Slides will illustrate good and bad practices, and give examples of where improvements have been made by combining advice with persuasion and incentive! These include fencing and the creation of buffer strips, alternative stock drinking, improved nutrient management, improved soil and land management, and woodland creation.

As the vast majority of land is farmed, to achieve any change in land management or land use, effective engagement with farmers and landowners is fundamental. What does this involve?

Start by putting yourself in the place of the farmer who needs to make a living from the land they farm (and farming returns at the moment are not good). What are the things which will persuade or discourage you from making changes over and above the fact that it is “good for the environment”? The financial element is obviously crucial - How much will it cost, and is there any grant help? But there are other important considerations too. Will long-term income be affected, particularly through the Basic Payment Scheme? Are there practical advantages (or disadvantages) to take into consideration, and could there even be opportunities to save money? The phrase “Doing well whilst doing good” perhaps captures this concept most concisely (Thanks to one of my clients for saying this to me years ago!).

Excluding livestock from watercourses and awkward areas has health benefits and can make stock management easier (don’t underestimate the value of the latter on a wet, windy, cold day in January!). Preventing bank erosion is also protecting the farmer’s basic resource – the soil. Improved utilisation of the nutrients in manures and fertilisers by better nutrient planning can save significant sums of money. Better soil and land management improves the length of stocking period on livestock farms, and the period of soil workability and therefore growing season on arable farms, and well as reducing runoff. Buffer strips can help to meet requirements for Greening & Ecological Focus Areas under the Basic Payment Scheme. Most of these things are not rocket-science, but effective informed advice and support is needed to achieve change and make sustainable improvements.

Research in the Netherlands (van der Meulen et al 1996) has suggested that “confidence in the contact person” is the most important aspect of influencing farmers in adopting “conservation” behaviour. Good advice from a good adviser is most important; irrespective of who they work for. In my view, a good adviser understands how farming works and speaks the same language as the farmer; listens more than they talk; deals with as much of the paperwork and “hassle factor” as possible; and puts themselves in the place of the farmer when considering the pros and cons. It also helps enormously of course to be able to offer some assistance (practical or financial) with the works under discussion, either from your own project or by levering in funds from other sources, and helping to organise the work on the ground too.

There are some big challenges ahead, particularly as regards integrating Natural Flood Management measures into our improvements to the water environment on farms. Rules, regulations and incentives are becoming increasingly labyrinthine, and this demands ever-better advice. Let’s do our best to deliver this and keep focused on what we’re aiming to achieve – A Better Water Environment.