DAY 1: - - - Wednesday 6th September - - -

08:30 **REGISTRATION & NETWORKING**

Session 1: Plenary room

Lecture Theatre 1 (LT1)

Chaired by Marc Naura, *RRC*

10:00 **Welcome announcements**
Prof. Doug Mair, Dean of School of Environmental Sciences, University of Liverpool & Marc Naura, RRC

10:15

KEYNOTE ADDRESS:
Prof. Phil Boon
Freshwater Biological Association
River restoration: are we there yet?

11:00 Connectivity as a framework for analysis of strategies and effects of restoration in fluvial systems
J. Hooke, University of Liverpool

11:20 Applying DPSIR as a framework for an integrated catchment-scale management: the Tzipori stream (Israel) as a model
Y. Hershkovitz, Steinhardt Museum of Natural History, Tel Aviv University, Israel

11:40 Resilience, recovery, and biodiversity of vertebrates and invertebrates following process-based floodplain restoration to a Stage 0 condition at multiple sites in Oregon, USA
R. Flitcroft, USDA Forest Service, PNW Research Station

12:00 LUNCH - FIRST FLOOR SOCIAL SPACE AND FLEX 2

Session 2: Parallel rooms

	Geomorphology **Lecture Theatre 1 (LT1)** Chaired by Hannah Joyce, *Atkins*	**Ecology** **Lecture Theatre 2 (LT2)** Chaired by Jennifer Dodd, *Edinburgh Napier University*
13:15	**A nine-year hydromorphological case study of a channel reconnection project. The Logie Burn, north-east Scotland** S. Addy, The James Hutton Institute	**Building the evidence-base for restoring river connectivity in New Zealand** P. A. Franklin, National Institute of Water & Atmospheric Research, New Zealand
13:35	**2D Sediment Modelling to Simulate Short Term Geomorphic Change for River Restoration** Z. Abid-Waheed, N. Entwistle, University of Salford.	**Characterising the terrestrial-aquatic biodiversity of winterbourne streams and springs to inform the design winterbourne restoration schemes** R. I. Collier, Nottingham Trent University
13:55	**The sedimentology of gravel beds in groundwater-dominated chalk streams: implications for the development of sediment modelling and management** B. Mondon, University of Southampton	**Macroinvertebrates and their response to restoration processes in Comana Marsh, Romania** C. Stoica, University of Bucharest, National R&D Institute for Industrial Ecology-ECOIND, Romania

14:15 ROOM MOVE (15 mins)

Session 3: Parallel rooms

	Social Partnerships **Lecture Theatre 1 (LT1)** Chaired by Sam Austin, *RRC*	Large Wood **Lecture Theatre 2 (LT2)** Chaired by Martin Wilkes, *University of Essex*	Decision Support Tools **Lecture Theatre 3 (LT3)** Chaired by James White, *University of Birmingham*
14:30	**Forming effective partnerships across multiple disciplines to advance river restoration and salmon recovery** H. Turnbull, Jamestown S'Klallam Tribe	**Assessment of channel changes after riprap removal and log placement on Redwood Creek, California** M.N.Papa, University of Salerno	**A database about river bioengineering techniques in France: building online map and first learnings** D. Jaymond, LESSEM, INRAE Grenoble
14:50	**Strategy for the restoration of the lower Elbe reach in the territory of the Czech Republic based on an interdisciplinary approach** J. Hradecký, University of Ostrava	**Reconstruction of a former anastomosing wet woodland at Avon Water, New Forest using UAV-derived Structure-from-Motion Photogrammetry** E. Fleming, Mott Macdonald	**Identifying corridors of river recovery in coastal NSW Australia, for use in river management decision support and prioritisation systems** D.Agnew, Macquarie University
15:10	**Homeless in one's own home: A conservation dilemma for gharial** G. Vashistha, University of Delhi	**Influence of bed roughness on backwater rise and flow redistribution for engineered logjams with a lower gap** E. Follett, University of Liverpool	**CatchmentLIFE: A decision support system for assessing pressures and impacts on species habitats** M. Naura, UK River Restoration Centre

15:30 COFFEE BREAK - FIRST FLOOR SOCIAL SPACE AND FLEX 2 (30 mins)

Session 4: Parallel room

Natural Flood Management

Lecture Theatre 1 (LT1)

Chaired by Alexandra Bryden, *RRC*

16:00 **Quantifying the hydrological implications of pre- and post-installation willowed engineered log jams in the Pennine Uplands, NW England**
N. Macdonald, University of Liverpool

16:20 **Understanding the geomorphic impacts of different leaky woody dam designs**
C. Carter, University of Hull

16:40 **Cascading structural interventions and consequences on a wandering gravel bed river: hydraulic modelling to assess restoration options**
P. Tolentino, University of Glasgow

Planning for river restoration

Lecture Theatre 2 (LT2)

Chaired by Jane Prady, *RRC*

16:00 **A catchment-based approach towards river restoration planning**
J. Robins, UK River Restoration Centre

16:20 **Process based restoration of agriculture streams in Israel: Facing the reality, Nahalal stream case study**
R. Egozi, Soil Erosion Research Station

16:40 **The implications of natural fluvial disturbance and dynamics for design of restoration on modified rivers in Central Japan**
H. Shimazu, Rissho University

17:00 ROOM MOVE

Session 5: Plenary room

Lecture Theatre 1 (LT1)
Chaired by James White, *University of Birmingham*

17:15 **The actors of river restoration in Romania: a network perspective**
G. Ioana-Toroimac, University of Bucharest

17:35 **Sediment flux changes linked to naturalisation: Implications for downstream flood risk**
N. Entwistle, University of Salford

17:55 **Beyond 'reference': making the case for new indicators of quality for river restoration and management**
R. Grabowski, Cranfield University

Poster session

FLEX Room 2

18:15 **Poster display session with drinks and nibbles**

19:30 END OF DAY 1

DAY 2: - - - Thursday 7th September - - -

08:00 **REGISTRATION & NETWORKING**

Session 6: Plenary room

Lecture Theatre 1 (LT1)
Chaired by Marc Naura, *RRC*

09:00

KEYNOTE ADDRESS:
Prof. Kirstie Fryirs,
School of Natural Sciences, Macquarie University
"BACK TO THE FUTURE": WORKING WITH GEOMORPHIC, VEGETATIVE AND HYDROLOGICAL RECOVERY IN NATURE-BASED RIVER MANAGEMENT

09:45 **Decade-scale sediment budgets and geomorphic unit evolution of six upland gravel-bed river restoration schemes**
H. Reid, SEPA

10:05 **Holocene lessons for Anthropocene rivers**
I. Persoiu, Stefan cel Mare University

10:25 **Analyzing the interaction between river restoration and urban regeneration: Evidence from international comparative research on old industrial regions**
L. Imbres, TU Dortmund University

10:45 COFFEE BREAK - FIRST FLOOR SOCIAL SPACE AND FLEX 2 (30 mins)

Session 7: Parallel rooms

	Condition assessment **Lecture Theatre 1 (LT1)** Chaired by Martin Janes, *RRC*	Climate change **Lecture Theatre 2 (LT2)** Chaired by Leonard Sandin, *NINA*	Restoration benefits **Lecture Theatre 3 (LT3)** Chaired by Jane Prady, *RRC*
11:15	**Building multi-scale understanding of river physical habitats and function to support identification of river improvement opportunities** L. Shuker, Cartographer Studios, Queen Mary University of London	**River restoration fully reconnecting streams to their floodplains changes wildfire behaviour to creates burn mosaics, increases habitat diversity and build resilience to climate change** L. MgBanyi, University of Nottingham	**Rewilding catchments: how does working with nature impact hydro-ecological processes?** S. Clarke, The National Trust
11:35	**Beyond river condition assessment: analysis of habitat survey and geomorphic river type data to provide geomorphological understanding and support river restoration design** H. Moggridge, A. Gurnell, Queen Mary University of London, Cartographer	**Impacts of Floodplain Restoration on Water Temperature and Macroinvertebrates in Whychus Creek, Oregon** W.N. Noone, Portland State University	**Process-based River restoration: Hydromorphological and ecological responses over two years of field experiment** T.H. Furley, APLYSIA Assessoria e Consultoria Ltda.
11:55		**Restoration to increase ecological resilience to climate change in groundwater-dominated streams** J. England, Environment Agency	**Defining flood risk benefits of nature-based solutions: what you need to know** D.J. Brown, Environment Agency
12:15	LUNCH- FIRST FLOOR SOCIAL SPACE AND FLEX 2		

Session 8: Parallel rooms

	Ecology **Lecture Theatre 1 (LT1)** Chaired by Judy England, *Environment Agency*	Lessons learned **Lecture Theatre 2 (LT2)** Chaired by Josh Robins, *RRC*	Building resilience **Lecture Theatre 3 (LT3)** Chaired by Imogen Speck, *RRC*
13:30	**Using bio-diagnostic tools to unravel multiple human pressures and guide river restoration strategies** J. White, University of Birmingham	**Ecosystem services: the role of the scales** Z. Poledniková, University of Ostrava, Faculty of Science	**Water attenuation and carbon storage: 2(+) for 1 benefits of a designed, low-order water corridors** J. Cockburn, University of Guelph
13:50	**Swim or die? Impact of heavy-duty vehicles on fish communities** V. Skarpich, University of Ostrava	**Challenges of creating nature in constrained urban environments: Key principles learned from 3 river restoration schemes in Glasgow** H.E. Reid, Scottish Environment Protection Agency	**Short- and long-term effects of a summer flood on the physicochemical parameters in a newly restored river** M. Hons, University of Antwerp
14:10	**Searching for the wiggle signal – using reference condition predictions to inform river restoration expectations** J. Dodd, Centre for Conservation and Restoration Science, Edinburgh Napier University	**We cannot turn back time: A framework for restoring and repairing rivers in the Anthropocene** R.H. Greene, University of New England	**Developing an innovative soil health index to support multiple environmental outcomes** H. L. Stott, Wyre Rivers Trust

14:30	ROOM MOVE (15 mins)

Session 9: Parallel rooms

	Modelling Tools **Lecture Theatre 1 (LT1)** Chaired by Angela Gurnell, *Queen Mary University of London*	Monitoring **Lecture Theatre 2 (LT2)** Chaired by Mark Everard, *University of the West of England*	Policy **Lecture Theatre 3 (LT3)** Chaired by Erik Ansink, *Vrije Universiteit Amsterdam*
14:45	**Geomorphological renaturalisation: Modelling flooding areas and hydrological regime connection in the Jarama River, Madrid, Spain** M. Diaz-Redondo, Centre for Studies and Experimentation on Public Works (CEDEX)	**Ten years later: medium-term effects of river restoration on riparian vegetation** J.H.T. Hoppenreijs, Karlstad University	**Research and monitoring priorities for meeting UK government biodiversity targets** J. Collins, WSP
15:05	**A novel modelling based approach to predicting ecological response to system naturalisation** R. Williamson, N. Entwistle, Dynamic Rivers.	**Assessing channel re-meandering on geomorphic diversity and flood risk reduction: Eddleston Water restoration, Scotland** I.C. Costaz, University of Dundee	**A leverage points framework to manage changes in river health** J. Picken, Arup
15:25	**Discussion: Models - their use and application to river restoration**	**Tools to assess the health status of restored braided hydrosystems** B. Belletti, Université de Lyon, CNRS, EVS	**Discussion: Global perspectives on river restoration policy**

15:45 COFFEE BREAK - FIRST FLOOR SOCIAL SPACE AND FLEX 2 (30 mins)

Session 10: Plenary room

Chaired by Phil Boon, *FBA*

16:15 **Understanding biodiversity recovery potential for river restoration planning and design**
M. Wilkes, University of Essex

16:35 **Using national-scale datasets of river modification, energy and riparian condition to plan river restoration in Scotland**
R. Martinez, Scottish Environment Protection Agency

16:55 **Evaluating the ecosystem services management style of a national-level river policy by content analysis: Using China's "River Chief" Policy as a case study**
X. Xue, Hubei Minzu University

17.15 END OF DAY 2

Networking Event

19:00 **Optional Evening Network Event at Anfield Stadium (pre-booked)**

DAY 3: **- - - Friday 8th September - - -**

08:30 **REGISTRATION & NETWORKING**

Session 11: Plenary room

Lecture Theatre 1 (LT1)
Chaired by Martin Janes, *RRC*

09:00

KEYNOTE ADDRESS:
Prof. Ellen Wohl
University of Colorado
A North American Perspective on Key Scientific Advances and Challenges for River Restoration

09:45 **Applying resilience-thinking for holistic riverine landscape restoration**
I. Fuller, Massey University

10:05 **Fascines for riverbank stabilization on meanders: lessons learned from field observation and small-scale modelling**
S. Leblois, INRAE - SUEZ Consulting

10:25 **Incorporating Hydro-Thermal Regimes into Environmental Flows Assessments and River Management**
R. Ó'Briain, Inland Fisheries Ireland

10:45 COFFEE BREAK - FIRST FLOOR SOCIAL SPACE AND FLEX 2 (30 mins)

Session 12: Plenary room

Lecture Theatre 1 (LT1)

Chaired by Janet Hooke, *University of Liverpool*

11:15 **RiverReST: a decision support tool for screening 'the right river restoration measure in the right place'**

P.W. Downs, cbec eco-engineering

11:35 **Evaluating the restoration of physical habitat and their influence on macroinvertebrate community structure in 18 lowland Danish streams**

M. Lauge-Fejerskov, NIRAS

11.55 **Expertise and funding as major drivers of river restoration objectives and their diversity**

É. Gariépy-Girouard, Université du Québec à Rimouski

Session 13: Plenary room

Lecture Theatre 1 (LT1)

Chaired by Marc Naura, *RRC*

12:15 **River restoration science and practice; where do we go from here?**

A debate with our panel of experts on the current state of river restoration science and practice, future developments, potential contribution to current environmental issues, and policy implications.

Submit your questions using this QR code.

SCAN ME

13:10 **RRC wrap up**

13:15 LUNCH - FIRST FLOOR LOBBY AND FLEX 2

END OF DAY 3

Abstracts

- - - Wednesday 6th September - - -

Session 1 – Plenary room

LECTURE THEATRE 1
10:15

KEYNOTE ADDRESS: Professor Phil Boon[1]

1 Freshwater Biological Association

River restoration: are we there yet?

This presentation will discuss some of the advances in river restoration since a conference organized in Denmark by the European Centre for River Restoration. My presentation at River Restoration '96 was arranged under five headings, described as 'dimensions' of river restoration: conceptual, spatial, temporal, technological and presentational. The same framework will be adopted here, with examples of key changes including:

- the greater significance of statutes and conventions in providing an incentive for restoration;
- an appreciation of the need to set reach-scale restoration within a catchment context;
- understanding the critical role of geomorphology in river restoration;
- recognizing the importance of restoring lateral and longitudinal connectivity;
- placing more emphasis on restoring physical processes, not merely restoring physical features;
- using historical data when planning river restoration projects;
- an acceptance that natural recovery and 'making space for nature' (where possible) is likely to be more sustainable than direct intervention;
- advances in technology that enable rivers to be surveyed, mapped and monitored remotely;
- applying 'citizen science' to river restoration.

These and other examples of significant change will be discussed within the context of a new European guidance standard on river restoration strategy that is under development. However, despite improvements in the approach to river restoration, many challenges remain if progress is to be maintained: for example, the need to take long-term monitoring seriously to demonstrate the ecological effectiveness of river restoration; the need to recognize that rivers are spatially three-dimensional by considering vertical connectivity in restoration projects; the need to show the wider public that river restoration can bring about improvements to their quality of life (i.e. by providing 'ecosystem services'), while also recognizing the inherent values of rivers and the 'rights' rivers have to flow unhindered and undamaged. This means promoting river restoration as an activity that needs input from a wide range of disciplines, as well as developing closer links between science, policy and practice. Perhaps above all there needs to be a balance between river conservation and river restoration. Indeed, 'river conservation' includes protecting the best and restoring the worst. If applied, this model would enable comprehensive assessments of river environments – locally, regionally and nationally – and allow a way of determining how to allocate limited resources to river protection, river management and river restoration.

Session 1 – Plenary room

LECTURE THEATRE 1
11:00

CONNECTIVITY AS A FRAMEWORK FOR ANALYSIS OF STRATEGIES AND EFFECTS OF RESTORATION IN FLUVIAL SYSTEMS

J. HOOKE[1]

1 University of Liverpool

Connectivity has become a major, and still developing. paradigm in analysing water and sediment sources and fluxes in catchments, with its focus on the actual pathways of delivery of water and sediment down hillslopes, and within river channels and floodplains. It has much potential for application in design and management of impacts of river restoration but application presents challenges in identification of connectivity status at various scales from catchments to river systems and reaches, Approaches to field identification and quantification are briefly evaluated. Research has revealed that sediment sources may be more localised than formerly considered and that sediment storage of can have feedback effects on outcomes of restoration, exemplified in a range of settings including degraded hillslope restoration, implementation of Natural Flood Management, meandering rivers, and urban channels. Vegetation plays a crucial role in restoration and ongoing research into effectiveness and suitability of different plants is illustrated. In the design of any restoration scheme connectivity goals need to be set and the implications both longitudinally and laterally analysed and modelled. Increase or decrease in connectivity may be desirable in different schemes in relation to hydromorphology, ecology and functioning of a river system and strategies for reconciliation of conflicting goals may need to be assessed. Lack of consideration of connectivity relations may mean restoration schemes have unexpected consequences. Use of a connectivity framework is shown to enhance spatial targeting of restoration actions and to facilitate analysis of the outcomes over various timescales.

LECTURE THEATRE 1
11:20

APPLYING DPSIR AS A FRAMEWORK FOR AN INTEGRATED CATCHMENT-SCALE MANAGEMENT: THE TZIPORI STREAM (ISRAEL) AS A MODEL

Y. HERSHKOVITZ [1], A. KATZ[1], A. COHEN[2], E. ELRON[4], D. KAPLAN[4], O. MOSHE[3],

1 Steinhardt Museum of Natural History, Tel Aviv University, 2 Israel Nature and Parks Authority, 3 Soil Erosion Research Station, Ministry of Agriculture, 4 Private ecological consultant

The Tzipori is a small intermittent stream situated in the Lower Galilee region of Israel. It drains ca. 300 km2 from the foothills of Nazareth to the Bay of Haifa. The region is characterized by a mosaic of intensive agricultural land, alongside small privately owned farmlands. It is also a home to a variety of cultures and religions, residing in rural and semi-urban settlements.

The Tzipori restoration plan is the first in Israel to apply an integrated management approach on a catchment scale, while using the DPSIR framework. The project was officially initiated in 2021. The first year focused on capacity building, data collection, mapping key stakeholders and local partnerships and setting restoration and management goals. A multidisciplinary survey was conducted to identify the main pressures affecting the ecological state of the stream: pollution sources, water quality and quantity, geomorphology, macroinvertebrates, plants, fish and amphibians.

The assessment shows that the Tzipori catchment is affected by water pollution from various sources (point and diffused), unauthorized water abstraction, in-channel cattle grazing, damming and an extensive agricultural land use. These resulted in a modified ecological state: low water quality and dwindled flows, degraded morphological condition, “poor” macroinvertebrate community and low diversity of typical plants and fish. In addition, non-native species of plants, fish and invertebrates, are prevalent in the catchment. Using this information, a restoration roadmap was developed to address these key stressors. The implementation phase is expected to take 5-10 years, coupled with a long-term monitoring scheme to assess the restoration progress.

Session 1 – Plenary room

LECTURE THEATRE 1
11:40

RESILIENCE, RECOVERY, AND BIODIVERSITY OF VERTEBRATES AND INVERTEBRATES FOLLOWING PROCESS-BASED FLOODPLAIN RESTORATION TO A STAGE 0 CONDITION AT MULTIPLE SITES IN OREGON, USA

R. FLITCROFT[1], S. CLAESON[1], K. MEYER[2]

1 USDA Forest Service, PNW Research Station, 2 USDA Forest Service, Willamette National Forest

Floodplain restoration that is bold in design and implementation is hypothesized to confer resilience to local ecosystems, enhance aquatic habitat diversity and quantity, and build the capacity of streams to respond to broad-scale disturbances such as climate change or wildfire. Monitoring and development of empirically driven understanding of the short-term effects of intensive floodplain reconnection projects such as those typically referred to as “Stage 0” are necessary to provide timely and informed information for nimble implementation design and modifications. Here, we present results of several monitoring and research-based efforts designed to quantify the effect of floodplain restoration in both dry, high-elevation landscapes, as well as moist-forest environments. Immediately post-restoration, aquatic macroinvertebrate and invertebrate community composition is characterized by a decline in biodiversity and abundance, but rebounds and exceeds pre-restoration metrics within two years. These early results indicate consistency in the biological response of invertebrates in alignment with in-stream disturbance processes such as landslides or earthflows. Thus, we observed a transition from larger bodied aquatic macroinvertebrates to smaller bodied high voltine species. This change in community composition was coupled with extensive expansion of the wetted floodplain environment, increasing aquatic invertebrate biomass across the whole site (although biomass per m2 declined). Additional monitoring over time is necessary to track the long-term trajectory of biotic response across different sites that can represent the spectrum of floodplains and river systems where restoration to Stage 0 has been implemented.

Session 2 - Parallel rooms

Geomorphology
LECTURE THEATRE 1
13:15

A NINE-YEAR HYDROMORPHOLOGICAL CASE STUDY OF A CHANNEL RECONNECTION PROJECT. THE LOGIE BURN, NORTH-EAST SCOTLAND.

S. ADDY[1]

1 The James Hutton Institute

Long term (≥10 years) assessments of river restoration projects remain rare but are needed to provide a robust evaluation of success. Moreover studies of low energy, sand-bedded restoration projects remain rare in contrast to higher energy gravel bed rivers. In such environments morphological degradation is often high due to channel straightening, dredging and fine sediment input (< 2 mm particle diameter). Questions remain over the nature of physical habitat changes (e.g. distribution of geomorphic units and changes in sediment texture) and whether or not there is an improvement. A 240 m long reach of the Logie Burn (catchment area: 25 km sq) in north-east Scotland was restored in 2011 through the reconnection of its meanders resulting in the formation of two backwaters. A monitoring project measured geomorphic, nutrient storage and sedimentary changes over time to evaluate the success of the project. Nine years after restoration, the reach appears to be still adjusting morphologically to the prevailing sediment supply and flow regimes as well as inputs of large wood. In common with other case studies of higher energy streams, diversity of in-channel geomorphic units improved over time and thalweg sinuosity increased indicating greater geomorphic complexity. However, sediment texture and total phosphorous (TP) within the active riverbed area appear to have largely stabilised to levels observed prior to restoration suggesting complete adjustment of these aspects to the flow and sediment supply regimes. In contrast the backwaters functioned as sinks where net fining and increased TP levels occurred.

Geomorphology
LECTURE THEATRE 1
13:35

2D SEDIMENT MODELLING TO SIMULATE SHORT TERM GEOMORPHIC CHANGE FOR RIVER RESTORATION

Z. ABID-WAHEED[1], G. HERITAGE[2], N. ENTWISTLE[1]

1 University of Salford, 2 Dynamic Rivers

2D modelling has become incredibly useful for river restoration and is used as a metric of estimating changes to flood extents as a result of modification. However, despite the developments in modelling, a gap remains in the usage and accuracy of sediment modelling to identify an important metric of river restoration: geomorphic change. Therefore, this paper investigates the accuracy of high-resolution sediment modelling to identify geomorphic change on Blaze Beck in Cumbria, a high energy wandering river system that has recently been restored. Comparisons have been made between the impacts of a simulated flood event created using HEC-RAS 6.2 modelling software and a real-life flood event on October the 27th 2021, to compare changes to geomorphology and identify the degree of accuracy of the 2D change modelling compared to change measured using drone-based photogrammetry. The results appear generally accurate, predicting locations of head cutting and more general low-level erosion and deposition. Bar formation, splay deposition and general bed raising are all predicted. The model is, however, sensitive to the gradation of sediment it has been trained with and unsensitive to vegetation induced stability and this can skew the ratio and pattern of deposition and erosion depending on the sample data used to simulate conditions. The model, once refined and iterated to best simulate potential change, is functional even in a high energy hydraulically diverse environment and will have significant value in predicting the degree to which geomorphic change will occur because of restorative or other changes to a river reach.

Session 2 – Parallel rooms

Geomorphology
LECTURE THEATRE 1
13:55

THE SEDIMENTOLOGY OF GRAVEL BEDS IN GROUNDWATER-DOMINATED CHALK STREAMS: IMPLICATIONS FOR THE DEVELOPMENT OF SEDIMENT MODELLING AND MANAGEMENT

B. MONDON[1], D. A. SEAR[1], A. L. COLLINS[2], P. J. SHAW[1]

1 University of Southampton, 2 Rothamsted Research

Excessive fine sediment in chalk stream gravel beds is well known to cause detrimental ecological impacts. Determination of management targets for chalk streams requires further knowledge surrounding the size of the pollution gap that needs to be closed. Analysis of 195 freeze-cores, encompassing 90 sites across 11 UK chalk streams, demonstrated that > 75% of their gravel beds have fine sediment quantities known to cause significant ecological degradation. Identification of regional differences in sedimentary characteristics, highlighted that both stream power and sediment sources play fundamental roles in influencing fine sediment quantities and composition. Results also indicate that experiments used to determine metrics describing interactions of fine sediment and immobile gravel beds, are not representative of the natural conditions in chalk streams. Subsequently, the use of such models as a basis to explore sediment management in chalk streams is questionable. As the surface 10 cm of chalk stream gravel beds are known to be the most ecologically sensitive to elevated fine sediment accumulation; management needs to focus on this layer. Reach-scale restoration and management, including the introduction of woody debris, management of instream macrophytes, channel narrowing and removal of weirs, could create a patchy stream power environment. To establish the required extent of such management to mobilise fine sediment from the surface layer of gravel beds, a flume study representative of the natural sedimentary characteristics of chalk streams was carried out. Results from these avenues of research will give a robust scientific basis for improving chalk stream fine sediment management.

Session 2 – Parallel rooms

Ecology
LECTURE THEATRE 2
13:15

BUILDING THE EVIDENCE-BASE FOR RESTORING RIVER CONNECTIVITY IN NEW ZEALAND

P. A. FRANKLIN[1],

1 National Institute of Water & Atmospheric Research, New Zealand

Many of New Zealand's iconic native fishes migrate between marine and freshwater habitats during their life cycle. This makes them highly susceptible to the impacts of river fragmentation. The National Policy Statement for Freshwater Management 2020 (NPS-FM 2020) sets out ambitious objectives to restore river connectivity by remediating instream structures to improve fish passage in New Zealand.

Evidence-based practice requires conscientious and judicious use of current best evidence to guide decision-making and practice. In New Zealand, the national Fish Passage Guidelines provide an unbiased and objective summary of the best available information to support restoration of river connectivity. Despite this, some of the most commonly deployed fish passage remediation methods continue to have no evidence-base to support their use, and in some cases directly contradict national guidance on suitable solutions. The ongoing deployment of these solutions in the absence of this evidence-base presents a significant risk to the achievement of the intended outcomes of the NPS-FM 2020.

There is an urgent need for independent, defensible, reproducible monitoring and expert evaluation of these and other novel solutions to counter misinformation and establish a credible and legitimate evidence-base to inform practice.

Ecology
LECTURE THEATRE 2
13:35

CHARACTERISING THE TERRESTRIAL-AQUATIC BIODIVERSITY OF WINTERBOURNE STREAMS AND SPRINGS TO INFORM THE DESIGN WINTERBOURNE RESTORATION SCHEMES

R. I. COLLIER[1], R. STUBBINGTON[1], T. SYKES[2]

1 Nottingham Trent University, 2 Environment Agency

England's 'winterbourne' streams and springs naturally transition between wet and dry conditions, creating high habitat diversity and thus supporting high biodiversity. Some winterbourne headwater springs and streams are relatively untouched by human activity—but most have been altered by anthropogenic influences including abstraction, pollution and physical habitat modification, threatening their natural form and function and their biodiverse communities. As a result, tailored restoration actions are needed to improve the ecological health of winterbournes. A core aim of our research is to assess the biological and physical diversity of headwater winterbourne streams and springs. We will determine how environmental characteristics influence their individual and collective biodiversity, and we will identify the physical habitat features that support high biodiversity and Nationally Rare winterbourne specialist insects. A second aim is to evaluate how restoration alters the physical habitat diversity and biodiversity of winterbourne streams, using a before-after-control-impact (BACI) approach. Specifically, we will compare the effects of specific restoration measures on the aquatic and terrestrial communities which inhabit winterbournes during their wet and dry phases, respectively. This presentation will report results from our first field campaign, which will document instream conditions in winterbourne streams prior to restoration, as a baseline against which future change can be measured. 'MoRPh' (Modular River Physical) surveys will be used to assess physical habitats, and aquatic and terrestrial communities including invertebrates will be sampled during wet and dry phases, respectively. Our ultimate goal is to inform the design of restoration schemes that enhance biodiversity within winterbourne stream and springs.

Session 2 – Parallel rooms

Ecology
LECTURE THEATRE 2
13:55

MACROINVERTEBRATES AND THEIR RESPONSE TO RESTORATION PROCESSES IN COMANA MARSH, ROMANIA

C. STOICA[1,2], I-A ŞANDOR[1], G-A MOROŞANU[1,3], D-M CONSTANTIN[1], M. NIŢÃ-LAZÃR[2], G. IOANA-TOROIMAC[1]

1 University of Bucharest, 2 National R&D Institute for Industrial Ecology-ECOIND, Romania, 3 Romanian Academy, Institute of Geography, Bucharest, Romania

Previous studies reported limited effect of restoration on macroinvertebrates, but some positive relationships were found between macroinvertebrate responses and microhabitats diversity and patchiness. In this context, the aim of our study was to conduct post-restoration monitoring on macroinvertebrates and to analyse their relation with other environmental variables in selected points across the restored site of a small-size marsh in the south of Romania.

The Comana Marsh (approx. 1200 ha) is located on a second order tributary of the Danube River. A small-size dam and a system of concrete dykes was built on Neajlov River (approx. 8 m3 /s, high-flow in March and low-flow in August) to recreate an upstream marsh, in the floodplain. The Comana Marsh was formed by a network of small natural connecting anabranching channels, higher ridges, and an open-water surface just upstream the dam.

Although more than 140 species of invertebrates were reported so far, the response of aquatic macroinvertebrates by quantitative and qualitative analysis was examined in Comana Marsh after the restoration processes. Physical and chemical environment variables (e.g. water depth, turbidity, oxygen regime, acidification level, nutrients) alongside macroinvertebrates community structure and composition were characterized. Our findings showed a strong response and a positive correlation between the aquatic macroinvertebrates diversity riparian marsh vegetation and hydrological regime, indicating an ongoing efficient restoration process.

Session 3 – Parallel rooms

Social partnerships
LECTURE THEATRE 1
14:30

FORMING EFFECTIVE PARTNERSHIPS ACROSS MULTIPLE DISCIPLINES TO ADVANCE RIVER RESTORATION AND SALMON RECOVERY

H. TURNBULL[1]

1 Jamestown S'Klallam Tribe

Given that river restoration projects are complicated on so many levels, shepherding a project from inception to outcome depends a great deal on working across scientific disciplines to communicate a projects worth to landowners, community members, funders and investors. At the heart of this is the ability to forge relationships across multiple scientific, social, and organizational levels. In 2022, the Jamestown S'Klallam Tribe completed four transformational restoration projects in the Dungeness River, a catchment on the north Olympic Peninsula of Washington State, USA. This achievement is the culmination of the Tribe's determination to restore treaty protected resources in their home watershed. How they accomplish this is the story of finding creative mechanisms to achieve successful large-scale nature restoration.

Social partnerships
LECTURE THEATRE 1
14:50

STRATEGY FOR THE RESTORATION OF THE LOWER ELBE REACH IN THE TERRITORY OF THE CZECH REPUBLIC BASED ON AN INTERDISCIPLINARY APPROACH

J. HRADECKÝ[1], V. ŠKARPICH[1], T. GALIA[1], J. ČUDA[2], J. KREJČÍ[3]

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The lower reach of the Elbe River in the Czech Republic is a naturalistically highly valuable area. Centuries-long use of the river by humans has led, especially in the last 150 years, to a significant transformation of the river course and its connection to the surrounding floodplain. The Elbe River valley represents a significant traffic route, however at the same time the river reach is threatened by planned navigation structures in the Děčín profile. The aim of our project was to determine the hydromorphological status (Ústí nad Labem – the CZ/DE state border), to create the concept of an interdisciplinary study to understand the development and functioning of valuable biotopes within Natura 2000 and to determine the main threats to their sustainable persistence based on climatological, hydrological, fluvial geomorphological and botanical analyses. The most valuable biotopes are created on fluvial accumulations (classified by Natura 2000 as habitat type "Rivers with muddy banks with Chenopodion rubri p. p. and Bidention p. p. vegetation"). Their threat is determined by the modification of the riverbed, banks and the management of the waterway. One of the species that are closely associated to this habitat is critically endangered plant Corrigiola litoralis. It is threatened by limited channel dynamics linked with inappropriate waterway management and its occurrence in the Czech Republic is restricted only to this area. As part of the solution, we proposed a suitable set of restoration strategies that also strengthen people's relationship with the important river of Central Europe.

Session 3 – Parallel rooms

Social partnerships
LECTURE THEATRE 1
15:10

HOMELESS IN ONE'S OWN HOME: A CONSERVATION DILEMMA FOR GHARIAL

G. VASHISTHA[1], D. SINGH[2], S.K. PATHAK[3], A. BADHAWAN[4], P. GUPTA[5]

1 University of Delhi, 2 Wildlife Institute of India, Dehradun, 3 Uttar Pradesh Forest Corporation, Uttar Pradesh, 4 Bahraich Forest Division, Uttar Pradesh, 5 Katerniaghat

Freshwater habitat modification via river damming is a principal driver of decline for habitat specialist species Gharial Gavialis gangeticus. Girwa River in Katerniaghat wildlife sanctuary has a wild breeding gharial population. It is river reservoir habitat where construction of an irrigation barrage in 1976 fragmented the habitat, while a channel shift in 2010 caused irreversible woody vegetation succession on riverine sandy areas. Unavailability of sand gradually reduced gharial nesting efforts, forcing experiment with in situ habitat restoration. Artificial sand bank construction (where riverine sand is piled up to mimic a gharial nesting site) was successful in doubling the gharial nest numbers and increasing hatching success from 63% to 90+%. However, gradually silting river channel, evidences of poor recruitment of hatchlings in parent population and possible flushing down of hatchlings downstream of barrage, calls for a landscape approach where small scale restoration is avoided and rather a logical approach on protecting the downstream river stretch is done. Being an international trans boundary river, augmentation of flow is a complex political matter requiring involvement of the national governments. Since the effect of habitat degradation are evident and prominent, how to tackle the river habitat restoration? Should we focus on returning the flow by transboundary co-operation, or accept the river channel shift and its effects and focus on species protection by exploring and protecting downstream river channels. We look for guidance and support from the globe community to help conserve gharial, an Evolutionarily Distinct and Globally Endangered (EDGE) and critically endangered freshwater crocodile.

Session 3 – Parallel rooms

Large wood
LECTURE THEATRE 2
14:30

ASSESSMENT OF CHANNEL CHANGES AFTER RIPRAP REMOVAL AND LOG PLACEMENT ON REDWOOD CREEK, CALIFORNIA

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1 University of Salerno, 2 National Park Service, USA, 3 University of California Berkeley, USA

Deep pools, vegetation cover and undercut banks provide refuge habitat for aquatic organisms, especially during critical periods such as high flows and dry periods. These complex habitats may be lost as a result of anthropogenic interventions such as installation of bank protection and the systematic removal of logs (to increase channel conveyance), resulting in the formation of simplified, straight streams with flat beds, and with consequent loss river biodiversity. Such interventions occurred in the 1930s on Redwood Creek in Muir Woods National Monument, California, USA, a unit of the National Park Service. In 2019, the Service implemented a restoration project to restore channel complexity and to improve the availability of habitat for juvenile coho salmon Onchorynchus kisutch) a resident species formally listed on the US Endangered Species List. The restoration project sought to remove rip-rap protecting banks and to add logs back into the channel, leaving it to the energy of the flow to reshape the morphology.

In the three years since the project, the stream experienced two high flow events with return periods of 2 and 5 years. We documented the evolution of the channel during these high flows through surveys performed at four times: before and after the intervention and following the first and second high flow events. We analyzed topographical data, maps of log position, the average distance between pools, and the grain sizes of bed sediments.

After the restoration, the morphology became more complex, the pattern more sinuous and the number and depth of pools increased. Bed sediments became finer and more varied. The results of the investigation show that in reaches with enough energy, the process-based approach allows for successful restoration of habitat availability even with only ordinary high flow events and thus in a relatively short time.

Large wood
LECTURE THEATRE 2
14:50

RECONSTRUCTION OF A FORMER ANASTOMOSING WET WOODLAND AT AVON WATER, NEW FOREST USING UAV-DERIVED STRUCTURE-FROM-MOTION PHOTOGRAMMETRY

E. FLEMING[1]

1 Mott Macdonald

In recent years there have been significant technological advances in Unmanned Aerial Vehicles (UAVs). This, combined with the development of structure-from-motion (SfM) technology have provided river restoration practitioners with a new tools that can be used to give an affordable, repeatable, and objective assessment of river restoration projects.

In this study, SfM photogrammetry is utilised on a section of the Avon Water, a small watercourse in the New Forest National Park. It was subjected to extensive Victorian-aged straightening and channelisation which have left the SSSI in an unfavourable ecological and morphological condition. Much of this is now being reversed by river restoration projects led by Forestry England.

Whilst historic maps reveal the rivers former alignment, the straightening pre-dates these maps in places. Furthermore, even where the former route is shown, it is likely that anthropogenic modification began much earlier, and these maps may not represent the natural course of the river.

High resolution orthophotos and 3D photogrammetric models of the site are created that reveal a palaeolandscape consisting of a series of anastomosing and anabranching channels. These are interpreted to represent a former anastomosing wet woodland and 'Stage Zero' of the river system. Cross-cutting relationships suggest that initial anthropogenic perturbation transformed the site into a single meandering thread. This was then followed by the most recent Victorian-aged straightening.

The palaeolandscape revealed by the study could provide a template for future 'Stage Zero' river restoration in the New Forest and demonstrates the capabilities of low-cost, UAV-derived photogrammetry in river restoration research.

Session 3 – Parallel rooms

Large wood
LECTUE THEATRE 2
15:10

INFLUENCE OF BED ROUGHNESS ON BACKWATER RISE AND FLOW REDISTRIBUTION FOR ENGINEERED LOGJAMS WITH A LOWER GAP

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1 Department of Civil Engineering & Industrial Design, School of Engineering, University of Liverpool

Engineered logjams with a gap at the bed are used in engineering practice to provide natural flood management and ecological benefits while preserving river connectivity at base flow. In addition, logjams with a gap at the bed form naturally in small streams with river width less than log length. The accumulation of wood pieces acts as a porous obstruction, and the distribution of flow through and beneath a jam with a lower gap satisfies a two-box, momentum-based model constrained by drag generated in the jam, momentum loss in flow through the lower gap, and net pressure force. In this experimental study, the impact of bed roughness on flow through the lower gap is investigated experimentally. The influence of confined lower gap widths on friction coefficient and are compared to the smooth bed case including implications for sediment transport and backwater rise generation.

Session 3 – Parallel rooms

Decision support tools
LECTURE THEATRE 3
14:30

A DATABASE ABOUT RIVER BIOENGINEERING TECHNIQUES IN FRANCE: BUILDING ONLINE MAP AND FIRST LEARNINGS

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1 LESSEM, INRAE Grenoble

Riverbanks form boundaries between aquatic and terrestrial habitats. Natural riparian habitats are known for their great biodiversity, which is extremely high compared to their relative area. To protect human activities from erosion and flooding, bioengineering techniques are being developed on riverbanks to replace environmentally damaging civil engineering techniques. But the lack of knowledge and experience feedback is one of the main obstacles to bioengineering techniques development.

To address this issue, we built the BDGeniVeg database in order to describe riverbank structures using bioengineering techniques in France. The inventory of structures is based on bibliography and field work. The information is gathered in six groups: the structure itself (e.g. location, bank characteristics), the watercourse (section in front of the bioengineering structure), the techniques (fascine, combs, cribwalls…), the origin of the data (institute, project), the plant species (planted, seeded or currently present) and the information on field visits (current state of the techniques). It currently contains 1527 structures. Part of this database is available online (https://genibiodiv.irstea.fr/en/database-of-french-constructions/).

It allows river managers to know what bank protection already exists in their neighbourhood and to learn from it. For research, it would allow scientists to improve their knowledge thanks to a large set of data including temporal evolution and the mechanical resistance of bioengineering techniques.

A first analysis of the database assessed the influence of some hydromorphological variables on the choice of different bank-foot techniques by studying a success rating index we constructed.

Decision support tools
LECTURE THEATRE 3
14:50

IDENTIFYING CORRIDORS OF RIVER RECOVERY IN COASTAL NSW AUSTRALIA, FOR USE IN RIVER MANAGEMENT DECISION SUPPORT AND PRIORITISATION SYSTEMS

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1 Macquarie University

By connecting corridors of river recovery, resilience can be built into river systems to mitigate against future floods and droughts. However, identifying where these corridors can be built is still lacking in river management practice. For coastal catchments of NSW, Australia that cover an area of 129,000 km2, the Open Access NSW River Styles database contains comprehensive information on geomorphic river condition and recovery potential for >84,000 km of stream length. The database can be used to systematically analyse where corridors of river recovery could be created when working with river recovery via conservation or rehabilitation.

We identified ~5,000 km of 'reach' connections, defined as upstream to downstream sections of river connected end-to-end, and >17,000 km of 'loci' connections defined as more isolated sections of river from which recovery can be seeded and extended into adjacent reaches. Combined with local on-ground knowledge, this information forms an important input to evidence-based prioritisation and decision making in river management.

To undertake corridor analysis using the database, a simplified GIS workflow was developed using publicly available proprietary GIS software, standard GIS tools, and a packaged digital elevation model. Using the workflow, non-technical GIS users in river management can establish where corridors of geomorphic river recovery occur or could be built at-scale. Decision making becomes more cost effective, consistent across landscapes, adaptive to local circumstances and changing river management priorities. The workflow, published on protocols.io, could also be adjusted and applied to other river monitoring and condition datasets where polyline data layers are available.

Session 3 – Parallel rooms

Decision support tools
LECTURE THEATRE 3
15:10

CATCHMENTLIFE: A DECISION SUPPORT SYSTEM FOR ASSESSING PRESSURES AND IMPACTS ON SPECIES HABITATS

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1 UK River Restoration Centre

As part of major legislation such as the Water Framework and Habitats Directives, UK governments, local authorities, water companies and major businesses need to ensure that their activities do not impact on species and their habitats. At present, there is limited knowledge of how environmental and human pressures act individually and interactively to alter habitats and impact on species, preventing us from correctly diagnosing problems and developing effective management actions.

With the help of a consortium of experts and using existing monitoring data, we are developing models describing pressures and impacts on habitats and species. The models and underlying data will be packaged in a Decision Support System software, CatchmentLIFE, that practitioners and volunteers will be able to use to identify best-practice management strategies for ecological improvements. The software will display data and models in a graphical way to help identify pressures and impacts.

A series of models were drawn by experts at workshops to describe causal relationships for key species and life stages. They will be analysed using Partial Least Square Path Modelling, an extension of linear regression. Examples of models and their statistical outputs, as well as a prototype Decision Support System interface will be demonstrated.

Session 4 – Parallel rooms

Natural flood management
LECTURE THEATRE 1
16:00

QUANTIFYING THE HYDROLOGICAL IMPLICATIONS OF PRE- AND POST-INSTALLATION WILLOWED ENGINEERED LOG JAMS IN THE PENNINE UPLANDS, NW ENGLAND

N. MACDONALD[1], M. NORBURY[2], H. PHILLIPS[1], D. BROWN[3], R. BOOTHROYD[4], C. WILSON[5], P. QUINN[6], D. SHAW[1]

1 University of Liverpool, 2 Mott MacDonald, 3 Environment Agency, 4 University of Glasgow, 5 Cardiff University, 6 University of Newcastle

Nature Based Solutions (NBS), including Natural Flood Management (NFM) schemes are becoming an important component of many governmental and organisation responses to increases in flood and aridity risk. NFM structures may take multiple forms to slow, store, disconnect and filter distributed overland flow pathways within a catchment that coalesce to generate a flood-wave downstream and runoff rather than infiltrate groundwaters. To date few studies have conducted observations pre- and post-installation monitoring at river reach-scales, despite widespread and frequent installation, to investigate the efficacy of willowed engineered log jams (WELJs) interventions used in abating flood-flows, through backing-up flood-pulses with consequent reductions in downstream discharges. This paper examines the efficiency, before and after installation of five 1 m high WELJs incorporating 1,000 Bay willow (Salix pentandra) saplings. The findings demonstrate a substantial reduction is achieved for most events, with an average of 27.3% reduction in peak discharge being achieved post-installation. The time to peak is little impacted, however there is demonstrable evidence of a longer and higher recessional limb to the events. These findings quantify for the first time the role that WELJs can play in a move towards re-naturalisation of water level regimes, with lower peak water flows achieved, and waters released from the river-reach more slowly. Furthermore, baseflow during dry periods is also elevated by 27.1%, offering greater resilience to dry periods and droughts.

Natural flood management
LECTURE THEATRE 1
16:20

UNDERSTANDING THE GEOMORPHIC IMPACTS OF DIFFERENT LEAKY WOODY DAM (LWD) DESIGNS

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1 University of Hull,

Leaky Wooden Dams (LWD) have become an increasingly popular feature of river restoration projects. LWD are in and/or across channel structures made from woody material designed to mimic naturally occurring woody debris that is often found in riverine environments. LWDs aim to reduce flooding downstream by holding back water and promoting flow onto the floodplain, increasing connection with the floodplain and infiltration by diverting water onto the floodplain. Whilst LWD are becoming common place there is still a lack of research around their impacts on geomorphology at the location they are installed. Researchers and practitioners have been using what is known about the geomorphic impacts of natural woody debris to explain and predict the geomorphic impacts of LWD - even though it has been established that they are fundamentally different.

This research uses analog physical models in a stream table to assess the geomorphic impacts of LWDs combined with anecdotal observations of real-world scenarios provided by practitioners and researchers. The laboratory work provides quantitative analysis of the geomorphic impacts using Structure from Motion (SfM) Photogrammetry, whilst anecdotal observations of real-world scenarios help to verify what is observed in the stream table. The aim of this research is to identify any geomorphic impacts of LWD. It is important to know this to be able to understand if LWDs are having a detrimental impact to the river systems where they have been installed and to be able to inform best practice for the future.

Session 4 – Parallel rooms

Natural flood management
LECTURE THEATRE 1
16:40

CASCADING STRUCTURAL INTERVENTIONS AND CONSEQUENCES ON A WANDERING GRAVEL BED RIVER: HYDRAULIC MODELLING TO ASSESS RESTORATION OPTIONS

P. TOLENTINO[1], R. D. WILLIAMS[1], M. D. HURST[1]

1 University of Glasgow

Traditional flood management includes river training measures that alter the flow path of a river to defend assets and livelihoods from flood risk. These structures alter flow conditions and sediment transport and can result in unintended consequences further downstream. Cascading impacts from structural interventions prompted the exploration of alternative solutions in addressing flood risk such as natural flood management, where strategies align with working with nature. In tropical countries such as the Philippines where climate change continues to exacerbate the magnitude and frequency of flooding, it is important to determine the effectiveness of these structures supposedly placed for flood mitigation and appraise their non-local impacts. Here, we developed a criteria analysis to screen for opportunities to provide space for the river through removal of existing structures. Subsequently one structure was identified to be removed. We used HEC-RAS 2D hydraulic modelling to assess the impacts of this flood structure, and its removal, on flood dynamics in a 36 km wandering gravel bed river under different flood magnitude return periods using high resolution (0.5m) digital elevation models (DEM). Removal of this structure shows that its presence has likely resulted in higher depth and velocity in the main channel. Increased discharge and thus stream power and bed shear stress is likely accelerating sediment mobility on the bed and erosion along the opposite banks. Increased bed and bank erosion downstream of the structure may lead to the requirement for another structure to protect the banks downstream, if left unabated. The result of the study emphasises the importance of assessment and strategic planning of locations of flood defences, and consideration of their non-local, cascading impacts. This study also gives insights as to where in the catchment can natural flood management strategies such as off-channel storage and floodplain management be implemented to promote habitat diversity and more effective flood risk management in the country.

Session 4 – Parallel rooms

Planning for river restoration
LECTURE THEATRE 2
16:00

A CATCHMENT BASED APPROACH TOWARDS RIVER RESTORATION PLANNING

J.ROBINS.[1]

1 River Restoration Centre (RRC)

Over recent decades, the increase in methods, tools and availability of data has been driven by the need to assist river restoration practitioners in planning at the catchment-scale. More information does not always lead to improved catchment understanding and decision making, as practitioners are required to assess many interconnecting variables across a range of temporal and spatial scales with limited resources. How to use data to make decisions is the crucial and often neglected part of catchment planning. RRC has developed a framework which encourages evidence-based decisions using the assessment of pressures and impacts, and ultimately the prioritisation of river restoration options based on how they will address catchment-scale impacts. We will briefly cover the challenges practitioners face, how our framework can help, and show some applications.

Planning for river restoration
LECTURE THEATRE 2
16:20

PROCESS BASED RESTORATION OF AGRICULTURE STREAMS IN ISRAEL: FACING THE REALITY, NAHALAL STREAM CASE STUDY

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1 Soil Erosion Research Station

Agriculture streams are degraded riverine systems with low eco-hydro-geomorphic functionality, reflecting the agricultural system's lack of resilience and sustainability. We present the causes and outcomes of the interweaving complex feedback that we are to understand and solve if we aim to restore and rehabilitate agriculture streams in the Mediterranean. The study identifies four stressors related to the agriculture Nahalal stream catchment in Israel: 1. Land use fragmentation and poor governance result in large quantities of soil losses and aggradation; 2. Flood-water harvesting reservoirs reduce the riverine system's self-process-based maintenance and recovery mechanisms; 3. Reclaimed water discharges to streams amend water quality and provide nutrient-rich fluxes via surface and subsurface drainage, leading to changes in riparian vegetation diversity and fluvial dynamics; 4. Implementing flood protection management and regulation lead to dredging bed sediment to maintain channel capacity to convey designed water discharges. We elaborate on each cause and use the Nahalal Stream Watershed as a living laboratory, part of the Model Farm for Sustainable Agriculture at the Neve Ya'ar Agricultural Research Center. In addition, we demonstrate potential solutions for improving the agricultural water cycle and gaining a resilient agricultural system. As part of this effort, we run extensive research and monitoring programs. The latter includes climate parameters (rainfall quantities and intensities, evaporation); stream water discharge; water quality (heavy metals, agro-chemicals, pH, EC, and nutrients); suspended sediment concentrations and dredged sediment quality; morphological parameters; and riparian vegetation surveys. We use the big data set to define success indicators for the upper Nahalal Stream restoration project.

Session 4 – Parallel rooms

Planning for river restoration
LECTURE THEATRE 2
16:40

THE IMPLICATIONS OF NATURAL FLUVIAL DISTURBANCE AND DYNAMICS FOR DESIGN OF RESTORATION ON MODIFIED RIVERS IN CENTRAL JAPAN

H. SHIMAZU[1],

1 Rissho University

Understanding of natural fluvial dynamics and changes is important for design of restoration schemes on modified rivers. A distinctive landscape, comprising a riverbed with isolated trees and communities of pioneer plants, is found in the Northern Japan Alps. This study aimed to reveal formation of environmental diversity of riverbed landforms and its relation to biodiversity of pioneer riparian vegetation in a steep braided gravel bed river. The field site is the upper Azusa River, located in the special protection zone of Chubusangaku National Park. Geomorphological maps made annually over 25 years and time-lapse photos taken during some flood events record changes of landforms and vegetation. Yearly severe floods, occurring in the rainy season, cause the erosion, deposition and channel migration on the riverbed, creating geomorphological diversity. After a flood event pioneer species germinate, creating plant communities, some of which are subsequently destroyed or reduced in size by erosion, year by year. These processes repeat, so that various generations of the communities are formed on the riverbed. Engineering works have been carried out on most Japanese river sections, even in special protection zones of national parks, resulting in reduced channel biodiversity. For the restoration of the artificially modified rivers, the recurrence of flood events that change channel landforms needs to be accepted. These fluvial processes are also essential to the re-establishment of vegetation biodiversity. Such disturbance caused by fluvial processes without artificial control of river is very important for preservation and restoration of the distinctive river landscape in this region.

Session 5 – Plenary room

LECTURE THEATRE 1
17:15

THE ACTORS OF RIVER RESTORATION IN ROMANIA: A NETWORK PERSPECTIVE

G. IOANA-TOROIMAC[1], C STOICA[1,2], G-A MOROȘANU[1,3], I-A ȘANDOR[1], D-M CONSTANTIN[1]

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The aim of this study was to identify the actors involved in river restoration in Romania and to untangle the complex networks that they are part of. Actors were considered nodes in a social network, tied by a common action or project. Nodes were characterized by centrality metrics of a network. From a total number of 50 stakeholders, we estimated that eight of them act as main actors of river restoration in Romania (i.e., four public authorities, two research organisations, and two NGOs). We expected to find the national authority for water with a central position in the network, because it is responsible for implementing the EU water policy in Romania. The other organizations, i.e. researchers and NGOs, have a great potential to diffuse knowledge in the network. This confirms that river restoration is not an exclusive competence of public authorities in Romania, but a polycentric system of managing resources in which scientists bring know-why and NGOs democratic legitimacy to governance processes. As recipe of success, we recommended the collaboration between public authorities and researchers, because most of the projects that got financed relied on this partnership, often supported by international partners. By contrary, local partners were missing from this successful partnership suggesting that restoration solutions in Romania are mostly perceived as technical projects, with no interest in local practices.

Acknowledgment. This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS - UEFISCDI, project number PN-III-P1-1.1-TE-2021-0600, within PNCDI III.

LECTURE THEATRE 1
17:35

SEDIMENT FLUX CHANGES LINKED TO NATURALISATION: IMPLICATIONS FOR DOWNSTREAM FLOOD RISK

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1 University of Salford, 2 Dynamic Rivers

Flooding frequency, magnitude and concentration have all increased as a result of alterations to river and catchment hydrological processes with flooding becoming increasingly common across the UK. The risk of flooding is also exacerbated by the presence of in-channel sediment reducing the local flow area and causing overbank flow. This sediment accumulates due to a change in channel hydraulics linked most often to over-widening and, when removed, is replaced by new material delivered from upstream where natural storage processes no longer operate. It is suggested that river and floodplain naturalisation can rejuvenate channel and valley sediment storage processes by restoring hydrological and hydraulic connections between the main channel and the valley bottom. This is demonstrated for the naturalisation scheme on Goldrill Beck at Patterdale. Repeat drone photogrammetric survey since the works were completed in summer 2021 has allowed quantification of the location, volume and type of erosion and deposition occurring following geomorphologically effective flows across the site. The data reveal that large volumes of material are being moved onto the reconnected floodplain as splay deposits, in-channel bars are increasing significantly (associated with local channel bank erosion and widening) and finer gravels, sands and organics are being spread and stored more widely across the valley floor. These data are compared to conditions on the pre-naturalised heavily modified river revealing that the downstream coarse sediment flux has been considerably reduced and suggests that naturally functioning river and floodplain systems would significantly decrease flood risk to sediment vulnerable areas.

Session 5 – Plenary room

LECTURE THEATRE 1
17:55

BEYOND 'REFERENCE': MAKING THE CASE FOR NEW INDICATORS OF QUALITY FOR RIVER RESTORATION AND MANAGEMENT

R. GRABOWSKI[1], M. WILKES[2], E. WOHL[3], J. HARRIS[1]

1 Cranfield University, 2 University of Essex, 3 Colorado State University

Approaches to the environmental assessment of rivers have evolved greatly over the last half century. Since thresholds were introduced to control point-source pollution, the science has advanced to enable us to tackle a wider range of ecological stressors (e.g. diffuse pollution, hydromorphological alteration). In this paper, we argue that continued evolution of assessment approaches is essential to developing ambitious ecological goals for river-floodplain systems. Central to this evolution is a re-evaluation of reference condition. 'Reference' is currently a fundamental part of how we appraise environmental quality; we compare the species composition at sites to an unimpacted one. It provides us with a physical vision to which to aspire. However, there are critical issues with a continued reliance on reference. First, it constrains our ecological goals; our best reaches have seen centuries to millennia of human-induced changes and simplifications. Secondly, it focuses narrowly on the wetted channel; the integral connections between rivers and other aquatic ecosystems and their interdependence with the wider terrestrial ecosystem are not sufficiently considered. Finally, it is not designed for application in a nonstationary system; we live in a rapidly changing world and need assessment techniques that can adapt. In this paper, we present evidence for these issues with 'reference' and summarize how advances in ecological modelling could help to overcome them. In do so, we outline a roadmap for new assessment methods for river restoration and management that build from the solid scientific foundation of current techniques and are designed for our changed and changing world.

- - - Thursday 7th September - - -

Session 6 – Plenary room

LECTURE THEATRE 1
09:00

KEYNOTE ADDRESS: Prof. Kirstie Fryirs[1]

1 School of Natural Sciences, Macquarie University

"Back to the future": Working with geomorphic, vegetative and hydrological recovery in nature-based river management

Human disturbance induces significant geomorphic, vegetative and hydrological changes to river systems, worldwide. In eastern Australia, land-use practices such as clearance of forests and riparian vegetation, and removal of wood from channels in the 19th and 20th centuries induced widespread impacts. However, since the 1980s there has been a noticeable shift in the geomorphic and vegetative condition of many rivers in eastern New South Wales (NSW). This is evidenced by a significant increase in structural and vegetative roughness along these rivers. These changes in geomorphic and vegetative roughness are having a measurable effect on flow and flood hydrology. This transition to a recovery trajectory reflects a reduction in land-use pressures and improved farming practices on the one hand, and adoption of nature-based recovery enhancement approaches to river conservation and rehabilitation by management authorities on the other.

Monitoring and tracking changes in river condition involves identifying when recovery is occurring so that decision-support frameworks can determine *whether* river management is required, *where*, *when* and *how much* to intervene to enhance river recovery and when to *opt-out* of management and leave the river alone because the system requires little (or no) intervention.

Following a brief review of river metamorphosis in eastern NSW since European colonisation, I outline an approach to identify and measure key geomorphic, vegetative and hydrological indicators of river recovery. I will use case studies to demonstrate examples of river recovery, prior to showing the effect this recovery is having on flood hydrology and flood mitigation. Finally I will consider how this understanding can be used to inform management and planning for a future where extreme events such as flood and fire are becoming more intense and arguably more frequent, and the biodiversity of riparian ecosystems is increasingly under threat.

LECTURE THEATRE 1
09:45

DECADE-SCALE SEDIMENT BUDGETS AND GEOMORPHIC UNIT EVOLUTION OF SIX UPLAND GRAVEL-BED RIVER RESTORATION SCHEMES

R. D. WILLIAMS[1], H. REID[2], C. MACDONELL[3], H. MOIR[4], E. GILLIES[4]

1 University of Glasgow, 2 Scottish Environment Protection Agency, 3 University of Glasgow, 4 cbec eco-engineering

Effective monitoring strategies are essential to learn from demonstration river restoration projects. However, a dearth of detailed, accurate and consistently acquired, long-term topographic monitoring constrains the available evidence base to evaluate the efficacy of different river restoration approaches. Upland gravel-bed river realignment schemes are emblematic of this challenge. Here, the results from monitoring six contemporary upland river restoration sites in Scotland and the North-West of England are presented. Detailed topography of restored reaches at Whit Beck, the River Lyvennet, Swindale Beck, Eddleston Water, Allt Lorgy and the River Nairn was measured for a period of approximately one decade after each river realignment. The full extent of each scheme was surveyed every 1-3 years, with the frequency dependent on the geomorphic dynamism of the scheme. A variety of geomatics technologies were deployed to survey topography including, robotic total stations, RTK-GNSS, Structure-from-Motion photogrammetry, Terrestrial Laser Scanning and Unmanned Aerial Vehicle LiDAR. This unique dataset has enabled geomorphic change to be mapped and annual sediment fluxes to be quantified. Moreover, the high-resolution topographic datasets enable the geomorphic unit evolution of each scheme to be mapped using the Geomorphic Unit Toolbox (GUT). The responses of different river restoration schemes are found to be influenced by upstream sediment supply, scheme constraints, in-channel and riparian wood and vegetation, and intervention through adaptive management approaches. All schemes are shown to maintain more diverse physical habitats.

Session 6 – Plenary room

LECTURE THEATRE 1
10:05

HOLOCENE LESSONS FOR ANTHROPOCENE RIVERS

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To better understand appropriate management measures, we argue for the need to place the current state of rivers and their possible future trajectories in a broader historical and Holocene context. Our case study is the Someș drainage basin, located in the NW part of Romania, Central-Eastern Europe. Based on the current, historical and Holocene fluvial behavior of the three main collectors, we define the Anthropocene rivers of this region and the temporal limit of natural reference conditions for them. Our findings point to the years 1970 – 1980 AD. as a reference interval for the definition of Anthropocene rivers in NW Romania, suggesting a delay of 20-30 years after the Great Acceleration, while the period of the last ca. 2500 years should be considered as the appropriate "natural" reference state to approach for current fluvial behaviors and their future trajectories. However, since at least three sub-cycles of channel incision/aggradation and overbank sedimentation are visible in this time frame, we also discuss the need to adopt a moving boundary in defining these "natural" reference condition, depending on the local fluvial history, the identified natural and human induced pressures and available management measures.

LECTURE THEATRE 1
10:25

ANALYZING THE INTERACTION BETWEEN RIVER RESTORATION AND URBAN REGENERATION: EVIDENCE FROM INTERNATIONAL COMPARATIVE RESEARCH ON OLD INDUSTRIAL REGIONS

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Although research on societal issues in the field of restoration have been growing steadily since the early 1990s, “the integration of social science into restoration is relatively rare” (Smith 2014). In addition, considering that most studies on the societal and spatial impacts of river restoration have been carried out by scholars from environmental disciplines, “addresses to the humanities and social sciences to invest more in the field of river restoration are recurrent” (Cottet, Morandi & Piégay 2022). Against this background, the paper aims at bringing in the debate an urban studies perspective by outlining the theoretical and methodological approach adopted to investigate the mutual relationship between river restoration and urban regeneration in old industrial regions, as well as the expected research outputs. The first part of the paper focuses on the research design, discussing the methodological challenges at the various stages of the ‘research cycle’ (Schmitter 2008). Particular emphasis is placed on the steps concerning the development of research questions, conceptualization, case study selection and variable operationalization. The second part of the paper illustrates the key features and rationale of the preliminary results. The case database is outlined, in which the collected data for each case is presented in tabular form and whose main analytical objective is descriptive. A comparative case study analysis of selected cases is also presented, the objective of which is to hypothesize how the mutual influence of urban regeneration and river restoration works in practice.

Session 7 – Parallel rooms

Condition assessment
LECTURE THEATRE 1
11:15

BUILDING MULTI-SCALE UNDERSTANDING OF RIVER PHYSICAL HABITATS AND FUNCTION TO SUPPORT IDENTIFICATION OF RIVER IMPROVEMENT OPPORTUNITIES

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1 Cartographer Studios, 2 Queen Mary University of London, 3 University College London, 4 Thames Water

Understanding of river condition and dynamics requires a multi-scale, hierarchical approach that sets the local, contemporary physical characteristics of a river into the catchment river network context and their joint changes through time. In this presentation we illustrate a simple hierarchical approach that synthesizes physical information from a range of sources, including data sets collected by Citizen Scientists. Our aim is to build a picture of the condition of a catchment river network in order to identify opportunities for habitat recovery or sustainable rehabilitation.

We propose a focus on four spatial scales to allow very detailed information at the local (e.g. 100m river length) scale to be set in the context of coarser but spatially more extensive information at river lengths from 0.5 to multiple kilometres. At the coarser scales, we also incorporate information from historical sources to identify trajectories of river channel change.

We illustrate the methodology using data from the River Crane catchment, Greater London, which is one of Thames Water's 'Smarter Water Catchments'. Here the method is being used (i) to build understanding of river condition across the entire river network, (ii) to build a vision of how and where more natural river functioning could be promoted, (iii) to identify key opportunities for river interventions and restorations, and thus (iv) to aim to achieve integrated uplift in river condition across the entire river network.

Condition assessment
LECTURE THEATRE 1
11:35

BEYOND RIVER CONDITION ASSESSMENT: ANALYSIS OF HABITAT SURVEY AND GEOMORPHIC RIVER TYPE DATA TO PROVIDE GEOMORPHOLOGICAL UNDERSTANDING AND SUPPORT RIVER RESTORATION DESIGN

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1 Queen Mary University of London, 2 Cartographer, 3 University College London

The River Condition Assessment (RCA) method is a component of DEFRA's Biodiversity Metric (Panks et al., 2022). It combines site-scale field surveys with a desk-based evaluation of the geomorphic river type (Gurnell et al., 2020) to deliver a categorical assessment of river condition (Good, Fairly Good, Moderate, Fairly Poor, Poor).

The method was developed and calibrated using literature-based, scientific understanding of river functioning and data from near-natural river reaches, representing the range of geomorphic river types that are found in the UK. The method judges (i) observed river morphology and vegetation structure in relation to what might be expected if the river were functioning naturally and (ii) the range and severity of local human interventions-pressures contributing to degradation of geomorphological functioning. To achieve this judgement, the RCA method generates scores for 32 intermediate condition indicators, which provide detailed evaluations of different habitats and interventions.

Although the RCA was developed to assign a river reach to one of five condition classes, we demonstrate the utility of the 32 condition indicators to support understanding of contemporary geomorphic functioning and help deliver prescriptions for restoration actions that can support that functioning. We illustrate this using pre-project surveys of several reaches of the River Crane, West London.

Gurnell, A.M., at al., 2020. Assessing river condition. River Research and Applications, 36(8): 1559-1578.

Panks, S., at al. 2022. Biodiversity metric 3.1 – User Guide. Natural England. Download at http://publications.naturalengland.org.uk/publication/6049804846366720

Session 7 – Parallel rooms

Climate change
LECTURE THEATRE 2
11:15

RIVER RESTORATION FULLY RECONNECTING STREAMS TO THEIR FLOODPLAINS CHANGES WILDFIRE BEHAVIOUR TO CREATES BURN MOSAICS, INCREASES HABITAT DIVERSITY AND BUILD RESILIENCE TO CLIMATE CHANGE

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1 University of Nottingham, 2 Portland State University, 3 US Forest Service, 4 Colorado State University, 5 Washington State University

We report a recent advance in river restoration science that supports the hypothesis that “pyro-diversity begats biodiversity”. Specifically, our research identifies a novel co-benefit of fully-restoring channel-floodplain connectivity in reaches that have been anthropogenically-separated from the floodplains (a river restoration goal colloquially termed "restoration to Stage Zero"). The numbers and intensities of wildfires sweeping through river valley floors are increasing. In rehydrated floodplains a uniformly-severe burn is replaced by a 'fire mosaic'. Interactions between the habitat mosaics on the floodplain generated by the impacts of (a) frequent flood inundation and (b) fire are found to generate benefits for habitat diversity and wildlife recovery, wildfire management, and people who live, work or rely on continued functioning of the river and its floodplain. We demonstrate this using the results of a study of the Holiday Farm Fire (September 2020) and post-fire recovery. The study site is a reach of the South Fork Mckenzie floodplain restored to 'Stage Zero' in 2018. Our approach is based on scientific principles, best practice field study practices and appropriate analytical treatments, coupled with cautious interpretation of our results that avoids over-stating our initial conclusions. As the frequency, intensity and extent of both floods and wildfires are expected to increase due to climate change, floodplain reconnection is vital to realising the positive environmental and ecological impacts of floods and fires, while minimising their adverse impacts on people, property, and infrastructure. Full floodplain reconnection is crucial to achieving national and international targets for climate change resilience and biodiversity.

Climate change
LECTURE THEATRE 2
11:35

IMPACTS OF FLOODPLAIN RESTORATION ON WATER TEMPERATURE AND MACROINVERTEBRATES IN WHYCHUS CREEK, OREGON

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1 Portland State University, 2 University of Nottingham

Stream restoration is a proposed climate adaptation tool, however, outcomes of floodplain restoration on stream temperature have been debated. Despite a growing number of studies that investigated water temperature in restored streams, few have quantified thermal heterogeneity in new habitat-types created by restored hydrogeomorphic processes and the impact of thermal diversity on the aquatic macroinvertebrate community. In this study, we evaluated three hypotheses: 1) restoration increases habitat diversity, 2) habitat diversity increases water temperature heterogeneity, and 3) restored reaches have more diverse macroinvertebrate communities. We collected a total of 40 macroinvertebrate samples and characterized environmental conditions in three reaches (degraded as control, recently restored as transitional, and restored) in Whychus Creek, Oregon, USA in summer, 2021. Temperature loggers were deployed to collect data at 30-minute intervals for multiple days at the location of each macroinvertebrate sample. Shannon index scores for habitat diversity were more than two times higher in restored reaches than in the control reach. Water temperature coefficient of variation for three common temperature metrics ranged from 5.5%-20.2% in two restored reaches, two times or more variability compared to the control reach. Median taxa richness was 19, 18, and 13 for the restored, control, and transitional reaches, respectively. Off-channel habitats in the restored reaches included 16 unique taxa. Range in weighted mean thermal optima for macroinvertebrates was 1.5-2 times more in restored reaches compared to the control. Results from this study support the idea that floodplain restoration creates thermal heterogeneity for diverse macroinvertebrate communities in streams.

Session 7 – Parallel rooms

Climate change
LECTURE THEATRE 2
11:55

RESTORATION TO INCREASE ECOLOGICAL RESILIENCE TO CLIMATE CHANGE IN GROUNDWATER-DOMINATED STREAMS

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1 Environment Agency, 2 Nottingham Trent University, 3 University of Essex, 4 University of Birmingham

Chalk streams are groundwater-fed river systems internationally recognised for their biodiversity, with the majority residing in England, but they are impacted by many pressures. We are working to better understand how river restoration can increase resilience to climate change in the presence of interacting anthropogenic pressures. We present a series of appraisals that demonstrate where restoration measures have successfully restored physical processes and longitudinal connectivity, resulting in improved habitat composition. Ecological responses to these changes have been largely positive with macroinvertebrate communities reflecting transitions from lentic to lotic conditions. Taxonomic diversity, richness and evenness became more similar to communities in control sections, which acted as targets for the restoration. However, the recovery of functional diversity varied depending on the restoration measure applied, the scale of observation and the presence of other pressures. To explore how different pressures interact with climate change we are using multi-decadal datasets to characterize the concurrent, interacting macroinvertebrate responses to specific stressors in five major pressure categories: temperature, hydrological extremes (i.e. drying, low flows and floods), land use, physical habitat modification and water pollution. Preliminary observations include evidence of profound change in community composition during the drought and heatwave events that affected chalk streams in summer 2022. By identifying the times and places at which ecosystems could cross tipping points to alternative, depauperate states, our results will help target restoration actions more effectively.

Session 7 – Parallel rooms

Restoration benefits
LECTURE THEATRE 3
11:15

REWILDING CATCHMENTS: HOW DOES WORKING WITH NATURE IMPACT HYDRO-ECOLOGICAL PROCESSES?

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Landscape scale restoration of natural processes, popularly termed 'rewilding' is increasingly a mainstream conservation approach. In parallel, river restoration practice has rapidly shifted to approaches which seek to work with natural processes as far as constraints allow. We are therefore seeing an increasing emphasis on natural processes in projects from reach to catchment scale with assertions that ecosystem resilience and ecosystem benefits will be enhanced as a result. However, the scale and novelty of landscape rewilding means that the evidence for these effects is limited. Here we discuss some of the ecological and hydrological changes that are predicted to arise from rewilding projects and smaller natural process-led interventions. We will present some preliminary data from recent projects (beaver reintroductions, Stage 0 channel restoration) and the results of a systematic review of rewilding impacts upon hydrological extremes. The systematic review uncovers a lack of research directly addressing rewilding, but highlights research in analogue contexts which can, with caution, indicate the nature of change.

Restoration benefits
LECTURE THEATRE 3
11:35

PROCESS-BASED RIVER RESTORATION: HYDROMORPHOLOGICAL AND ECOLOGICAL RESPONSES OVER TWO YEARS OF FIELD EXPERIMENT

T. H. FURLEY[1], S. L. M. CALADO[1], K. R. CHAGAS[1], D. P. ANDRADE[1], H. D. FERNANDES[2], P. I. D. BELO[2], M. E. B. R. GOTTARDO[2]

1 APLYSIA Assessoria e Consultoria Ltda., 2 Fundação Renova

In November 2015, Gualaxo do Norte River (Brazil) was impacted by iron ore tailings from the Fundão Dam rupture. The deposition of tailings on the riverbed changed the hydrogeomorphological characteristics, resulting in a decrease in the diversity of physical habitats and the ecological biodiversity. The main aim of this study was to apply a river restoration project to restructure the hydrogeomorphological characteristics and to enhance the reestablishment of biota, mainly for macroinvertebrates and fishes. In order to reach the goal, 203 wooden structures were installed in two sections of the river (T6R and T7R), totalling 1.8 km long following a BACI design. Upstream of each Restored reach there is a Control (impacted and without structures) and a Reference reach (not impacted). Five campaigns were carried out, 2 before and 3 after the restoration process. After 26 months of the woody installation, an increase in hydraulic retention in the Restored reaches was observed (T6R-15.84%; T7R-53.67%), when compared to the Control, which favoured the accumulation of sediments (T6R-417; T7R-804 metric tons). In addition, after the wooden installation was also observed the enrichment of substrate types (T6R-41.11%; T7R-58.73%). The benthic macroinvertebrate community showed an increase in the total abundance (T6 – 83,44%), including the most sensitive groups (T6R-104.95%; T7R-44.26%). For fish, the increase of recruitment (hand nets capture) was up to 7.24%, and the abundance and the biomass of some species were also higher than the Control reaches. The results showed positive impacts of river restoration in the Restored, indicating the success of the study.

Session 7 – Parallel rooms

Restoration benefits
LECTURE THEATRE 3
11:55

DEFINING FLOOD RISK BENEFITS OF NATURE-BASED SOLUTIONS: WHAT YOU NEED TO KNOW.

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1 Environment Agency, 2 Jacobs

There are numerous approaches and modelling techniques available to try and determine the benefits of a given restoration scheme, be that in terms of flood risk reduced, habitat created, climate change resilience, biodiversity net gain, health, or carbon. The complexity of the problem and the sensitivity of the environment may well require a proportionately complex analysis, but in many cases the broad benefits require some definition.

From the flood risk perspective, we present a simple approach to try and unlock some of the complexity around benefits for Nature-Based solutions, looking at catchment characteristics upstream of communities at flood risk.

Session 8 – Parallel rooms

Ecology
LECTURE THEATRE 1
13:30

USING BIO-DIAGNOSTIC TOOLS TO UNRAVEL MULTIPLE HUMAN PRESSURES AND GUIDE RIVER RESTORATION STRATEGIES

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River ecosystems globally continue to be degraded by a multitude of anthropogenic pressures. Identifying the key stressor(s) determining the ecological health of river systems is critical in guiding effective management decisions. While river restoration interventions often report biodiversity improvements as a primary ambition, few collect baseline data characterising how human impacts have limited ecological health. In this paper, we examined secondary data sources from one of the most urbanised UK catchments to inform where and what type of river restoration interventions could be prioritised. Specifically, macroinvertebrate community bio-diagnostic tools were examined in relation to different environmental controls and anthropogenic pressures (e.g., flow regime modifications and water quality stressors). The catchment displayed widespread nutrient enrichment issues that limited ecological health. While such water quality pressures prevail, river restoration practices addressing physical habitat conditions alone may limit freshwater biodiversity recovery trajectories. Consequently, further analyses was undertaken to identify future project locations where restoration is likely to yield maximum ecological benefits. This entailed assessing physical habitat conditions alongside potential ecological dispersal pathways and land cover types that are more conducive to certain restoration techniques. Optimal potential restoration sites were typically located in the headwaters, in urban parks or rural areas where faunal communities were less impacted and there is greater scope to alter the lateral profiles of channels. Hence, findings from this research could help inform future restoration efforts within the catchment (e.g., planned rewilding initiatives and reach-scale interventions), and could be easily implemented in other systems to prioritise management interventions.

Ecology
LECTURE THEATRE 1
13:50

SWIM OR DIE? IMPACT OF HEAVY-DUTY VEHICLES ON FISH COMMUNITIES

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Headwater streams are subjected to a number of interventions. River modification by heavy-duty vehicles for the purpose of repairing and maintenance of technical infrastructure, bridge construction, removal of obstacles from watercourses, gravel mining, or also river restoration is a common commercial practice. Data and information on the impact of heavy duty vehicles during realization of these interventions on fish and other aquatic communities (e.g. on mortality) are very scarce. The aim of the study was to evaluate the rate of mortality of alpine bullhead (Cottus poecilopus) and brown trout (Salmo trutta) and to obtain information on fish movements during these treatments. We selected a total of six research areas for the experiment. They were located in four watercourses in the Odra River Basin in the Moravskoslezské Beskydy Mts (Outer Western Carpathians) in the Czech Republic. We used Passive Integrated Transponders (PIT tags) implanted into selected species of fishes. During technical interventions, the average mortality rate for fish was 31 %. The mortality of the alpine bullhead during the technical interventions decreased with decreasing size of the individual. On the contrary, the mortality of brown trout did not depend on size of the individual. The mean value of the movements (irrespective of the direction downstream/upstream of the movement) for the alpine bullhead and brown trout was 10 m during the experiment. The movement distances of the alpine bullhead were longer during high flows (up to 566 m upstream), compared to the low flow period (a few meters). In contrast, movement distances of the brown trout did not differ during high and low flow periods.

Session 8 – Parallel rooms

Ecology
LECTURE THEATRE 1
14:10

SEARCHING FOR THE WIGGLE SIGNAL – USING REFERENCE CONDITION PREDICTIONS TO INFORM RIVER RESTORATION EXPECTATIONS

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Macroinvertebrates are a commonly used group to investigate the ecological response of a river to restoration intervention. Reviews of the literature summarising the response of macroinvertebrates to river restoration highlight variability in the strength and direction of the response. Disentangling whether this variability is a true reflection of the system or a lack of consistent and robust study design is difficult at best. The River Invertebrate Prediction and Classification System (RIVPACS) is a tool which uses information collected from a suite of reference condition sites (sites of perceived high ecological quality) to predict macroinvertebrate community composition, based on environmental conditions, expected to be found at a site in the absence of (human) stress. This tool presents an opportunity to investigate the 'response' of the macroinvertebrate community to common river restoration actions (e.g. changing the channel slope through increased sinuosity or changing the riverbed composition through substrate addition). By holding the simulated environment constant and adjusting the variable of interest (e.g. slope), predicted macroinvertebrate community composition can be compared across a gradient of variable change. The results of this simulation study shows patterns of change in community composition in response to changes in slope (a response of increasing channel sinuosity) and substrate change (changing riverbed roughness) across rivers of different size. Patterns are interpretated within a river restoration monitoring context.

Session 8 – Parallel rooms

Lessons learned
LECTURE THEATRE 2
13:30

ECOSYSTEM SERVICES: THE ROLE OF THE SCALES

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According to the European Environmental Agency, more than 70% of the river landscape has poor hydromorphological conditions. River restoration is considered to be one way to improve river conditions. We propose that ecosystem services assessments should be included in the planning process of river restoration. Ecosystem services are benefits that people obtain from nature for free. We noted that in the last 20 years, the number of published papers has been increasing in 2009, 217, and 2019 1145 based on the search for keywords “ecosystem services” and “river restoration”. However, the remaining question is which spatial scale of ecosystem services assessment should be appropriate. In this contribution, we present three different scales to discuss the connection between ecosystem services, river restoration, and scale relevance. The first scale is focused on the entire fluvial corridor (~ 10^3 m), which is ideal for the evaluation of river conditions. The second scale represents the river segment in more detail on the river reach scale (~ 10^2 m), and the third scale represents individual fluvial forms (~ 10^0–10^1 m). In our case, we aimed to apply the concept of ecosystem services to the entire fluvial corridor and selected fluvial forms, namely large wood and gravel bars. The outcomes for appraisal of the relevancy scale to conduct ecosystem services are based on a few case studies conducted in the fluvial corridor of the Odra River and its tributary, the Ostravice River, Czech Republic. We propose a framework that can be applied to river restoration and used to evaluate the (potential) ecosystem services delivered by restored rivers.

Lessons learned
LECTURE THEATRE 2
13:50

CHALLENGES OF CREATING NATURE IN CONSTRAINED URBAN ENVIRONMENTS: KEY PRINCIPLES LEARNED FROM 3 RIVER RESTORATION SCHEMES IN GLASGOW

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1 Scottish Environment Protection Agency, 2 AECOM

Rivers in urban environments suffer some of the greatest rates of impact globally. They also offer the greatest opportunities for reconnecting large numbers of people with the natural environment. Hence, SEPA have been concentrating its efforts on restoring rivers in this setting. Constraints have been significant and multi-faceted ranging from the physical, (contamination and utilities) to the conceptual (understandings of naturalness and perceived risk). This talk sets up key principles to enable ‘naturalness’ to be maximised within such complex projects using examples from the Tollcross, Garrell Burn and Levern restoration schemes. These principles include:

i. Have clear objectives.

ii. Start with a comprehensive, technically assessed and numerically modelled design.

iii. Redesign (if needed) as constraints become better understood.

iv. Maximise the channel’s ability to self-adjust and recover wherever possible and accept other sections will need to be constrained.

v. Groundworks will present the unexpected (e.g. utility locations). Be flexible and evidence-based to maximise outcomes (i.e. wetland sections).

vi. Contractors may want to ’over engineer’ to reduce risk and liability. Accurately assess and communicate risks and remove if not necessary.

vii. Ensure geomorphology specialists are present on-site during works, especially at key stages.

viii. The restoration is not complete when construction is finished. Follow ups visits and minor changes based on patterns of channel recovery are essential for maximising potential benefits, i.e. wetland or riparian planting.

Whilst science is a key aspect of restoration design, communication, flexibility and a good understanding of geomorphology is essential for maximising the outcomes at delivery.

Session 8 – Parallel rooms

Lessons learned
LECTURE THEATRE 2
14:10

WE CANNOT TURN BACK TIME: A FRAMEWORK FOR RESTORING AND REPAIRING RIVERS IN THE ANTHROPOCENE

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Restoration activities commonly aim to reverse the impacts of environmental degradation and return a system back to an original, "pre-disturbance" condition. Is this realistic, achievable, or reflective of an unconscious bias in the Anthropocene, the current geological epoch where human disturbances dominate ecosystems? Billions of dollars are invested into river restoration globally each year, but there are limited empirical data to evaluate river recovery after these activities. Current response models, typically based on concepts of equilibrium and stability, assume rivers return to pre-disturbance conditions by removing or ameliorating a disturbance or stressor. Conceptual frameworks are useful tools to order phenomena and material, and understand patterns and processes in data-limited situations. A framework for the recovery of rivers in the Anthropocene is presented. The framework includes components of resilience thinking, landscape ecology, and river science. It is proposed that rivers in the Anthropocene have metamorphosed to a different basin of attraction (regime/state) displaying alternative functions, structures, and interactions. Resilience thinking suggests that once a river moves beyond the Anthropocene tipping point, recovery to its original state is not possible. If a river system cannot be returned to its original state, it must be repaired to something else. Using principles of landscape ecology for restoring structural and functional heterogeneity the capacity of Anthropocene rivers to withstand current and future disturbances would be enhanced. River science recognizes the significance of physical heterogeneity at multiple scales, resulting in differences in sensitivities to disturbance and associated recovery trajectories. All of these should guide the selection of river restoration activity types at given locations within a river network.

Session 8 – Parallel rooms

Building resilience
LECTURE THEATRE 3
13:30

WATER ATTENUATION AND CARBON STORAGE: 2(+) FOR 1 BENEFITS OF A DESIGNED, LOW-ORDER WATER CORRIDORS

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Water corridor restoration, naturalization and/or creation often coincides with major land use changes (e.g., re-developing rural areas into residential or commercial land use, expanding urban areas). In these projects, the primary focus is often runoff attenuation, water conveyance, and potentially stormwater management as it relates to water quality. In addition to these important project goals, the design elements used to achieve attenuation and improved water quality, can also provide other benefits, such as increased carbon storage, improved habitat and potentially improved channel resilience. We evaluated the change in particulate organic carbon within various design elements for a recently built low-order stream corridor. Bed sediments were collected and analysed for particulate organic carbon (POC) estimated by loss on ignition through spring, summer and fall in 2020 (one year after project completion), with plans to collect similar samples in 2023 (3-years post-completion). The 2020 results show that bed sediments downstream of attenuated flow had higher POC throughout the 2020 field season compared to other sample collection points (e.g., riffles, pools). Organic carbon storage varied throughout 2020, the highest amounts were observed mid-summer (ranging~7%-27%), with the lowest values (ranging ~5%-15%) in the fall. By returning to the site in 2023, we will be able to assess potential supply limits within the system and evaluate additional changes in carbon storage as the site matures. We demonstrate, that in addition to meeting the primary were goals, channel corridor designs can provide significant carbon storage. This is an important supplemental benefit in corridor restoration projects.

Building resilience
LECTURE THEATRE 3
13:50

SHORT- AND LONG-TERM EFFECTS OF A SUMMER FLOOD ON THE PHYSICOCHEMICAL PARAMETERS IN A NEWLY RESTORED RIVER

M. HONS[1], J. SCHOELYNCK[1]

1 University of Antwerp

Summer floods are becoming an issue of increased concern. In 2021, western Europe experienced a summer flood with devastating consequences for the ecological quality of rivers. Heavy pollution of riverine systems occurred as a result of run-off from land and sewage overflows, consequently affecting the water quality and biodiversity. It is important to gain more knowledge on such increasingly occurring events for optimal river restoration practices.

In this study, the short- and long-term effects of a summer flood in a newly restored river system were explored. Several meanders in this river were reconnected by different types of reconnections, allowing to measure differences among the meander types and differences between a meandering and straight trajectory. This study aimed to identify which physicochemical parameters were impacted during the floods and to identify whether the re-connection of meanders had an impact on the buffer and restoration capacity of the water. This study also briefly looked at the effects on fish diversity and abundancy, macrophytes and erosion or sedimentation.

The flood had a significant impact on many physicochemical parameters, mostly causing sudden drops in nutrient contents as a result of dilution, followed by steep inclines. Water quality differed only slightly between straightened and restored river parts, possibly because of the relative short time since reconnection. A small incline in total phosphorus was seen downstream of the meander. As the waterbed is still unstable, high discharges may cause flushes of phosphorus. Long-term, meanders resulted in increased deposition of floating substances, resulting in lower phosphorus.

Session 8 – Parallel rooms

Building resilience
LECTURE THEATRE 3
14:10

DEVELOPING AN INNOVATIVE SOIL HEALTH INDEX TO SUPPORT MULTIPLE ENVIRONMENTAL OUTCOMES

H. L. STOTT[1]

1 Wyre Rivers Trust

A catchment-based approach to address river degradation in the Wyre Catchment has involved working with farmer groups to protect our common goals of keeping soil and nutrients on their land and out of our rivers. To alleviate the issue of soil degradation an innovative soil health index has been developed by the Wyre Rivers Trust. This has involved conducting soil surveys that assess a range of biological, chemical, and physical soil properties on fields known to be at high risk of soil degradation and fields with good soil management practices. These measurements have guided the development of Upper Wyre Catchment specific, theoretical minimums and maximums, and the relationships between these values to healthy soils, to develop a soil health index model. This model allows the Wyre Rivers Trust to survey soils and produce a quantitative value of soil health, pinpointing areas for improvement with recommendations for land management practices that reduce soil degradation and restore soil functioning. Through a monitoring programme the benefits of the changes in land management can also be quantified, supporting farmers transition to regimes which protect their soils, are more resistant to climate change perturbations, supporting food production, biodiversity and in turn river health.

Session 9 – Parallel rooms

Modelling tools
LECTURE THEATRE 1
14:45

GEOMORPHOLOGICAL RENATURALISATION: MODELLING FLOODING AREAS AND HYDROLOGICAL REGIME CONNECTION IN THE JARAMA RIVER, MADRID, SPAIN

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Nowadays, the floodplains and channel of the Jarama River (Madrid, Spain) show the geomorphological impacts (artificial lagoons and channel degradation) of the intensive regulation and gravel extraction that took place during the 20th century. Although these lagoons are now reservoirs for fauna and protected wetlands, some of them are the object of geomorphological naturalization projects to reduce the depth and improve biological quality. For one particular lagoon, a potential area for the extraction of fill material was identified on the left bank of the Jarama River, close to the confluence with the Tajo River, where a geomorphological renaturalization could also be undertaken. Mostly, actions proposed in this area are intended at creating flatter surfaces and the recovery of a secondary arm as a flood channel. The present study aims at i) assessing the potential consequences of the geomorphological actions proposed in the Jarama River by evaluating the hydraulic reconnection in the study areas, and the effects on flooding downstream; and ii) discussing the implications for river restoration and flood prevention of this type of initiatives. A two-dimensional hydraulic model was applied to both the current situation and the renaturalization alternative, under three different discharges. Results showed slight reductions in flooded areas downstream and improved evident hydraulic reconnection of the secondary channel, even with low discharges. This study highlighted that, with this type of nature-based solutions, it is possible to expand selective flooding zones, promote longitudinal, lateral and vertical hydrological reconnection, and create heterogeneity of suitable habitats.

Modelling tools
LECTURE THEATRE 1
15:05

A NOVEL MODELLING BASED APPROACH TO PREDICTING ECOLOGICAL RESPONSE TO SYSTEM NATURALISATION

R. WILLIAMSON[1], G. L. HERITAGE[1]

1 Dynamic Rivers (Survey & Design)

Predicting ecological response to river restoration/naturalisation works has traditionally been restricted to in-channel hydraulic habitat characterisation using Froude number using data from 2D hydraulic modelling of low flows. Whilst this has been useful in the context of fish and aquatic invertebrates it fails to adequately capture likely changes to valley bottom habitats. This paper reports on the use of seasonal (mean spring, summer, autumn and winter flows) inundation depth predictions and published species and vegetation community wetness tolerance ranges to map optimal in-river and valley floor habitat development. Results are presented for the naturalisation of Goldrill Beck in Patterdale completed in the summer of 2021 and these data are compared to the habitat distribution recorded for the heavily modified rural site prior to the works. The predictions suggest that in-channel hydraulic habitats will move towards lower energy biotopes whilst the wider site will alter from unimproved grassland and rush pasture to become a far more diverse set of habitats, ranging from swamp, mire, fen and ditch habitat through to wet grassland, dependent primarily on the new wetting regime. Predictions are also made at a species level with the optimal areas for Devils Bit Scabious (Succisa pratensis) presented as an example linked to the potential reintroduction of the Marsh Fritillary (Euphydryas aurinia) at the site. It is suggested that this approach to quantifying in-channel and floodplain habitat gains be adopted at all restoration sites to guide species reintroduction and strengthen the case for system naturalisation into the future.

Modelling tools
LECTURE THEATRE 1
15:25

DISCUSSION: MODELS -THEIR USE AND APPLICATION TO RIVER RESTORATION.

Session 9 – Parallel rooms

Monitoring
LECTURE THEATRE 2
14:45

TEN YEARS LATER: MEDIUM-TERM EFFECTS OF RIVER RESTORATION ON RIPARIAN VEGETATION

J. H. T. HOPPENREIJS[1], L. KUGLEROVÁ[2], R. JANSSON[3], R.L. ECKSTEIN[1], E. M. HASSELQUIST[2], L. LIND[1]

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Swedish streams and their riparian zones have been modified to support timber-floating until the 1990s, when efforts to restore these streams have been undertaken. The “basic” restoration programme (1990s and 2000s) consisted of removal of guiding structures and restructuring substrate. An additional “demonstration” restoration programme (2010) consisted of placement of dead wood and large boulders from upland in the streams. Streams were sampled before the restoration in 2010, during 2011-2013 and in 2020 to see whether the changed hydrology and geomorphology affect the vegetation in riparian zones. We inventoried plant species richness along an elevational gradient, and along a 60 m long reach. The gradient consisted of plots at the waterline (0 cm elevation), peak riparian vegetation (40 cm elevation) and upland habitat (80 cm elevation). The immediate effect of restoration seemed neutral to negative as plant species richness remained the same from 2010 to 2011 in the 0 and 80 cm elevations, and decreased in the species-richest 40 cm elevation. From 2011 to 2013, species richness increased significantly in the plots overall but there was no further increase in 2020. The largest post-restoration increase on the reach scale was found between 2013 and 2020, with species numbers increasing from (mean±SE) 42.6±1.0 to 59.7±2.1. It is unclear whether this inconsistency can be explained by the scale on which the samples were taken or whether the system needs longer time to recover from the channelisation and restoration.

Monitoring
LECTURE THEATRE 2
15:05

ASSESSING CHANNEL RE-MEANDERING ON GEOMORPHIC DIVERSITY AND FLOOD RISK REDUCTION: EDDLESTON WATER RESTORATION, SCOTLAND

I.C. COSTAZ[1], A. R. BLACK[2], C.J. SPRAY[2], R.D. WILLIAMS[3]

1 GRAIE, Villeurbanne, 2 University of Dundee, 3 University of Glasgow

Channel re-meandering is commonly used in river restoration. However, few studies have used multi-temporal, reach-scale data from hydrological and topographic monitoring, and hydrodynamic numerical modelling to evaluate this restoration approach, particularly for low to medium energy meso-scale rivers. The Eddleston Water project focuses on the application and evaluation of Natural Flood Management measures to reduce flood risk to downstream communities and improve riverine physical habitat; providing a natural laboratory to examine re-meandering. A 1.6 km section of river was re-meandered between 2013 and 2016, increasing river length by 18%. Assessment of the impact on flood attenuation was made using three techniques: analysis of hydrological time series (2011-2020); comparing repeat (2018 and 2020) reach-scale topographic surveys of the channels to map geomorphic change; and numerically modelling two-dimensional flood extents and dynamics for flood events of different magnitude, using HEC-RAS software. Results from the hydrological analysis are mixed. The repeat topographic surveys and sediment budgets identified bed degradation by channel lowering, leading to ongoing incision. The numerical modelling showed a small impact on flood attenuation (<15 min peak travel time delay, <1.2% peak attenuation). This magnitude of change is less than has been for other types of restoration measures (e.g. embankment removal). Reach-scale re-meandering of rivers with relatively low energy, low sediment supply and high vegetation cover may be of limited value for system-scale flood attenuation. However, such schemes do increase physical habitat diversity. To maximise attenuation, scheme design should consider interactions between channel and floodplain topography to maximise connectivity.

Session 9 – Parallel rooms

Monitoring
LECTURE THEATRE 2
15:25

TOOLS TO ASSESS THE HEALTH STATUS OF RESTORED BRAIDED HYDROSYSTEMS

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1 Université Côte d'Azur, CNRS, ESPACE, France, 2 Université de Lyon, CNRS, EVS

Alpine braided rivers have been harnessed for their natural resources and modified profoundly through decades of human activity, sometimes to the point where major risks and ongoing management issues have arisen. Restoration is then a process that aims to return functionality to these hydrosystems, especially in order to reach good ecological status according to the Water Framework Directive. To evaluate and quantify the success of hydromorphological restoration operations in four braided rivers, we combined morphological and ecological analysis tools, in order to produce restoration feedback. We adapted existing morphological metrics developed for near-natural braided rivers (Liébault et al., 2013; Piégay et al., 2009) and showed that, applied to systems impacted by human pressures, they effectively help assessing the success of a restoration operation from a morphological point of view (Devreux et al., 2022). We also developed a sampling strategy for benthic invertebrates adapted to braided rivers (Devreux et al., 2021), based on 4 different spatial scales (station, macro-, meso-, and microscale). Using a BACI approach (Before-After-Control-Impact: Marteau et al., 2022) and a hypothetico-deductive approach on biological and ecological traits, we demonstrated that 1/ five years after restoration, biodiversity was higher in channels discarded by national sampling protocol, thus stressing the importance of considering channel types diversity (macroscale habitats) in braided rivers' sampling protocol and 2/ in the absence of morphogenic flood after restoration, river morphology had a smaller effect on community composition compared to inter-annual variability (Devreux et al., in prep.). Key considerations for the effective management and understanding of these hydrosystems are also presented and discussed within the evolutive trajectories of the studied sites along with a systemic and transdiciplinary perspective.

Session 9 – Parallel rooms

Policy
LECTURE THEATRE 3
14:45

RESEARCH AND MONITORING PRIORITIES FOR MEETING UK GOVERNMENT BIODIVERSITY TARGETS

J. COLLINS[1], L. MITCHELL[1], E. JARDINE[2],

1 WSP, 2 Defra

The UK Government has committed to legally binding targets, as part of the Environment Act, to halt biodiversity loss by 2023 and longer-term targets for 2042 which include: i) a reversal in the decline of species abundance; ii) no net increase in the extinction risk of species; and, iii) to either create or restore 500,000 hectares of wildlife-rich habitat outside of protected sites. The creation and restoration of rivers and other aquatic habitats will be an important component of achieving these species and habitat targets. Habitat restoration will be needed along with a programme of works to address the wider anthropogenic pressures on species and habitats.

The Department for Environment Farming and Rural Affairs (Defra) have commissioned WSP to undertake a rapid literature review to identify the knowledge gaps surrounding the impacts and pressures on aquatic biodiversity. The purpose of this exercise is to summarise the current evidence base available for pressures on aquatic habitats and species recovery, including evidence from the river restoration community. The project will include a review of open access scientific literature and grey literature to focus the study on information which is readily available within the public domain for practitioners and policy makers. This review will identify existing knowledge gaps and requirements for future research and monitoring, to develop appropriate strategies for achieving these government targets. The presentation will summarise the findings of the project and identify opportunities for future collaboration with academia and the wider river restoration community.

Policy
LECTURE THEATRE 3
15:05

A LEVERAGE POINTS FRAMEWORK TO MANAGE CHANGES IN RIVER HEALTH

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1 Arup, 2 Helmoltz Institute for Functional Marine Biodiversity, Oldenburg University

In many regions globally, river health has continued to decline throughout the 21st century due to legacy and ongoing human activities, posing risks to biodiversity, ecosystem services, and human health from water hazards. Restoration efforts range from in-channel changes and reach-scale river corridor interventions, to iterative stakeholder engagement to legitimise adaptive management. A new era of adaptive management is required that is centred around a social-ecological understanding of river systems. This view fosters that restoration efforts are multifaceted interventions and must address challenges at many scales to drive self-reinforcing positive feedbacks that improve river health.

A prominent conceptual lens for environmental change is social-ecological frameworks. We developed a framework centred around approaches to river restoration using the concept of leverage points together with social-ecological feedbacks. Leverage points is a systems thinking approach that attempts to class intervention efforts into categories which range from deep and impactful but difficult to implement, to shallow and less impactful but easier to implement. For river restoration, this rethinking is essential to provide an understanding of how we can target adaptive management action at various scales to have long-lasting impacts.

The output framework is aimed to identify how existing restoration efforts can leverage small-scale interventions and systemic change and achieve positive social-ecological outcomes. The framework is supported by appropriate case studies, and demonstrates the specific (e.g. reach location and river health parameter), accumulative yet bounded (e.g. small-scale interventions across catchments limited by systemic land-use), and multidisciplinary nature of river restoration.

Session 9 – Parallel rooms

Policy
LECTURE THEATRE 3
15:25

DISCUSSION: GLOBAL PERSPECTIVES ON RIVER RESTORATION POLICY.

Session 10 – Plenary room

LECTURE THEATRE 1
16:15

UNDERSTANDING BIODIVERSITY RECOVERY POTENTIAL FOR RIVER RESTORATION PLANNING AND DESIGN

M. WILKES[1], M MCKENZIE[2], M. NAURA[3], M. MORRIS[4], M. VAN DE WIEL[5], A. J. DUMBRELL[1], A. BANI[1], C. LASHFORD[5], T. LAVERS[5], J. ENGLAND[6]

1 University of Essex, 2 Loughborough University, 3 River Restoration Centre, 4 Nature Metrics, 5 Coventry University, 6 Environment Agency

River restoration practitioners and scientists have gained a sound understanding of the recovery potential of rivers from geomorphological and engineering perspectives. However, more research is needed to understand the biological processes involved in successful river restoration. In the global environmental policy arena, nature recovery has become a priority, leading to debates about the use of historical reference conditions to guide ecosystem restoration. We contend that the quest for historical natural or semi-natural reference conditions is inappropriate because analogues for modern ecosystems may not be found in the historical record. Global heating, land use change and the emergence of novel species combinations means that the past is an increasingly poor guide to the condition of twenty-first century ecosystems. We present an alternative to the use of historical reference conditions through paired correlative and process-based models. First, we present a correlative species occupancy and abundance model that can be used to set baselines, quantify the biodiversity recovery potential of rivers, and identify optimal restoration strategies. Second, we discuss the application of a process-based metacommunity model to simulate how abiotic niche processes, biotic interactions, and landscape-scale dispersal combine to realise the recovery potential. Finally, we identify the research gaps that must be filled in order to bring this alternative approach to full scale, focusing in particular on the integration of physical and biological models of river systems.

LECTURE THEATRE 1
16:35

USING NATIONAL-SCALE DATASETS OF RIVER MODIFICATION, ENERGY AND RIPARIAN CONDITION TO PLAN RIVER RESTORATION IN SCOTLAND

R. MARTINEZ[1], H. REID[1]

1 Scottish Environment Protection Agency

Climate change and Biodiversity loss are key challenges needing to be tackled by river management at the landscape scale. This includes restoring geomorphic form and process to slow flood flows, increase biodiversity and improve riparian condition. SEPA has compiled data via remote sensing and field surveys (~7000 km of river length), which have been developed to provide a suite of tools to inform higher level catchment planning. This includes:

1) The river anthropogenic modification index combines river type (sensitivity) with anthropogenic pressures to predict local geomorphic condition (1 km resolution).

2) The Riparian vegetation condition dataset maps riparian health based on density and structure.

3) The River Recovery Potential layer maps stream power to assess if the river can self-recover and whether active (full channel construction) or passive (self-healing) approaches are needed.

4) The Geomorphic risk layer uses results from the S:TREAM model which predicts the degree of erosion or deposition likely, to identify high adjustment zones.

5) The Priority for woodland planting layer combines the riparian condition dataset with stream power to identify active locations with poor riparian margins, so riparian planting can maximise benefits.

6) The Riparian buffer width layer suggests the minimum riparian buffer strip width needed based on channel width.

Combined, these datasets map at a catchment-scale i) the degree of river and riparian degradation, ii) the capacity of reaches to self-heal and iii) where riparian improvements offer the most benefit, thus providing an evidence base to identify zones for more in-depth restoration planning.

Session 10 – Plenary room

LECTURE THEATRE 1
16:55

EVALUATING THE ECOSYSTEM SERVICES MANAGEMENT STYLE OF A NATIONAL-LEVEL RIVER POLICY BY CONTENT ANALYSIS: USING CHINA'S "RIVER CHIEF" POLICY AS A CASE STUDY.

X. XUE[1], Y. LIU[1], D. J. GILVEAR[2]

1 Hubei Minzu University, 2 University of Plymouth

The majority of river restoration efforts are driven by new environmental policies, the success of which often relies on rational management of river ecosystem services (ESs). However, evaluation of the ESs management styles of river policies and implications for restoration has rarely been investigated. This paper aims to evaluate the way in which policy manages river ESs and river restoration initiatives. A content analysis-based approach applied to policy documents was undertaken on China's River Chief (CRC) policy. ESs attributes were summarized according to categories, values, interrelationships among ESs, and stakeholders. A hierarchical evaluation indicator system and its graded keyword series were established to quantify the ESs management styles of the CRC policy. The degrees with which ESs indicators are managed were measured by the weighted keyword frequencies in the policy document. We found that the CRC policy primarily relied on the management of ESs categories, followed by ESs interrelationships, but much less on stakeholders and ESs values to manage rivers. Within the ESs categories emphasis is just placed on water pollution reduction, regulating sand extraction and drinking water supply provision. Among the package of ESs values, only value of pollutants reduction has been integrated into management. For ESs interrelationships, only trade-offs/synergies and spatial relationships have been managed to some degree. For stakeholders, the CRC policy focuses on regulation of administrators and employers. This case study showed a partial and selective management style of river ESs, which would hamper the holistic restoration of rivers. We concluded that the proposed policy document-based evaluation approach can help to identify the policy deficiency in relation to river ESs management, and river restoration possibilities.

- - - Friday 8th September - - -

Session 11 – Plenary room

LECTURE THEATRE 1
09:00

KEYNOTE ADDRESS: Prof. Ellen Wohl[1]

1 University of Colorado

A North American Perspective on Key Scientific Advances and Challenges for River Restoration

I review fundamental aspects of river form and function, as well as human alterations of rivers, before discussing implications for restoration. River form and function rest on fluxes occurring in a biogeomorphic context. Fluxes can be characterized as natural regimes of water, sediment, and large wood. Context includes reach- to network-scale spatial and temporal dimensions and can be characterized by natural range of variability, spatial heterogeneity, three-dimensional connectivity, resilience, physical and ecological integrity, and alternative states. Human alterations include indirect alterations within the catchment and direct alterations within the river corridor. These alterations are ubiquitous, extensive, and intensive in most catchments of the temperate latitudes. Even if these alterations are no longer actively occurring, they typically create legacy effects. Failure to recognize legacies can skew perceptions of river process and form and the natural range of variability in river ecosystems and can constrain restoration options. Key scientific and management challenges are to (i) recognize the existence of a legacy that continues to affect river ecosystem process and form, (ii) understand the source of the legacy (chronology, type, spatial extent, intensity of human activities), (iii) understand the implications of the legacy for how river ecosystem process and form and ecosystem services have changed, and (iv) design management or restoration strategies that can mitigate the loss of river ecosystem services.

LECTURE THEATRE 1
09:45

APPLYING RESILIENCE-THINKING FOR HOLISTIC RIVERINE LANDSCAPE RESTORATION

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1 Massey University, 2 University of New England

To apply resilience-thinking to river restoration requires a perspective extending beyond river channels. However, river resilience and restoration may be over-narrowly conceived. Engineers define a resilient river as one with sufficient structural flood protection to defend against a 500 year flood. Ecologists define a resilient river as one with a robust biology able to adapt to pulse, press and ramp disturbances. Geomorphologists reinvent the wheel and substitute resilience for terms relating to equilibrium theory and sensitivity. These communities, and the emphasis on restoration, invariably focus on what's happening in the river channel, but riverine landscapes are complex mosaics comprising and reflecting holistic interactions between physical and human landscapes: they are truly geo-eco-social systems. River restoration must take people in the catchment into account at multiple scales within the riverine landscape if it is to be resilient. Resilience-thinking recognises the cross-scalar interactions between the landform that is the river and the social-ecological system into which it is nested. A river cannot be conceived as resilient unless these interactions are recognised. A stopbanked-river is shut off from both the human community and its floodplain. Resilience thinking restores these human- and physical connections with the river, which is vital in New Zealand, since for Māori an awa is not just a river – it is an interconnected, living system that for many is ancestral: "I am the river, the river is me". We argue that resilience in riverine landscapes should be best understood as a geo-eco-social property and argue for holistic approaches to restoration.

Session 11 – Plenary room

LECTURE THEATRE 1
10:05

FASCINES FOR RIVERBANK STABILIZATION ON MEANDERS: LESSONS LEARNED FROM FIELD OBSERVATION AND SMALL-SCALE MODELLING

S. LEBLOIS[1,2], G. PITON[1], A. RECKING[1], A. EVETTE[1]

1 INRAE, 2 SUEZ Consulting

Soil and water bioengineering structures implemented for riverbank stabilization bring many co-benefices coming from the vegetation development. These structures highly constrained because placed at bank toe are particularly fragile the first years after implementation before the vegetation recovers. This study details the processes of destabilization of non-cohesive riverbanks implemented with early stage fascines installed at riverbank toe. The understanding of such processes crossed referenced with terrain observation gives insights for future design developments. Fascines with geotextile and other bank configurations are implemented on meanders in a small-scale model, at a scale 1:25. The results are analysed in the scope of field feedback from 470 fascines. The results confirmed by terrain observations show that the major process of this type of riverbank destabilization implemented with fascines is fluvial entrainment. The process is described in three steps: (i) scour development bellow the fascine; (ii) bank material stocked behind the fascine falling to the scour hole; and (iii) fascines stakes uproot. The various tested bank configurations highlighted the necessity to reduce the bank slope to the maximum and to stabilize bank toe below the level of vegetation recovery. Fascines with two bundle show promising results. Specific assemblage with Large Woody Debris to stabilize the scour and soil and water bioengineering to stabilize the bank with vegetation recovery are future options to explore to implement sustainable structures on constrains rivers.

LECTURE THEATRE 1
10:25

INCORPORATING HYDRO-THERMAL REGIMES INTO ENVIRONMENTAL FLOWS ASSESSMENTS AND RIVER MANAGEMENT

R. Ó'BRIAIN[1], C. O'LEARY[1], B. COGHLAN[1]

1 Inland Fisheries Ireland

Flow regulation caused by dams has resulted in long-term ecological degradation of rivers by interrupting fluxes of water, sediment and nutrition. ‘Environmental flows’ has emerged as a management concept that seeks to restore some components of the natural flow regime to conserve stream biota and, in parallel, maintain the ecosystem services required by humans. Yet prevention or mitigation of thermal degradation associated with dams has received far less attention when environmental flows are discussed, despite the fundamental importance of temperature in structuring ecological communities. Here, we present findings from an Irish case study investigating the impact of flow regulation on three rivers downstream of east coast reservoirs by contrasting their hydro-thermal regime with free-flowing rivers draining the same area. Results revealed prolonged periods of disrupted flows and sub-optimal temperatures that threaten sensitive resident salmonid populations in the regulated systems. Regulated rivers generally lacked the expected functional flow types that support the ecological and hydromorphological processes associated with resilient river ecosystems. Managing the impact of hydro-thermal degradation on stream biota will, therefore, be essential to meeting conservation objectives for these water bodies. The trade-off between water uses is made more difficult by the impacts of climate change and a growing human population which is rapidly changing the geography of water demand and land use practices on the east coast of Ireland, both of which have direct and indirect implications for hydro-thermal regimes.

Session 12 – Plenary room

LECTURE THEATRE 1
11:15

RIVERREST: A DECISION SUPPORT TOOL FOR SCREENING 'THE RIGHT RIVER RESTORATION MEASURE IN THE RIGHT PLACE'

P. W. DOWNS[1], A. WILSON[1], H. J. MOIR[1], L. CAMELO[1], C. LAVARINI[2], P. MORRISSEY[3], E. QUINLAN[4], J. DEAKIN[4]

1 cbec eco-engineering, 2 WSP, 3 Trinity College Dublin, 4 Environmental Protection Agency, Ireland

Decision support systems (DSS) help solve loosely structured decision problems using easily understood and interactive systems, adding transparency to decision-making. While the need for DSS in river restoration is recognised, working examples are rare. We outline a recently developed DSS, 'RiverReST', intended to rapidly guide users towards identifying the 'right measure in the right place'; that is, to screen for appropriate, sustainable and effective restoration methods as part of integrated catchment management. RiverReST consists of three primary components. First, an indication of the 'Geomorphic Process Intensity' (GPI) is obtained using remotely derived reach-scale estimates for sediment transport, supply and storage, based on the river's physical characteristics. Combining the GPI with a Modification Index derived from a database of reach-scale human pressures on hydromorphology provides an Index of Recovery (IoR) – the likelihood of the reach self-recovering from those pressures. The third component involves expert scoring to filter prospective restoration measures according to the identified morphological pressures and relative IoR into recommendations for active, assisted or passive restoration approaches. A potential fourth step is to apply a multi-criteria assessment framework to assess practicability. The tool was developed using three pilot catchments to help prioritise restoration measures at the catchment scale, to identify target reaches for applying specific measures, or measures for focal reaches. Once digital data inputs are assembled, the tool can be applied in several hours to provide an initial screening of suitable measures. The tool is currently undergoing validation and calibration tests ahead of potential application across Ireland.

LECTURE THEATRE 1
11:35

EVALUATING THE RESTORATION OF PHYSICAL HABITAT AND THEIR INFLUENCE ON MACROINVERTEBRATE COMMUNITY STRUCTURE IN 18 LOWLAND DANISH STREAMS

M. LAUGE-FEJERSKOV[1]

1 NIRAS

We evaluated the restoration of physical habitats and its influence on macroinvertebrate community structure in 18 Danish lowland streams comprising six restored streams, six streams with little physical alteration and six channelized streams. We hypothesized that physical habitats and macroinvertebrate communities of restored streams would resemble those ofnatural streams, while those of the channelized streams would differ from both restored and near-natural streams. Physical habitats were surveyed for substrate composition, depth, width and current velocity. Macroinvertebrates were sampled along 100 m reaches in each stream, in edge habitats and in riffle/run habitats located in the center of the stream. Restoration significantly altered the physical conditions and affected the interactions between stream habitat heterogeneity and macroinvertebrate diversity. The substrate in the restored streams was dominated by pebble, whereas the substrate in the channelized and natural streams was dominated by sand. In the natural streams a relationship was identified between slope and pebble/gravel coverage, indicating a coupling of energy and substrate characteristics. Such a relationship did not occur in the channelized or in the restored streams where placement of large amounts of pebble/gravel distorted the natural relationship. The analyses revealed, a direct link between substrate heterogeneity and macroinvertebrate diversity in the natural streams. A similar relationship was not found in either the channelized or the restored streams, which we attribute to a de-coupling of the natural relationship between benthic community diversity and physical habitat diversity. Our study results suggest that restoration schemes should aim at restoring the natural physical structural complexity in the streams and at the same time enhance the possibility of re-generating the natural geomorphological processes sustaining the habitats in streams and rivers.

Session 12 – Plenary room

LECTURE THEATRE 1
11:55

EXPERTISE AND FUNDING AS MAJOR DRIVERS OF RIVER RESTORATION OBJECTIVES AND THEIR DIVERSITY

É. GARIÉPY-GIROUARD[1], T. BUFFIN-BÉLANGER[1], P. M. BIRON[2]

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Integrating hydrogeomorphological principles in the restoration of degraded rivers can allow achieving sustainable results to a variety of objectives and benefits that are consistent with potential functioning of rivers as well as their uses. Despite recent management approaches inspired by these principles (e.g. freedom space for rivers), they are still very little considered in Québec. The projects widely consist of controlling fluvial processes, and they often aim for unique and specific objectives that are frequently associated with the habitat of a few high-value fish species. Despite a general lack of monitoring, several projects seem to have led to failure or mixed success. This research aimed to answer the question "Why do river restoration projects hardly integrate hydrogeomorphological principles and diverse benefits?" Four projects have been characterized through a qualitative research process of accompaniment and interviews with the organizations leading them. In addition, two government ministries representatives involved in river restoration and management were interviewed. The results identify two major drivers for the formulation of restoration objectives: project funding and stakeholder expertise. Both contribute to existing frameworks, acting at the same time as conditions and motivations orientating the project objectives. Depending on their content and following diverse contexts, they can restrain or facilitate the integration of hydrogeomorphological principles and the diversity of restoration objectives. This supports policy directions that are better informed by scientific knowledge about hydrogeomorphological and sociocultural river dynamics, knowledge exchange between scientific community and environmental organizations, and concertation between organizations and communities living around rivers.

Session 13 – Plenary room

LECTURE THEATRE 1
12:15

QUESTIONS WITH OUR EXPERT PANEL

Debate with our panel of experts on the current state of river restoration science and practice, future developments, potential contribution to current environmental issues, and policy implications.

Questions can be submitted at any time before or during the conference. If you wish to ask a question, please submit your question using the following QR code.

SCAN ME