Developing transboundary collaboration in the Yellow/West Sea region of East Asian – Australasian Flyway Partnership (EAAFP)

Miss Hyeseon Do

Concurrent 1A, October 11, 2021, 10:59 AM - 12:45 PM

Following the China and Republic of Korea's successful stories on the inscription as the World Nature Heritage in the Yellow/West Sea region, we expect a continuity of this momentum for the next decades on conservation of intertidal wetlands and migratory waterbirds depending on them. Addressing the ongoing threats including climate change, pollution and spread of invasive species, national governments will strengthen their measures for conservation. Nonetheless, more immediate regional cooperation and dialogues based on knowledge base at the flyway, governmental and local level are pivotal.
The East Asian-Australasian Flyway (EAAF) for migratory waterbirds extends across 22 countries from their breeding as far north from Russia Far East and Alaska via East Asia to their non-breeding grounds as far south as Australia and New Zealand. The EAAF is home to some 50 million migratory waterbirds. It is the most threatened of the nine global flyways worldwide, supporting some 36 globally threatened species. Along the EAAF over 1000 internationally important sites for migratory waterbirds are under threat of habitat loss and degradation. While the Yellow/West Sea region provides critical habitats for migrating waterbirds, 65% loss of the tidal flats has been documented over the past five-decades. Hence, the migratory waterbird population has declined, particular those dependent on the Yellow Sea tidal-flats The EAAFP was established to build regional cooperation among various stakeholders to conserve migratory waterbirds and their habitats. This presentation will explain how transboundary and international collaboration can be enhanced by sharing knowledge, science, and management lessons across the EAAF, particularly in Yellow Sea region.

Migrations of bar-tailed godwits around the east Asian-Australasian flyway – threats and responses

Mr David Melville[1], Mr Keith Woodley[2]
[1]Global Flyway Partnership, Nelson, New Zealand, [2]Pūkorokoro Miranda Naturalists' Trust, , New Zealand

Concurrent 1A, October 11, 2021, 10:59 AM - 12:45 PM

The population of the Alaskan-breeding Bar-tailed Godwit Limosa lapponica baueri, endemic to the East Asian-Australasian Flyway, is in steep decline – having dropped 12.7% in New Zealand over the past four years. This population spends the non-breeding season (austral summer) in New Zealand and eastern Australia. Godwits migrate north, undertaking a direct 10,000km flight to the Yellow Sea, where they stage for 4-6 weeks before making a 6,000km flight across the Bering Strait to their Alaskan breeding grounds. After breeding both adults and juveniles fly over the central Pacific to New Zealand – a nonstop 11,500km flight taking some 8-9 days and nights – the longest sustained flight migration of any bird. Godwits require rich feeding grounds to enable the build-up of fat and protein reserves to fuel these remarkable flights. It is thought that massive land claim around the Yellow Sea, which has resulted in a loss of 68% of tidelands in the past 5 decades, mostly in China and South Korea, is driving significant population declines in many migrant shorebird species – the more a species relies on the Yellow Sea the greater the rate of population decline. We will discuss ongoing problems of coastal loss and degradation, and highlight various positive actions, including China's 2018 ban of most coastal land claim and moves to achieve a trilateral World Heritage site.

Raising the awareness of environmental security through collaboration to share knowledge, science, and management lessons of wetlands across boundaries

Prof Changwoo Ahn, Felix Glenk
[1]*George Mason University, Fairfax, Virginia, United States*

Concurrent 1A, October 11, 2021, 10:59 AM - 12:45 PM

There is an increasing need for better science communication and more effective broader impact activities to both conserve and wisely use wetlands globally. As an important habitat for migratory birds, wetlands in Northeast Asia are a bottleneck for various migrating species along the EAAF between Alaska, Russia, China, and Mongolia in the North and Oceania in the South. Therefore, the region is in strong need of more knowledge and further studies for the conservation and wise use of its wetlands. Recently, the Ramsar Convention has entered into force in DPRK with its two wetlands designated as such closing gaps that persisted, which opens up an opportunity to understand the ecology of the region better. This presentation focuses on the background of the symposium and reviews the state-of-art knowledge of wetland ecology and management that has been established mostly based upon the experiences in Europe and North America. It will facilitate much-needed discussion on how we can establish a network of collaborators and knowledge across boundaries to better conserve and wisely use the wetlands in Northeast Asia with a special attention to DPRK.

Securing a future for endangered cranes and wetland biodiversity along the East Asian Flyway

Dr Richard Beilfuss[1], Mr. Spike Millington[1], Ms. Qian Yu[2]
[1]*International Crane Foundation, , United States,* [2]*International Crane Foundation, Beijing, China*

Concurrent 1A, October 11, 2021, 10:59 AM - 12:45 PM

Four endangered crane species – Siberian, Red-crowned, White-naped, and Hooded Cranes – migrate long distances across East Asia where they face increasing threats due to water diversion/regulation, wetland conversion to agriculture, urban expansion, invasive species, fires, powerlines, and poisoning. The future of these imperiled migrants requires a whole-of-flyway conservation approach, with strategies that address needs at every stage of the annual migration cycle. On their breeding grounds, cranes disperse widely to territories that offer essential conditions for nest success: security from predators, adequate food, and optimal water conditions. As the impacts of climate change and land use change increase, we focus on protecting key wetlands that sustain substantial numbers of nesting cranes within their overall breeding range. Along their migration routes, cranes require multiple wetlands for stopover and staging to meet their feeding and roosting requirements. Natural drought and flood cycles, exacerbated by climate change, requiring us to conserve a strategic network of stopover sites and implement best management practices across those sites—aimed at ensuring that sufficient suitable habitat always will be available, despite conditions that can change unexpectedly from year to year. In the winter, cranes form large flocks, and the wintering sites must support large concentrations of birds for months at a time. Unique flyway conservation opportunities include Mongolian wetland/grassland complexes, the fragile Korean DMZ, and China's Poyang Lake, the most important freshwater wetland in East Asia. We draw on the deep cultural and spiritual connection that cranes inspire to safeguard these spectacular birds and wetlands.

The Yellow Sea working group- an innovative regional platform to support the conservation and management of the intertidal wetlands and associated species in the Yellow Sea

Mr Raphael Glemet
[1]*Water and Wetlands, Science and Strategy Group, IUCN Asia Regional Office, ,*

Concurrent 1A, October 11, 2021, 10:59 AM - 12:45 PM

The Yellow Sea ecosystem of intertidal wetlands, associated habitats and the biodiversity that depends on them, encompassed by People's Republic of China (PRC), the Democratic People's Republic of Korea (DPRK) and the Republic of Korea (RoK), is among the ecological wonders of the world. It represents the largest area of intertidal flats on the planet. It provides an important number of vital ecosystem services including fisheries, tourism, disaster risk reduction, blue carbon storage and climate change resilience, which profoundly underpin socio-economic development. Furthermore, this ecosystem provides a major contribution to the global natural heritage as well as that of the three Yellow Sea nations. It is the most important staging area for migratory waterbirds in the East Asian-Australasian Flyway (EAAF) with millions of waterbirds using these wetlands.

These Yellow Sea intertidal and associated coastal wetlands are critically threatened by a wide range of pressures, resulting in their degradation and destruction, especially through unprecedented rates of conversion; around 66% of intertidal wetlands in the Yellow Sea have been lost in the past 50 years. Consequently, fisheries and other coastal natural resources dependent livelihoods are at risk and populations of a number of migratory bird species have recently declined sharply. Considering the transboundary nature of the Yellow Sea, the interrelation between coastal and intertidal areas and species (e.g. birds, fish and shellfish) and the interdependency of coastal dependent livelihoods in the three countries, successful management and conservation are reliant on an informed and coordinated approach among the countries.

The need for the establishment of a regional cooperation mechanism in the Yellow Sea was discussed and identified as part of several national and regional workshops organised by IUCN and partners. During the International Symposium on the Conservation and Management of Intertidal Wetlands of the Yellow and Bohai Sea, held in Yancheng, China in December 2017, participants from the three countries agreed to participate in a joint working group for the conservation and management of the intertidal and associated coastal wetlands of the Yellow/West Sea, or Yellow Sea Working Group (YSWG). It is facilitated by IUCN, the EAAFP and the RRC-EA and implemented under the umbrella of IUCN World Conservation Congress Resolution 26 on the Conservation of intertidal habitats and migratory waterbirds of the East Asian-Australasian Flyway, especially the Yellow Sea, in a global context.

This working group, gathering government representatives and NGOs from the three Yellow Sea countries, is the first of its kind and ensures a coordination at regional level, to harmonise and catalyse national and joint actions on the conservation and management of the intertidal wetlands and associated species in the Yellow Sea.

Constructed wetlands at a landscape scale: Experience from Te Ahuriri

Ms Su Young Ko[1], Mr Stu Farrant[2]
[1]*Environment Canterbury, Christchurch, New Zealand,* [2]*Morphum Environmental, , New Zealand*

Concurrent 1D, October 11, 2021, 10:59 AM - 12:45 PM

Whakaora Te Ahuriri wetland is an ambitious project to restore ecological, cultural and social values through the construction of a large wetland system on land previously drained to support agriculture. The site is located where the margins of Te Waihora/Lake Ellesmere once met the freshwater input of the Huritini/Halswell River within the large flat gradient catchment in the Canterbury Plains. With an intent to improve water quality from upstream agricultural inputs, support mahinga kai uses and reinstate 'lost' biodiversity values, the design and construction followed a collaborative process to reflect the vision of the Te Waihora Co-Governance Group to work closely as iwi, central and local government, industry and the wider community, to restore the mauri of Te Waihora/Lake Ellesmere.

The design and construction of a large-scale wetland on a flat gradient catchment presented a number of challenges which needed to be worked through. These included a careful balance of cut and fill to manage potential impacts on flooding, design of hydraulic controls and wetland bathymetry to pass a controlled flowrate through the system and a well-considered earthworks and construction strategy to avoid too much disturbance of the soil which was highly responsive of the river and groundwater levels and quickly became unworkable with too much vibration.

Long-term, Te Ahuriri wetland will support a study of the effectiveness of constructed wetlands in terms of both Matauranga Maori and 'western' science to contribute to the progressive improvement of New Zealand's freshwater lakes and estuaries.

The Whakaora Te Ahuriri Constructed Wetland: An Example of Collaboration and Consensus

Mr David Murphy[1], Dr. Tim Davie
[1]*Environment Canterbury, Christchurch, New Zealand*

Concurrent 1D, October 11, 2021, 10:59 AM - 12:45 PM

Ahuriri Lagoon, which drains into Te Waihora/Lake Ellesmere, was once a significant mahinga kai resource to Ngāi Tahu. However, with European settlement, the Lagoon was completely drained and the mahinga kai values had been all but lost. To improve water quality, mahinga kai, and biodiversity values, the Whakaora Te Ahuriri project was initiated to develop a constructed wetland at the site. The project has been a model of collaboration and consensus, with: the constructed wetland co-designed by consultants, staff, and representatives of mana whenua and neighbouring farmers; the delivery of the project by a multi-disciplinary project team; and the project's governance by the Te Waihora Co-Governance Group. With the completion of engineering and earthworks over the four-hectare site, and the installation of 124,000 plants, the wetland is now operational. The outcomes of the project will be measured via the complementary approaches of a Mātauranga Māori monitoring programme and an applied research methodology. Time invested in project relationships resulted in a design that met the aspirations and expectations of all partners, and the ability to overcome challenges during the design and construction phases.

Whakamataara Ahuriri – the journey towards reinstating and restoring a once thriving cultural ecosystem and habitat

Miss Mapihi Martin-Paul

Concurrent 1D, October 11, 2021, 10:59 AM - 12:45 PM

Ahuriri Lagoon is a former open water wetland and significant mahinga kai located on the Huritini / Halswell River in the Te Waihora / Lake Ellesmere catchment. For Ngāi Tahu whanui, Ahuriri is associated with their longstanding settlement and occupation of the Port Hills, Te Waihora and the wider Canterbury Plains.

Boffa Miskell consultants were tasked with designing and delivering a Mātauranga Māori Monitoring Programme as part of the wider Whakaora Te Ahuriri project. The objectives of the Mātauranga Māori Monitoring Programme were to demonstrate how to measure the cultural outcomes of the Whakaora Te Ahuriri project and determine whether the reinstated Ahuriri Lagoon has improved cultural outcomes for Ngāi Tahu Papatipu Rūnanga.

The Mātauranga Māori Monitoring Programme sought to integrate cultural values and aspirations into the design and construction of the wetland, with a particular focus on improving mahinga kai, by providing a catalytic wetland system that tests both its probability and value in restoring the lagoon, its habitats, and some of its original functions for Ngāi Tahu.

The design and implementation of the monitoring programme involved working in collaboration with Papatipu Rūnanga representatives to monitor six sites across the Ahuriri area, in the Huritini / Halswell River and within the reconstructed Ahuriri Lagoon, using various cultural monitoring tools such as the Takiwā tool, the Cultural Health Index and monitoring of the fish communities. Throughout the Whakaora Te Ahuriri project, mātauranga Māori has been identified as critical to successful design and reconstruction of the traditional wetland, and an essential tool to monitor the wetland's progress and performance.

“Wetlands don’t work”: wetlands, water quality and confronting barriers to change

Mr Robert Mcinnes[1]

[1]RM Wetlands & Environment Ltd, Littleworth, United Kingdom, [2]Institute for Land, Water and Society, Charles Sturt University, Albury, Australia

Concurrent 1E, October 11, 2021, 10:59 AM - 12:45 PM

All over the world, wetlands are used to address point or diffuse pollution. The history of creating or constructing wetlands goes back almost seventy years, so the concept of utilising wetlands to tackle water quality issues is not new. However, with increasing concern regarding the quality of surface waters, the loss of aquatic biodiversity, the risks to human health, the unsustainable costs (in terms of both capital and operational costs) and inherent, high levels of embedded carbon, there should be unmitigated enthusiasm to embrace wetlands as low-cost, multi-benefit natural infrastructure solutions for water quality challenges. Alas, drawing on examples of the implementation of integrated constructed wetlands from North West Europe, but with relevance at global scale, it is clear that there are major evidential, institutional and psychological barriers that impede widespread adoption of wetlands in future water quality management. This presentation will discuss some of the challenges to, and propose possible solutions for, enhancing future uptake of wetlands in water management in order to ensure that well-designed wetlands, which integrate across social, economic and environmental landscapes, proliferate.

CONSTRUCTED URBAN WETLANDS - THE OPPORTUNITIES THAT LIE BEYOND TRADITIONAL STORMWATER MANAGEMENT

Mr Giuseppe La Spina[1]
[1]*WGA Engineers, Adelaide, Australia*

Concurrent 1E, October 11, 2021, 10:59 AM - 12:45 PM

Land use changes from human activities have altered natural drainage patterns and water regimes resulting in degradation and decline of surface and groundwater dependant ecosystems. While sensitive areas of land are set aside for conservation, unfortunately these natural habitats can be completely cut off from water sources. Implementation of Constructed Urban Wetlands offers an opportunity to restore environmental function and facilitate ecosystem services.

Traditional Constructed Urban Wetlands are designed to provide treatment and visual aesthetics in an urban setting. Indeed, wetlands can provide functions beyond the traditional realm. They can restore natural environmental functions to existing isolated remnant conservation areas. This approach challenges the traditional role beyond current practice. One such example was the new wetland constructed as part of 170 Hectare developing urban area located south of Adelaide, Australia. It lies directly adjacent to a Conservation Park that lies on natural sand lenses and a shallow perched aquifer system, which supports a coastal woodland system and its marshes. Historical development has seen its freshwater marshes dry up, resulting in declining plant diversity and vegetation health.

A urban growth area adjacent to this Park presented an opportunity to re-think traditional stormwater management approaches. The shallow aquifer was recharged through the planned urban wetland to reinstate controlled stormwater flow back towards the Park with a passive recharge scheme. After 12 months of the scheme's establishment, the Park has seen the activation of its freshwater marshes and re-germination of historical plant species. This project provides a blueprint for other planned development areas.

Flood control and water quality benefits accruing from wetlands in urban environments

Dr Priyanie Amerasinghe[1], Dr. Matthew McCartney[1]
[1]*International Water Management Institute, Pelawatte , Sri Lanka*

Concurrent 1E, October 11, 2021, 10:59 AM - 12:45 PM

Ingenuity in the design of cities is a prerequisite for meeting the current and future aspirations of urban populations. It is also essential to ensure sustainability and resilience in the face of climate change and other disruptors to the normal evolution of cities. Wetlands in urban and peri-urban settings can, in the right circumstances and in combination with built infrastructure, mitigate floods, act as buffers against storms and improve water quality. Evidence is mounting that integrated systems, combining built and natural infrastructure (i.e. both natural and constructed wetlands) are not only more resilient but also, in some cases, require less operational effort and reduce the costs of water resources development. However, care is needed to understand dynamic wetland functions and limitations. For example, to ensure that chemical loadings do not exceed the physiological tolerances of wetland microbes, plant and animal species. Drawing on experience from both the developed and developing world, this presentation will demonstrate the value of integrating wetlands with traditional built infrastructure to enhance the livability of cities and build the resilience of urban communities. The need for strong political will to protect urban wetlands and support green growth is emphasized as is the importance of systems monitoring.

Investing in flood management: lessons on making the case for natural processes

Dr James Robinson, Dr Matthew McCartney[1], Ms Anne Harrison[1], Ms Estefania Golob[1], Dr Hannah Robson[1], Dr Geoff Hilton[1]
[1]*The Wildfowl & Wetlands Trust, Slimbridge, United Kingdon*

Concurrent 1E, October 11, 2021, 10:59 AM - 12:45 PM

Climate change is likely to mean more frequent and intense fluvial and coastal flooding for many countries across the globe, often affecting the poorest communities. In the UK, governmental and non-governmental organisations have been working together to develop a more sustainable and efficient way to manage flooding using natural processes at the coast and in river catchments.

Hard flood defences have been used to manage flooding but it is now widely recognised that these defences alone are not enough. In recent years, there has been increased attention given to softer approaches that offer more sustainable ways of managing flood risk. Natural Flood Management (NFM) is an approach in fluvial systems that uses opportunities in the landscape to hold back and slow down the flow of water before it reaches homes and businesses.

In this presentation, we discuss the policy platform and financing mechanism that have underpinned NFM in the UK to date and present evidence on the effectiveness of this technique in two freshwater catchments in southwest England. We also explain the multiple additional benefits this approach provides for people and wildlife and identify how more much-needed action could be facilitated through more innovative financing mechanisms.

Technical and stakeholder solutions to enhance the functions of natural infrastructure

Dr Matthew Simpson[1], Dr Priyanie Amerasinghe[2]
[1]35percent, Stroud, United Kingdom, [2]International Water Management Institute, Colombo, Sri Lanka

Concurrent 1E, October 11, 2021, 10:59 AM - 12:45 PM

To effectively deliver sustainable water resource investments they need to be resilient to emerging challenges such as climate change whilst realising multiple benefits for the environment and local communities. In practice this is often hard to achieve, particularly if local communities are not fully engaged in the design, construction and management process. To examine issues related to delivering successful wetland natural infrastructure projects two case studies in the UK (River Swilgate) and Sri Lanka (Metro Colombo Catchment) will be discussed. Severe flooding of the River Swilgate has impacted residents and raised the profile of river management among stakeholders. Government agencies have identified the flood mechanisms responsible and that the river is in poor ecological status due to physical river alterations and diffuse pollution. Extensive community consultation led to the establishment of a partnership project which brought together government agencies, local community and civil society groups to consider wetland natural infrastructure options for the river and floodplain. Colombo's wetlands are fundamental natural infrastructure supporting the well-being of residents. The wetlands provide a range of benefits, such as flood mitigation, climate cooling and water treatment. Despite recognition of the importance of these urban wetlands, extensive loss and degradation has occurred with 60% being lost since the 1980s. To halt this loss it is essential that the value of the wetlands is fully recognised and natural infrastructure is incorporated into urban planning. This paper will present the technical and stakeholder engagement challenges, successes and solutions in recognising and delivering effective wetland natural infrastructure.

Wetlands and flow regulation

Dr Matthew McCartney[1], Dr Priyanie Amerasinghe
[1]*International Water Management Institute, Colombo , Sri Lanka* , [2]*International Water Management Institute, Colombo, Sri Lanka*

Concurrent 1E, October 11, 2021, 10:59 AM - 12:45 PM

By affecting evapotranspiration and influencing how water is routed and stored in a basin, wetlands make a significant contribution to the hydrological cycle. Although widely attributed a major role in regulating flows (i.e. both attenuating floods and maintaining flow during dry periods) these services are rarely factored into the planning and management of water resources. One reason for the failure to include them is lack of understanding of the hydrological functions occurring, their dynamic nature, and the interaction of these functions with the catchments in which wetlands are located. Both the lack of quantitative information and a recognized method to incorporate them into decision-making processes, make it very difficult to integrate natural hydrological functions into the planning and management of water resources. This presentation summarizes the findings of a study conducted to quantify the flow regulating functions of wetlands in the Zambezi basin. A simple pragmatic approach, utilizing readily available flow data, was developed and applied at different locations within the basin. The results demonstrate the difficulty of generalizing impacts; simple correlations between extent of wetlands within a catchment and impacts on flow were not found. The strength of the method is that it enables the impacts of wetlands on flow to be made explicit without the need to resort to complex computer models. As such, it provides a way for water resource planners and engineers to deduce the impacts of wetlands on flows and assess the implications (positive or negative) for communities living downstream.

Calibration of a global model for regulating ecosystem services of inland wetlands

Dr Anne Van Dam[1,5], Dr Jeroen J.M. de Klein[2], Dr Anne A. van Dam[3,6], MSc Edwin M.A. Hes[3], Dr Rens van Beek[4], MSc Isabel Wallnöfer[3], Prof Jos T.A. Verhoeven[4]

[1]PBL Netherlands Environmental Assessment Agency, The Hague, The Netherlands, [2]Wageningen University, Wageningen, The Netherlands , [3]IHE Delft Institute for Water Education, Delft, The Netherlands, [4]Utrecht University, Utrecht, The Netherlands, [5]Netherlands Institute of Ecology, Wageningen, The Netherlands, [6]Institute for Land, Water and Society, Charles Sturt University, Albury, Australia

Concurrent 2A, October 11, 2021, 3:00 PM - 4:45 PM

Natural wetlands deliver a range of ecosystem services like water, food and fiber provisioning, carbon sequestration, nutrient retention, and support for biodiversity. Wetlands also play an important role in adaptation to climate change. Despite their value, wetlands are disappearing at an alarming rate, and the remaining wetlands are threatened by hydrological alteration, pollution and climate change. For more effective wetland management and conservation, decision makers need to relate the loss and degradation of wetlands to regional and global land-use and climate change, and improve wetland management to optimize their ecosystem services. Wetlands are, however, grossly under-represented in global models and assessments. Here we present a model that estimates biomass production, carbon emissions, and water quality of freshwater wetlands globally for different climate and land-use scenarios. The main hydro-ecological processes are described in a generic way, accounting for climate zones and main wetland types (rain-/groundwater fed and floodplain wetlands). The model is coupled to global hydrological (PCR-GLOBWB) and climate and land-use (IMAGE) models. It estimates the contribution of wetlands to ecosystem services, particularly regulating ecosystem services like water regulation, carbon sequestration and nutrient retention that are difficult to quantify otherwise. We report the results of application of the model to wetlands in widely varying climate regions (Sweden, Spain and Kenya). A regionalized parameterization is in progress. Further potential applications of model outcomes include regional assessments of wetland ecosystem services, and determining trade-offs in ecosystem services under alternative management or land use scenarios.

Coastal blue carbon ecosystems: state of knowledge of blue carbon in the Ramsar site network

Dr Siobhan Fennessy[1], Dr Leanne Wilkinson[2], Dr Lisa Beers[3]
[1]Kenyon College, Gambier , United States, [2]Australia Department of Agriculture, Water and the Environment, Canberra, Australia , [3]Silvestrum Climate Associates, San Francisco, USA

Concurrent 2A, October 11, 2021, 3:00 PM - 4:45 PM

Coastal wetlands contain some of the highest stores of blue carbon (i.e., carbon held in tidally influenced coastal systems) in the biosphere. However, more than a third of global blue carbon wetlands have been lost and many others impacted by human activities, making it critical to understand and protect the quantity and distribution of carbon stored in those that remain. Globally, between 25-40% of all of the atmospheric carbon captured by the earth's ecosystems occurs in blue carbon wetlands and coastal Ramsar sites make a substantial contribution to this vital ecosystem service. Despite this, the blue carbon stocks of Ramsar sites have not been assessed. We find that the Ramsar network supports 789 blue carbon sites (e.g., seagrass beds, intertidal marshes, and mangroves) in 115 member countries; 71 countries support all the major blue-carbon ecosystem types. We present estimates of carbon stocks in each Ramsar region, and link those to the presence of anthropogenic stressors (including vulnerability to sea level rise, conversion, infrastructure development, drainage, invasive species, fire or natural disasters) that place these stocks at risk. The most common stressors were identified as resource overuse in forested wetlands, and impacts from pollution for seagrass beds and intertidal marshes. Understanding the role of Ramsar Sites in providing this service is critical for international efforts to protect stored carbon, making them an integral part of efforts in climate mitigation, particularly in the context of reporting of Nationally Determined Contributions under the Paris Climate Agreement.

Emerging issues for wetland conservation and wise use

Prof Max Finlayson[1]
[1]*Institute For Land, Water & Society, Charles Sturt University, Albury, Australia*

Concurrent 2A, October 11, 2021, 3:00 PM - 4:45 PM

The Ramsar Convention on Wetlands has been working for almost 50 years through the activities of its 171 Contracting Parties. This has included the listing of a large number of wetlands as internationally important. This is an impressive outcome, but runs in parallel with the failure to make wise use of other wetlands and secure the many benefits that accrue to local people and communities wider afield. This is shown in the 2018 Global Wetland Outlook produced by the Convention. With this in mind what else needs to be done, and what are the emerging issues for wetlands? The struggle to effectively address climate change and develop guidance on adaptation for wetlands is one key issue. We also have emerging pollutants. At the same time it may be necessary to address the mechanisms of the Convention itself - recent analyses have shown that many are not that effective. While the Convention has had many successes the near future brings major biophysical challenges as well as a need to address administrative and reporting processes. If these can be done then the worth of wetlands globally and locally may be achieved and the many touted benefits from wetland ecosystem services achieved. This is important and can be done if Contracting Parties step up to the mark - they have had 50 years and its time the prevarification ceased and the ambition of the founders finally realised. It will benefit all of us if this was the case. Its time...its needed.

Peatland ecosystems – status, restoration and role in climate regulation

Mr Lars Dinesen[1]
[1]*Ramsar Convention Strp, Copenhagen, Denmark*

Concurrent 2A, October 11, 2021, 3:00 PM - 4:45 PM

Peatlands are crucial for their contribution to conserve biodiversity and for climate change regulation including carbon storage. Peatlands take up no more than 3 % of the land surface of the world but store twice as much carbon as forests. The importance of peatlands for the climate is increasingly recognized both at the global as well as national level. The latter is crucial to combat climate change. Most of the world's peatlands are still in pristine condition and it will be crucial to future generations to seek to conserve these peatlands in this condition to the extent possible. Only 15 % of the world's peatlands are degraded primarily by draining and these degraded areas contribute with 5 % of global carbon emissions from no more than 0.4 % of the global land area. Thus peatland restoration provides a significant contribution to mitigate climate change by reducing carbon dioxide emissions due to reestablished waterlogged conditions preventing oxidizing of organic material which until recently had been stored under water but drained due e.g. cultivation of crops or plantations. Hence, focus in recent years is on peatland inventories, designation of peatlands as Wetlands of International importance (Ramsar sites) to promote peatland conservation as well as on ways and means to restore peatlands. Restoration methodologies will be shared by the convention based on experiences from a number of countries while vast peatlands stores are still being discovered in others adding up to be the global importance of peatlands for climate change regulation.

Sustainable agriculture and wetlands – reviewing the positive and negative impacts of agricultural practices

Dr Hugh Robertson[1], Dr Anne van Dam[2]
[1]Department of Conservation, NZ, Nelson, New Zealand, [2]IHE Delft Institute for Water Education, Delft, The Netherlands

Concurrent 2A, October 11, 2021, 3:00 PM - 4:45 PM

Urgent action is needed at the international, national and local level to promote sustainable agricultural practices for the conservation and wise use of wetlands. Agriculture has expanded and intensified in many regions of the world to meet increasing food demand and respond to changes in food preferences. While there is increasing recognition and application of nature-based solutions, agriculture remains one of primary global drivers of wetland loss, decline of biodiversity and reduction of ecosystem services.

To improve sustainability, policy makers, the agricultural sector and environmental managers require greater understanding of the impacts of intensive versus extensive cropping and livestock farming on different wetland types. An issue being addressed by the Ramsar Convention's Science and Technical Review Panel (STRP) during the 2019-2021 triennium.

A review of positive and negative impacts of agricultural practices on wetlands has been initiated by Ramsar STRP. This examines recent global assessments on the status of wetlands, trends in land and water development and climate change. It also draws on case studies of sustainable farming systems, and, evaluates the extent that agriculture is affecting the world's Ramsar sites. We will report on the outcomes of this international review and describe 'responses' to alleviate adverse effects on wetlands.

Protecting New Zealand's Wetlands: Essential Freshwater Policies, Regulations and Implementation Tools

Ms Jessica Dickinson[1]
[1]*Ministry for the Environment, , New Zealand*

Concurrent 2B, October 11, 2021, 3:00 PM - 4:45 PM

The Ministry for the Environment will present an overview of current wetlands policies and regulations in the National Policy Statement for Freshwater Management (NPS-FM) 2020, and the Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (Freshwater NES), which came into force in September 2020, and are designed to protect the remaining extent and values of New Zealand's natural inland wetlands.

The session will also cover implementation of the policies and regulations in practice, including an overview of guidance and support tools already released and those in progress.

Manaaki Whenua Landcare Research will lead an overview of the wetland delineation protocols, which have been adapted from the US system to a New Zealand context, and are incorporated by reference into the NPS-FM to assist councils where there is uncertainty or dispute as to the existence or extent of a natural inland wetland.

Morphum Environmental and Lynker Analytics will lead an overview of a mapping methodology developed as a first step to assist councils to map the extent of remaining natural inland wetlands.

The Policy of Building Constructed Wetland Systems: A Case Study in Metropolitan Taipei, Taiwan

Prof Wei-Ta Fang[1]
[1]*National Taiwan Normal University, Taipei, Taiwan*

Concurrent 2B, October 11, 2021, 3:00 PM - 4:45 PM

Since 2004, fourteen clustered constructed wetland systems have been built along the Danshui River and its tributaries. This “big-dig” project was designed to: 1) achieve water-quality standards according to the regulations of the Taipei municipal governments for connecting households to public sewage systems from clustered constructed wetland systems, 2) improve wastewater purification, and 3) use all corridor wetlands to promote sustainable development while supporting urban recreation, environmental education, and habitat restoration for biodiversity. Total construction cost was $33,706,600 ($US) for the systems. For 10 years, I have studied and examined their functional capabilities associated with treating non-point source pollution. To date, monitoring water indicators, such as dissolved oxygen, biochemical oxygen demand, suspended solids, ammonia, and Escherichia coli, at 13 sampling sites have demonstrated that water quality in Taipei metropolitan rivers has improved. Constructed wetlands in Metropolitan Taipei thereby play a crucial role in preventing extreme deterioration in water quality. The Millennium Ecosystem Assessment was used to evaluate ecosystem services for the constructed wetlands in Metropolitan Taipei. My work has also shown that these constructed wetlands also control the flow of rivers in drought/flood seasons and increase biodiversity in this river corridor. Constructed wetlands in Metropolitan Taipei play a crucial role in preventing extreme deterioration in water quality as well as water quantity. Therefore, I recommend that local governments consider building more constructed wetlands to improve water quality. These constructed wetlands, a simulated wild land, will also provide various opportunities of biophilic participation by metropolitan citizens.

Identifying priority habitats for protecting braided river birds

Dr Amy Whitehead[1]
[1]*NIWA, Christchurch, New Zealand*

Concurrent 2D, October 11, 2021, 3:00 PM - 4:45 PM

Braided river ecosystems are globally rare, with a unique suite of species adapted to their dynamic habitats. However, braided rivers are increasingly impacted by water abstraction, impoundment and flood control. These modifications alter flow regimes, which in turn alters the availability and quality of habitat for endemic species, including braided river birds. Flow regime alterations also affect adjacent terrestrial habitats, and consequently, the distributions of invasive weeds and pests. Many of New Zealand's endemic braided river birds are threatened, partly attributable to flow alteration. With increasing pressure on water resources projected for the future, braided rivers need to be managed to complement biodiversity conservation and restore resilient ecosystems. There is currently little guidance on how to manage flow regimes for braided river birds, which has impeded management actions and regulatory planning.

We use a systematic conservation planning approach to identify high priority areas in the New Zealand riverscape for braided river birds and assess where potential conflicts are likely to occur due to high human demand for water. Understanding the landscape-scale habitat requirements of braided river birds and the proximity of this habitat to areas of high demand for water abstraction may help to identify areas where measures can to be taken to reduce potential conflicts. We compare the findings of this research with previous understanding about braided river bird habitat and existing mechanisms used for flow setting.

Tōrea/South Island pied oystercatcher on the move: Linking movements and vital rates to inform conservation of New Zealand mobile species

Dr Anne Schlesselmann[1], Dr Emma Williams[2], David Melville[3]
[1]Manaaki Whenua - Landcare Research, Dunedin, New Zealand, [2]Department of Conservation, Christchurch, New Zealand, [3]Ornithological Society of New Zealand, Nelson, New Zealand

Concurrent 2D, October 11, 2021, 3:00 PM - 4:45 PM

Most New Zealand's endemic migratory species using coastal and inland wetland areas are in decline, but management of these species is challenging given they are not at one site year-round. A new research partnership between the Department of Conservation, Manaaki Whenua–Landcare Research and the Ornithological Society of New Zealand aims to substantially boost knowledge of which conservation actions are most effective for inland migrants. Tōrea/South Island Pied Oystercatchers (SIPO; Haematopus finschi) have been chosen as a focal species to a) test GPS tracking technologies, b) build richer data on flyways and nodes nationally, and c) to develop a spatial population model linking wintering and breeding sites under different management regimes, to better understand how threats and local management regimes affect population dynamics. We report the first field season's results showing high nesting success and chick survival in the upper Rangitata Valley, and pre- and post-breeding movements across New Zealand. Two national routes have emerged as common flight-paths for SIPO: a northern route along the southern alps/up the western Waikato coastline, and a southern route down the eastern side of the South Island. We've also been able to identify regional site networks and hotspots for less mobile non-breeders, as well as tag fledglings to show juvenile migration patterns that remain independent from adults. We are now starting to combine this research, enabled through technological advances, with citizen science contributions. The inter-agency collaboration and citizen science partnership allows researchers, conservation managers, and other stakeholders to enabling better conservation decisions for mobile species.

Carbon Storage During Upslope Marsh Transgression in Chesapeake Bay, USA

Prof Kathryn Schreiner[1], Dr. Glenn Guntenspergen[2], Rachel Van Allen[1]
[1]University Of Minnesota Duluth, Duluth, United States, [2]United States Geological Survey, Duluth, United States

Concurrent 3A, October 12, 2021, 10:45 AM - 12:15 PM

Salt marsh, mangrove swamp, and seagrass bed ecosystems comprise a global carbon stock known as “blue carbon.” While these ecosystems have a small global areal extent, their total carbon burial rates are comparable to global marine carbon burial rates, giving them an important and outsize role in the global carbon cycle that is just beginning to be fully understood. Under various scenarios of environmental change, including climate warming, sea-level rise, and vegetation change, the role of these systems in the global carbon cycle could change significantly, potentially becoming a source of carbon to the atmosphere. It is therefore important to understand the factors controlling carbon storage in coastal wetland systems in order to better predict their future behavior. Here, we will present data from a study marsh in the Blackwater National Wildlife Refuge in Chesapeake Bay, Maryland, USA, where a marsh is transgressing inland with sea level rise into an upland forest environment. Surface carbon accumulation rates range from 0.022 g C cm-2 yr-1 in the lower-elevation, oldest reaches of the marsh to 0.061 g C cm-2 yr-1 at the middle elevations of the marsh. Stable carbon isotope analysis of marsh soils gives evidence for a transition from C3 upland-sourced organic matter to C4-dominated marsh vegetation over time. Stable isotope and lignin chemistry results illustrate that landward encroachment of marsh grasses results in deposition of herbaceous tissues that exhibit relatively little decay. This presents a possible mechanism for organic matter stabilization in marsh soils as marshes migrate inland.

Coastal wetland carbon storage is controlled by accommodation space and influenced by sea-level rise

A/Prof Kerrylee Rogers[1], Prof Neil Saintilan[2], Dr Jeffrey Kelleway[1]
[1]School of Earth, Atmospheric and Life Sciences, University of Wollongong, Wollongong, Australia, [2]Macquarie University, Sydney, Australia

Concurrent 3A, October 12, 2021, 10:45 AM - 12:15 PM

The urgent need to mitigate climate change has focussed attention on the capacity of coastal wetlands, primarily mangroves and saltmarshes, to sequester and store carbon. Substrate carbon storage is related to vegetative capacity to add organic matter to substrates, and physical processes that enhance organic matter preservation and/or limit decomposition. Inundation by saline tidal waters is crucial for vegetative additions, and processes favouring preservation over decomposition. Global scale analyses have variably highlighted the role of temperature and precipitation on wetland carbon storage, but have ignored the fundamental influence of sea level on tidal inundation. By conceptualising the accommodation space available for carbon storage as being bounded by sea level, the influence of global variation in relative sea level over the past few millennia on soil organic matter and carbon storage within substrates of coastal wetlands is demonstrated. Using a unique study site exposed to rapid relative sea-level rise that resulted in a substantial increase in accommodation space, the relationship between carbon sequestration and sea-level rise is validated over short time scales. This confirms the capacity of coastal wetlands to adjust to sea-level rise by storing soil organic matter. The space available for carbon storage within mangrove and saltmarsh has become increasingly limited for many coastal wetlands where sea level has been stable for the past few millennia, particularly in the southern hemisphere. This paper verifies that sea-level rise will enhance carbon sequestration providing sediment supply is sufficient and space for lateral expansion does not become limited by coastal squeeze.

Mangrove extent and carbon burial during the closing stages of the postglacial marine transgression

Prof Neil Saintilan[1], Dr Nicole Khan[2], Dr Erica Ashe[3], Dr Jeffrey Kelleway[4], Associate Professor Kerrylee Rogers[4], Professor Colin Woodroffe[4], Professor Benjamin Horton[5]
[1]Macquarie University, Sydney, Australia, [2]Department of Earth Sciences, Hong Kong, China, [3]Rutgers University, New Brunswick, USA, [4]University of Wollongong, Wollongong, Australia, [5]Nanyang Technological University, Singapore, Singapore

Concurrent 3A, October 12, 2021, 10:45 AM - 12:15 PM

Evidence is presented of pan-tropical mangrove expansion co-incident with the closing stages of the post-glacial marine transgression from ~9000BP-7000BP. In situ mangrove vertical substrate development was analysed across 78 locations and occurred as rates of sea-level rise fell below 7mm per year. These forests represented a significant carbon sink and coincided with 5 ppmv lower global atmospheric CO2 concentrations. Ongoing vertical accretion led to the replacement of mangrove by freshwater wetland and terrestrial vegetation in many geomorphic settings, possibly contributing to mid- late-Holocene increases in atmospheric methane concentrations.

Quantifying nutrient addition impacts on pristine wetlands & methods to calculate change from baseline

Dr Olivia Burge[1], Dr Beverley Clarkson[2], Ms Kerry Bodmin[3], Mr Scott Bartlam[2], Dr Hugh Robertson[4], Mr James Sukias[3], Dr Brian Sorrell[5,6], Dr Chris Tanner[3]

[1]Manaaki Whenua - Landcare Research, Lincoln, New Zealand, [2]Manaaki Whenua - Landcare Research, Hamilton, New Zealand, [3]National Institute of Water and Atmospheric Research, Hamilton, New Zealand, [4]Department of Conservation, Nelson, New Zealand, [5]Aarhus University, Aarhus, Denmark, [6]National Institute of Water and Atmospheric Research, Christchurch, New Zealand

Concurrent 3B, October 12, 2021, 10:45 AM - 12:15 PM

Increased nutrients in wetlands can lead to a decline in species richness, and compositional turnover. While the whole-community foliar N:P is a useful indicator of N or P limitation, in long-lived, sensitive ecosystems, it is not practicable to remove the biomass of an entire plot to ascertain the foliar N:P ratio. Fertilisation experiments were conducted at four wetlands around New Zealand to examine the vulnerability of pristine wetlands to increased nutrients and the utility of sampling only the foliage of dominant vegetation. Vegetation composition and foliar nutrients were assessed before and after nutrient addition, which lasted four years. Biomass was sampled after four years. We discuss (a) the ecological effects of nutrient (nitrogen) addition at a rate that simulates realistic agricultural run-off on pristine wetlands; (b) the utility of sampling a small amount of foliage from several dominant species to generate an N:P ratio and whether this predicts community nutrient limitation; and (c) how to incorporate natural variability in baseline condition when testing for impacts of nutrients and other disturbances. Although little compositional turnover was seen from realistic N addition, the New Zealand biota (including species found on our plots) is known for its longevity. Longevity is one factor contributing to ecological lags, and we suggest that longer periods of monitoring are required to understand long-term effects (i.e. delayed invasion by species adapted to higher nutrients).

Rare ecosystems – recovery of Sporadanthus raised bog

Dr Beverley Clarkson[1]
[1]*Manaaki Whenua - Landcare Research, Hamilton, New Zealand*

Concurrent 3B, October 12, 2021, 10:45 AM - 12:15 PM

Peatland extent and condition in New Zealand have declined significantly over the last 180 years, coinciding with the main period of European settlement. Many remaining peatlands continue to degrade from the impacts of drainage, invasive species, fires and peat mining. A comparison of historic and current wetlands was used to determine priorities for restoration according to extent, type and distribution in northern New Zealand. This identified the widespread loss of an endemic and rare ecosystem type, restiad (family Restionaceae) raised bog dominated by the threatened species, Sporadanthus ferrugineus and Empodisma robustum. Experimental trials following peat mining in this bog type were based on species and environmental conditions typical of both early and late succession, and showed vegetation recovery was most successful when it emulated bog development. Upscaling to whole project restoration involved a patch approach, whereby small 'islands' of the desired peatland vegetation are established, and which provide habitat and seed sources for spreading into bare mined surrounding areas. Patch development restoration techniques have also been successful in restoring degraded peatlands elsewhere, such as alpine Sphagnum bogs. In these cases, the key steps focus on 1) reinstating hydrological function, e.g., by raising water tables, 2) re-establishment of a suitable microclimate, e.g., by creating tall nursery vegetation, 3) reintroduction of invertebrates, and ultimately 4) recovery of ecosystem processes such as peat formation. Restoration of natural function (step 4) involves much longer timescales and remains a real challenge for peatland conservation, particularly under projected climate change scenarios.

Respecting our tuākana: Using eDNA and mātauranga Māori to restore healthy tuna (eel) populations

Rangi Elkington[4], Rawenata Gieger[4], Tiwini Hemi[4], Dan Moore[2], Rewi Newnham[5], Pirihira Paul[1], Xavier Pochon[1], Hugh Robertson[2], Charlotte Šunde[1], Amanda Thomas[5], Georgia Thomson-Laing[1], Puhanga Tupaea[4], Marcus Vandergoes[3], Susie Wood[1], Mr Russleigh Parai[2,4,5]

[1]Cawthron Institute, Private Bag 2, Nelson, New Zealand, [2]Department of Conservation, Private Bag 5 , Nelson 7042, New Zealand , [3]GNS Science, PO Box 30-368, Lower Hutt, New Zealand, [4]Ngāti Koata, 137 Vickerman Street, Port Nelson, Nelson, New Zealand, [5]Victoria University of Wellington, Wellington, New Zealand

Concurrent 3B, October 12, 2021, 10:45 AM - 12:15 PM

Lake Moawhitu, situated at Rangitoto ki te Tonga (d'Urville Island), has been a culturally important site for mahinga kai (food gathering) for Ngāti Koata manawhenua. Of great cultural significance is tuna (short- and long-finned eel). Tuna is a taonga species (gift from the gods) with its own mauri (life force). Tuna have a unique relationship with Māori: they are upheld as our tuākana (elder brother) and as kaitiaki (guardians) of our waterways. Yet their populations and health are increasingly endangered, largely due to declining water quality, habitat destruction and the pressures of commercial takes. Ngāti Koata, among others, acknowledge that tuna have sustained human life over centuries, but now it's our turn to reciprocate by taking responsibility to ensure our tuākana are healthy and live in safe, healthy environments.

This presentation draws on an academic study of tuna at Lake Moawhitu, using both contemporary methods and environmental DNA analysis from sediment cores extracted as part of the Lakes380 project. It also draws from mātauranga Māori shared by Ngāti Koata kaumātua during wānanga and interviews. Both knowledge sources use records from the past to offer insights about tuna populations at Lake Moawhitu. Interweaving these knowledges is both challenging and rewarding, and it signifies an exciting time for kairangahau and kaitiaki who are connected by a mutual desire to enrich our understanding of tuna to improve sustainable restorative strategies. Another motivation for Ngāti Koata is retaining cultural practises, including allowing sustainable cultural harvesting of tuna to once again be practised by manawhenua.

Restoring Aotearoa New Zealand's wetlands: threats, management challenges and the development of restoration tools

Dr Colin O'Donnell[1]
[1]*Department Of Conservation, Christchurch, New Zealand*

Concurrent 3B, October 12, 2021, 10:45 AM - 12:15 PM

Greater than 90% of Aotearoa New Zealand's wetlands have been lost since the arrival of humans, and in some regions, loss is >98%. Those wetlands that remain are frequently fragmented and degraded. A wide range of threats that limit our ability to restore wetlands have been identified, but our understanding of their relative importance is variable. The Department of Conservation's Arawai Kākāriki Wetland Restoration Programme is developing restoration techniques across representative wetland types at a landscape (7,000-20,000 ha) scale. Arawai Kākāriki is using conceptual models to plan restoration targets and identify threats and management requirements. Critical threats include significant ecosystem modifying weeds, invasive aquatic and terrestrial predators, declining habitat quality and human impacts. The programme also focuses on developing new restoration tools and robust monitoring techniques for measuring effectiveness of management. For example, a recent focus has been on describing and understanding the importance of wetland networks using examples from the programme's threatened wetland bird research. Real-time GPS tracking of matuku/Australasian bittern is revealing use of complex national networks that will require restoration in their entirety if populations of mobile threatened species are to recover.

The threat of invasive non-native plants to New Zealand wetlands and management to protect and restore them

Paul Champion[1]
[1]*NIWA, HAMILTON, New Zealand*

Concurrent 3B, October 12, 2021, 10:45 AM - 12:15 PM

Around 50% of New Zealand's plant species growing outside of cultivation are not indigenous. It is a similar picture in New Zealand wetlands. Impacts of introduced species range from establishment into indigenous vegetation with little perceivable impact or at the other extreme, the competitive exclusion of indigenous vegetation and the fauna this supports, alteration of hydrology, nutrient cycling and/or susceptibility to fire damage (known as 'transformer species').
Human related activities including modified hydrology, eutrophication and grazing by livestock all contribute to increased invasibility. The establishment of many non-native plants in wetlands may reflect the change in wetland ecology rather than the plant being a driver of change. Unmodified wetlands, especially nutrient-poor systems, contain relatively few transformer species.
This talk discusses the management of invasive non-native plants in the Whangamarino Wetland and across New Zealand more broadly. Critical barriers to wetland protection from non-native invasive plants are the initiation of effective proactive, rather than reactive, biosecurity. This involves identification of transformer species (species risk assessment), knowledge of the their current and potential distribution (database), the risks the species poses to the conservation values of different wetland types (habitat risk assessment), management interventions to reduce the likelihood of introduction (pathway management) and the early detection, delimitation and rapid response to new non-native invasions (surveillance and incursion response).

Understanding predator-prey interactions in New Zealand freshwater wetlands

Dr Emma Williams[1]
[1]*NZ Department Of Conservation, Christchurch, New Zealand*

Concurrent 3B, October 12, 2021, 10:45 AM - 12:15 PM

The impact of introduced predators on indigenous threatened birds is of international concern, particularly in relation to island populations. A recent review of the impacts of introduced mammalian predators in New Zealand found that mustelids, feral cats and rats are common predators of wetland birds, and as such, are likely to be causing significant impacts to populations of threatened wetland bird species. Despite this, predator control is rarely a focus for most wetland restoration projects.

Here I present response rates of Australasian bittern (Botaurus poiciloptilus), spotless crake (Porzana tabuensis) and fernbird (Bowdleria punctata) populations in relation to experimental predator control at Whangamarino and Awarua wetlands. Results show crakes and fernbird populations are slowly increasing at treatment sites, whereas bittern populations continue to decline. Reasons for this are complex, but an adjacent study investigating the relative impacts of avian and terrestrial predators on artificial crake/bittern nests, shows nest predation rates remain high despite predator control (> 90 % nests failed). This trial, conducted across five New Zealand wetlands, showed that although artificial nests were visited by a suite of predators, collectively > 70 % of predation events were caused by a single native avian species - the Australasian harrier (Circus approximans). This suggests predation pressures switch from mammalian to avian once the former is removed, further hampering the recovery of wetland bird populations.

Results highlight the importance of including predator control as part of wetland restoration efforts, as well as understanding the effect of that predator control on existing predator-prey interactions.

A snap-shot of microbial populations at the Lake Areare floating wetland

Dr Suzanne Lambie[1], Dr Jo Cavanagh[2], Mr David Hunter[1]
[1]Manaaki Whenua - Landcare Research, Hamilton, New Zealand, [2]Manaaki Whenua - Landcare Research, Christchurch, New Zealand

Concurrent 3C, October 12, 2021, 10:45 AM - 12:15 PM

Microbial populations drive nutrient cycling and the ability of floating wetlands to provide water treatment ecosystem services. We identified the microbial community composition in water, fresh humus (FH) and soil compartments of Carex virgata on the floating wetland using phospholipid fatty acid analysis (PLFA) to obtain a deeper understanding of nutrient cycling. The floating wetland (60 m2) was constructed in a watercourse, which flows into Lake Areare, between dairy grazed pasture and the Waikato Expressway and was completed in December 2015. PLFA determined total microbial biomass, and biomarkers were used to allocate microbes into bacteria, fungi, gram-positive and gram-negative bacteria, and actinomycetes groups. The water compartment contained the least microbial biomass but relative abundances of the various microbial groups were more consistent between the compartments. Water contained a greater relative abundance of bacteria, but less fungi, and also had less gram-positive, gram-negative and actinomycetes compared to FH and soil. Absolute abundance of all the microbial groups, in all compartments, were positively correlated with total C, N, and P, with sigmoidal relationships indicating a tipping point where microbial biomass no longer increased with increasing nutrient concentrations. The tipping point was reached for all bacteria groups but not for fungi indicating greater nutrient demand/tolerance for these organisms. This snap-shot assessment indicated that microbial communities differed in their abundance and composition across floating wetland compartments. More information on the effect of plant species and season, as well as linking to microbial function, would be valuable in enhancing treatment efficiency of floating wetlands.

Aerated Floating Treatment Wetlands for enhanced wastewater treatment

Dr Chris Tanner[1], Dr Jason Park[1], Mr James Sukias[1]
[1]*NIWA, Hamilton, New Zealand*

Concurrent 3C, October 12, 2021, 10:45 AM - 12:15 PM

Floating Treatment Wetlands (FTWs) are an alternative approach for treatment of contaminated water involving emergent macrophytes growing on buoyant mats or rafts. Water is treated in the submerged root-mass suspended beneath the mats. The extensive root mass and attached microbial biofilms create a large respiratory biomass, commonly resulting in anaerobic zones beneath the mats. Organic sediments accumulating in the quiescent water beneath the FTWs can exert further oxygen demand, exacerbated by shading of algal photosynthesis and restricted gaseous exchange through the floating mat. These anaerobic conditions processes such as denitrification and sequestration of metals, but they inhibit the aerobic processes necessary for efficient treatment of organic and ammonium-rich wastewaters. This one-year pilot-scale study evaluates the treatment benefits of aerating the initial stages of single-pass and recirculating FTW systems treating primary domestic wastewaters. The recirculating system achieved >95% of TSS and >85% removal of cBOD5. The single-pass system showed slightly better removal with >97% of both TSS and cBOD5, maintaining the final effluent TSS and cBOD5 concentrations at below 2.5 and 2 mg/L respectively. The recirculating and single-pass FTW systems achieved 66 and 75% overall TN removal respectively. While the single-pass system had lower levels of nitrification than the recirculating system (NH4-N removal 76.9%), it achieved higher denitrification (NOx-N removal 81.3%), thus resulting in ~10% higher overall TN mass removal. This one-year mesocosm-scale FTW study showed that FTWs supplemented with mechanical aeration of~15% of the total FTW area can provide enhanced levels of wastewater treatment and nitrogen removal.

Floating wetlands and stream enhancement in an urban stream

Miss Katie Noakes[1]
[1]*Christchurch City Council, Christchurch, New Zealand*

Concurrent 3C, October 12, 2021, 10:45 AM - 12:15 PM

Many waterways that flow through Christchurch have historically been channelised and artificially lined, to drain the swamp areas around the district and improve drainage function. Today, timber and concrete lined channels are still common. No.1 Drain, a waterway in east Christchurch, suffered extensive damage to its concrete lined channel from the 2010-2011 Christchurch Earthquake sequence. As part of Christchurch City Council's waterway renewal programme, and a growing focus on stormwater treatment and ecological enhancement, a multi-faceted restoration approach was undertaken to improve water quality and ecology, and improve flood attenuation. In 2016, the vertical concrete banks were replaced with more natural banks with native riparian planting, instream habitat features were installed, and an online stormwater pond system was created. Floating treatment wetlands were then installed in 2019. An ecological monitoring programme was instigated prior to works to establish the baseline condition and monitor the success of restoration over the long-term. The results from the first round of post construction monitoring show that overall the project has successfully enhanced aquatic habitat, and improved the diversity of invertebrate and fish communities. However, there are some aspects that still require improvement. A monitoring programme has recently been instigated to assess the effectiveness of the stormwater ponds and floating wetlands in improving water quality. Monitoring will continue in the future to further assess restoration success, guide further improvements at the site, and to determine the effectiveness of using floating wetlands at this site and elsewhere in Christchurch.

Nutrient removal and hydraulic performance of a floating wetland treating agricultural pollutants in the Lake Areare catchment

Dr Rebecca Eivers[1], Dr Suzanne Lambie[2]
[1]*Streamlined Environmental Ltd, Hamilton, New Zealand,* [2]*Manaaki Whenua Landcare Research, Hamilton, New Zealand*

Concurrent 3C, October 12, 2021, 10:45 AM - 12:15 PM

Diffuse pollution from agricultural catchments has led to widespread degradation of lakes, wetlands, rivers and estuaries in New Zealand and worldwide. More recently, the expansion and intensification of dairy farming to meet growing global demand for milk solids has accelerated water quality decline due to increased nutrient and sediment loads. Numerous and varied mitigation measures have been developed in attempts to alleviate the negative impacts of intensive agriculture on aquatic environments, including constructed wetlands.

Floating treatment wetlands (FTWs) are being trialed as tools to improve peat lake ecosystems in the Waikato region, New Zealand. This study investigates FTW efficacy, evaluating nutrient and sediment attenuation, and exploring biological and environmental variables influencing treatment performance. Three FTWs were placed in a watercourse flowing through intensive dairy land use into Lake Areare, a shallow peat lake managed by for protection and enhancement of wetland flora and fauna and recreational values. The FTW rafts were placed in series and planted with one of three species of indigenous sedge. Surface water concentrations of nitrogen, phosphorus and suspended solids were evaluated as well as biomass accumulation in the leaf and root systems of the three different sedges. The monitoring of the FTWs began in April 2019 and will be completed in May 2020. The results of this study will be presented in due course.

FTWs in agricultural watercourses have the potential to provide inexpensive and effective water quality treatment whilst fitting practically within the productive farming landscape, requiring little maintenance and no loss of productive land.

Treatment of organic compounds in floating plant root mat

Dr Zhongbing Chen, Prof Jan Vymazal
[1]*Czech University of Life Sciences Prague, Prague, Czech Republic*

Concurrent 3C, October 12, 2021, 10:45 AM - 12:15 PM

Floating plant root mat (FPRM) is hybrid of soil matrix-free pond systems and conventional soil matrix based constructed wetlands (CWs) containing macrophytes, growing as a floating mat on the water surface or touching to the bottom of the water body where it function as a plant root mat filter (PRMF) for the contaminated water. Recently, floating treatment wetland were used for different types of wastewater. However, investigation on FPRM for the treatment of wastewater contaminated by organic compounds such as volatile organic compounds (VOCs) and herbicides are missing. In this study, a FPRM and PRMF (polit scale) were investigated for the treatment of water contaminated by benzene and methyl tert-butyl ether (MTBE), and a FPRM and four conventional CWs were investigated for the treatment of water contaminated by herbicides. Results show that both systems have the similar removal behavior for benzene and MTBE removal during the two years operation. However, better removal for both pollutants during the summer was found in the first year. The emission rates of benzene and MTBE were less than 16 and 12 mg/m/d, respectively. This means less than 7% benzene was removed through volatilization. But the volatilization of MTBE reached up to 60% of the total removal. The metabolites (OA and ESA) of herbicides peaked at 9 days in the FPRM, while the detected metabolites account for 20% ~ 25% of the mother compounds. In conclusion, FPRM is the most cost-efficient alternatives for VOCs and herbicides removal due to the absent of substrate.

Mai te rangi ki te whenua, mai te whenua ki te rangi: kaupapa Māori literature review identifying land-based values and actions to benefit freshwater systems

Mr Corey Ruha[1]
[1]*Scion, Rotorua, New Zealand*

Concurrent 3D, October 12, 2021, 10:45 AM - 12:15 PM

Land, water, climate, and communities in Aotearoa New Zealand are part of a large web of interconnected systems undergoing significant change due to numerous events of natural and anthropogenic origins. With increasing frequency of disruption to these systems the adverse impacts to the physical and spiritual wellbeing of the environment are felt by the indigenous Māori people. This literature review was funded by Our Land and Water National Science Challenge to support the development of a free online tool that will record efforts to improve water quality. By applying kaupapa Māori methodology, this literature review identified 5 actions, as shown below, that support the wellbeing of land, water, and indigenous people from a uniquely Māori perspective.

- Engage with tāngata whenua to incorporate their values into policies, plans, and decisions that affect land and water
- Conserve and restore wāhi tapu (culturally significant sites)
- Support opportunities to enhance kaitiakitanga
- Strengthen the practice of traditional and contemporary tikanga (holistic methods) on the whenua
- Revitalise the use of traditional Māori place names

The resulting actions should be implemented by all parties – from large entities to individual landowners. The actions that have emerged from the literature are centred in improving empathy and communication with tāngata whenua (local indigenous Māori tribes). If the identified actions are explored further with genuinely good intent, they are expected to benefit the land, water, and people of Aotearoa New Zealand.

Fundamental shifts in aquatic systems following evidence Maori settlement in high country New Zealand

Miss Julia Short[1], Dr John Tibby[1], Dr Marcus Vandergoes[2], Dr Susie Wood[3], Dr Xun Li[2], Dr Jamie Howarth[4]
[1]The University Of Adelaide, Adelaide, Australia, [2]GNS Science, Lower Hutt, New Zealand, [3]Cawthron Institute, Nelson, New Zealand, [4]Victoria University of Wellington, Wellington, New Zealand

Concurrent 4A, October 12, 2021, 1:00 PM - 3:00 PM

Understanding aquatic ecosystem response to the first human impacts upon landscapes is often confounded by the long-term human habitation in many regions of the world. Due to its short period of human occupation, New Zealand is in a unique position to provide insights into lake response to initial human-induced landscape changes. Polynesians arrived in New Zealand ~800 years ago and settled rapidly across the country. Vegetation on the South Island was transformed, and in the Canterbury high country, the region of this study, native forests were converted to tussock grassland. We examined the diatom record from two small; Lakes Emma and Emily, and two medium sized lakes; Heron and Pearson, to explore aquatic ecological response to the aforementioned landscape change. The expectation was that smaller lakes would be more responsive to the landscape changes. The lacustrine response to deforestation within the catchment, however was more pronounced in Lakes Pearson and Heron. In Lake Pearson, diatom assemblages shift from both planktonic and benthic taxa to a primarily planktonic assemblage. In Lake Heron, there were major shifts between planktonic taxa Discostella stelligera and Aulacoseira ambigua, representing increases in nutrients. While lakes Emma and Emily experienced significant changes in diatom assemblages, these shifts were subtle, and were associated with changes between benthic and epiphytic taxa. This study, nevertheless, indicates that major ecological shifts have occurred in lakes in the Canterbury high country as a result of the first human activity in the area, while demonstrating the complexity of lake systems in the region.

Prospects for wetland recovery clouded by the long-term legacy effects of catchment development, the Murray Darling Basin.

Prof Peter Gell[1]
[1]*Federation University, Mt Helen, Australia*

Concurrent 4A, October 12, 2021, 1:00 PM - 3:00 PM

Australia's Murray Darling Basin hosts 30,000 wetlands, 16 listed under the Ramsar Convention. Recently, the Basin has become internationally renowned for massive fish kills, intense droughts and a highly contested $13B Plan that aims to take water allocations from irrigated agriculture to restore aquatic ecosystems. The wetlands that exist in the floodplain of the southern basin are among the most studied paleolimnologically and over 20 years of evidence has attested to considerable change over centuries. In particular the wetlands have suffered elevated sedimentation rates, eutrophication, reduced light environment and critical transitions in food webs leading to the collapse of submerged macrophyte beds and littoral fauna. The monitoring and management focus of the Plan is on returning water to benefit channel ecosystems and improve connectivity with wetlands. However, the sediment record suggests that the river is a major source of nutrients and fine sediments to adjacent wetlands. Further, to meet watering and allocation obligations, the main channel is being used to transfer large volumes of water leading to extensive bank collapse, augmenting causes of the high turbidity. The lesson from the past, that remains unheeded in this rush to restore, is that the management of water quality is central to the recovery of the light environment needed to rehabilitate the plant beds that hosted the diverse ecosystems that existed in Indigenous times.

Reconstructing historical cyanobacteria abundances from lake sediment cores: do pigments and DNA tell the same story?

Miss Mailys Picard[1,2], Dr Susie Wood[1], Dr Xavier Pochon[1,3], Dr Marcus Vandergoes[4], Lizette Reyes, Jamie D. Howarth, Pr Ian Hawes[2], Jonathan Puddick

[1]Cawthron Institute, Nelson, New Zealand, [2]School of Biological Sciences, University of Waikato, Hamilton, New Zealand, [3]Institute of Marine Science, University of Auckland, Leigh, New Zealand, [4]GNS Science, Lower Hutt, New Zealand

Concurrent 4A, October 12, 2021, 1:00 PM - 3:00 PM

Understanding the historical onset of cyanobacterial blooms in freshwater bodies can help identify potential drivers. Lake sediments are historical archives, containing information on what has occurred in and around lakes over time. Paleolimnology explores these records using a variety of techniques but choosing the most appropriate method can be challenging. We compared results obtained from a droplet digital PCR assay targeting a cyanobacterial-specific region of the 16S rRNA gene in sedimentary DNA and cyanobacterial pigments (cyanopigments; canthaxanthin, echinenone, myxoxanthophyll and zeaxanthin) analysed using high-performance liquid chromatography in four sediment cores. There were strong positive relationships between the 16S rRNA gene copy concentrations and pigment concentrations, while differences were observed among lakes and sediment core depths within lakes. This is most likely due to differences in cyanobacterial species between lakes and over time within each lake. Because not all cyanobacteria species produce the suite of pigments analysed in this study, the relationships were more consistent when all pigments were summed. We recommend this approach when making inferences about changes in the entire cyanobacterial community. Each method had benefits and limitations which should be taken into consideration during method selection and when interpreting the data. Overall, the measurement of cyanobacterial abundance using sedDNA was comparable to measurement using sedimentary pigments and could be adopted in future paleolimnological studies.

Recovery of lake communities following volcanic eruptions: evidence from the palaeoecological record

Mr Stuart Caird[1,2], Dr Andrew Rees[1,2], Dr Susie Wood[2,3], Dr Marcus Vandergoes[2,4]
[1]Victoria University of Wellington, Wellington, New Zealand, [2]Lakes380 Project , , New Zealand , [3]Cawthron Institute, Nelson , New Zealand, [4]GNS Science , Lower Hutt, Wellington, New Zealand

Concurrent 4A, October 12, 2021, 1:00 PM - 3:00 PM

The sediment of freshwater lakes can be used to track environmental change over short and long temporal scales. In New Zealand, lakes have been subject to a range of natural and human-induced perturbations over the last 1,000 years. There is limited data on how lakes respond to natural events, such as volcanic eruptions, and whether communities change in a similar manner to shifts observed after anthropogenically-induced impacts, or whether they recover to pre-disturbance condition. The catchment of Lake Okataina, in the Central Volcanic Plateau, is dominated by native vegetation making it an ideal setting to explore these questions. The 1886 eruption of the nearby Mt Tarawera, deposited a significant layer of ash into the lake and initiated a significant shift in the limnological and biophysical properties within the system. In the present study, a sediment core from Lake Okataina was analysed using suite of paleoenvironmental techniques including; environmental DNA, hyperspectral imaging, ITRAX scanning, morphological analysis of chironomids and pollen identification. These methods were used to assess and quantify the relative changes resulting from the volcanic eruption. Results will be presented and implications for lake management discussed.

Critical barriers, and responses, to achieving wetland restoration in New Zealand

Dr Hugh Robertson[1]
[1]*Department of Conservation, NZ, Nelson, New Zealand*

Concurrent 4B, October 12, 2021, 1:00 PM - 3:00 PM

Wetland loss in New Zealand is continuing, and where remnant wetland systems remain, the impact of invasive species, hydrological modification and water quality contamination are extensive. Of the c.250,000 ha of inland wetlands that now exist it is estimated that some form of restoration, or conservation management, is underway for at least 30,000 ha (>12% by area). The degree that measurable and meaningful restoration outcomes are being achieved is however variable, or often not monitored. There is also limited knowledge on whether 'gains' from wetland restoration are greater than the 'losses' due to ongoing land and water development.

This paper provides a summary of the symposia on 'Advances in wetland restoration in New Zealand'. It presents a framework to 1) evaluate critical barriers that impede restoration outcomes and 2) establish landscape-scale action plans (responses). It draws on symposia conclusions that within New Zealand the primary ecosystem pressures are habitat loss, invasive species and catchment modifications, which give rise to secondary drivers that are often highly complex, including altered predator-prey interactions, fragmentation and interruption of peatland development.

A set of wetland restoration principles for New Zealand are presented – these principles emphasise investment in wetlands: that are rare, depleted or regionally significant; contain core habitat for threatened or taonga species; provide critical ecosystem and cultural benefits (services); deliver important landscape functions; and, critically, where ecosystem pressures can be effectively managed.

Up, up, and away – aquatic macroinvertebrate community responses to wetland rewetting

Mr Tom Drinan[1], Hugh Robertson[2], Dan Moore[3], Alice Woodward[4]
[1]Department Of Conservation, Christchurch, New Zealand, [2]Department Of Conservation, Nelson, New Zealand, [3]Department Of Conservation, Picton, New Zealand, [4]Ngāti Koata Trust, Nelson, New Zealand

Concurrent 4B, October 12, 2021, 1:00 PM - 3:00 PM

Aquatic invertebrates are one of the most diverse and abundant faunal groups found in wetlands, and they play a pivotal role in the functioning of these ecosystems. Aquatic invertebrates are the primary trophic link between plant-based organic carbon (detritus, algae) and high vertebrates. However, hydrological alteration can adversely affect these communities, which in turn can have a major influence on the ecological structure and functioning of wetlands. Many wetlands have had drainage channels cut through them to lower their water tables for agricultural development. One such example, and the focus of this study, is Moawhitu wetland on Rangitoto ki te Tonga (d'Urville Island). This wetland forms part of a project, primarily led through a partnership between Ngāti Koata and the Department of Conservation (DOC), which aims to restore the mauri and wairua at this mahinga kai site. To help restore the wetland, a water level control structure was installed on the wetland outlet. This structure has resulted in increased water levels over large areas of the wetland. To assess the response of the invertebrate community to this rewetting, aquatic invertebrate surveys were undertaken at five sites throughout the wetland on three separate occasions: November/December 2018 (pre-install), February 2020 and 2021 (both post-install). These surveys, and the resulting data, have enabled us to quantify the response in wetland invertebrate communities to restoration efforts. Following rewetting, species richness increased, while the composition of the invertebrate community shifted towards that more indicative of a lentic habitat (more aquatic coleopterans and hemipterans, and odonates).

Wetland drainage and large-scale catchment modifications in New Zealand

Mr James Blyth[1]
[1]*Collaborations, Lower Hutt, New Zealand*

Concurrent 4B, October 12, 2021, 1:00 PM - 3:00 PM

New Zealand follows a similar theme to the rest of the globe, large scale drainage of our wetlands over the last century. Remaining wetlands are often under pressure from wider catchment processes, including land clearance and agricultural intensification, which often leads to water quality degradation. This paper will discuss the importance of ceasing ongoing wetland habitat decline which may lead to irreversible change, and the complexity of wetland restoration.
Local case studies will be presented on wetlands that are currently impacted from hydrological and catchment modifications and how restoration is or could be approached in each of these environments. This will range from large Ramsar wetlands impacted by flood control schemes and wider catchment pressures such as farming, forestry and urbanisation, through to isolated wetlands in conservation reserves with minimal ongoing anthropogenic pressures. We observe that eco-hydrological restoration at each site is dependent on 1) an understanding of the necessary hydrological changes and potential ecological responses, 2) defining the end goal for restoration, and 3) identifying the limitations and trade-offs in implementing changes to hydrological regimes. Restoring wetlands takes time, effort and can be costly. Whilst it is important to undertake these restoration works, protecting our existing wetlands from ongoing threats (and reducing the need for restoration) should be at the forefront of wetland conservation works.

Indigenous and traditional knowledge can be the new foundation for Wise Use of wetlands

Dr Swapan Paul[1]
[1]*Sydney Olympic Park Authority, Sydney, Australia*

Concurrent 4C, October 12, 2021, 1:00 PM - 3:00 PM

This talk is based on the literature and observations on the pattern of engagement of traditional knowledge in wetland conservation. The Ramsar Resolution XII.2 recognised that the wise and customary use of wetlands by indigenous peoples and local communities could play an important role in their conservation and Wise Use. However, this talk claims that there has been a general consensus that in recent decades traditional and indigenous knowledge and participation by traditional owners have not been as much it should be. With the increasing damage that global wetlands are set to face under the Climate Change and Sea Level Rise scenarios, wetlands do need modern scientific knowledge, however, it is believed that the effectiveness and efficiency of modern tools can be much greater and time-efficient if combined with traditional knowledge. It is even plausible that some problems may only be overcome with traditional knowledge. It is proposed that much valuable traditional knowledge would have to be retrieved from various sources and their history. Increased and regular participation of traditional knowledge-keepers requires their willingness but most importantly, a need for creating a favorable environment so that they feel welcome, valued and involved. The talk also projects a probable mismatch between the format of traditional knowledge and modern technologies, which will be another future challenge to face.

Mekong University Network as a premiere training and research network for wetland management in the Mekong region

Dr Triet Tran[1], Dr. Sansanee Choowaew[2], Dr. Ni Duong[3], Mr. Jeb Barzen[4], Professor Richard Keim[5]
[1]International Crane Foundation, , United States, [2]Mahidol University, , Thailand, [3]Can Tho University, Can Tho, Vietnam, [4]Private Lands Conservation LLC, , United States, [5]Louisiana State University, , United States

Concurrent 4C, October 12, 2021, 1:00 PM - 3:00 PM

In 2002, eight large public universities from Cambodia, Lao PDR, Thailand and Vietnam, with facilitation from the International Crane Foundation-USA, joined to create a network of universities with the primary purpose of advancing wetland ecology and management in the Mekong Region of Southeast Asia through teacher training and curriculum development. Since then, the "University Network for Wetland Research and Training in the Mekong Region" has facilitated annual training courses for teaching staff and young researchers, and the network's membership has grown to include 24 major universities from all six Mekong countries and Malaysia. To date, the Mekong Network has organized 16 regional and 4 country-level training courses, engaging more than 400 university lecturers and wetland managers in Southeast Asia. In addition to training, the Network facilitated regional research projects on subjects related to wetland ecology and biodiversity conservation. The largest study—which involved 10 Southeast Asian and 3 US universities and research institutes, with the participation of 120 researchers and technicians— operated at an unprecedented scale, sampling more than 450 wetlands across five countries of the Mekong River basin to evaluate the state of contamination by persistent organic pollutants in natural wetland ecosystems. By pooling the resources and expertise available among member universities, the Network provides high quality training at an affordable cost. The Network has also proven a good conduit for connecting wetland research and academic communities of the Mekong region with the world and provides an excellent model for advancing wetland training on other continents.

Revival The Theory of "Unity between Heaven and Man": Fit Traditional and Community Knowledge In Contemporary Wetland Conservation Scheme and Policy of China

Dr Yinru Lei[1], Professor Li Juan Cui[2]
[1]Institute of Wetland Research, Chinese Academy Of Forestry, Beijing, China, [2]Chinese Academy Of Forestry, Beijing, China

Concurrent 4C, October 12, 2021, 1:00 PM - 3:00 PM

Among its glorious history of civilization, the theory of “Unity between Heaven and Man” is the core value of Chinese towards the relationship between man and nature. Numerous ancient philosophy books, government decrees and folk laws recorded how ancient Chinese protected and utilized the precious resources of wetlands. At an era of ecological civilization renaissance, China’s central government now put a great effort on wetland conservation and restoration among other green development measures. It is a challenge but also an opportunity to integrate ancient wisdom into contemporary wetland conservation scheme and policy. This paper reviewed Chinese traditional and community knowledge on wetland conservation and wise use, then compared with some of the ongoing wetland conservation practices to identify bonding points between traditional and community knowledge with current scientific practices. Then the paper presents a case study at National Wetland Park to show how indigenous people, the Ewenki nationality, conserve surrounding wetland, inherit their culture and develop ecotourism as an example of the implementation of “Unity between Heaven and Man” in modern society.

WWT – engaging local people for sustainable wetland conservation

Mr Chris Rostron[1]
[1]*Wildfowl & Wetlands Trust (wwt), Slimbridge, United Kingdom*

Concurrent 4C, October 12, 2021, 1:00 PM - 3:00 PM

Steart Marshes, UK, is a major project creating nearly 500 ha of salt marsh from existing arable land to mitigate for sea level rise. WWT employed staff with the skills to engage and consult with local people, and this has resulted in a positive project that has been welcome by local communities.
With the impacts of climate change being increasingly felt in the UK, particularly extreme weather events and flooding, we cannot continue to rely in traditional built flood structures. WWT staff skilled in outreach are working with farmers and land managers to put in place more natural flood management approaches.
In urban areas, WWT employs consultative techniques to raise awareness of wetlands and SuDS (Sustainable Drainage Systems) as positive elements of the urban environment. Work with schools, community groups, local authorities and park managers has raised awareness and led to creation of wetlands in urban areas.
WWT's 10 wetland centres now welcome over one million visitors a year across the UK. Many of our visitors have little or no knowledge or experience of wetlands. We use formal and informal techniques to raise awareness and support learning.
Citizen science has been used at WWT for decades, with our members and the public sending in reports of sightings of wetland birds to inform our long-term reporting on numbers and distribution of key species.
In conclusion, a vast range of techniques can be employed to engage local stakeholders, leading to positive acceptance of change and proactive support for wetland creation and conservation.

Cultural, local community and Indigenous peoples' issues for a Declaration of the Rights of Wetlands

Dr Matthew Simpson[1], Dave Pritchard[3]
[1]35percent, Stroud, UK, [2]Cobra Collective, Egham, UK, [3]Ramsar Culture Network, ,

Concurrent 4D, October 12, 2021, 1:00 PM - 3:00 PM

Much of the recent growth in contemporary formal recognition of the rights of nature draws on improved understandings about the belief systems and traditional practices of Indigenous peoples and local communities (IPLCs). The cultural and linguistic heritage of IPLCs contributes to the world's diversity. Their knowledge and practices have enhanced respect for the environment and natural resources, often offering models of sustainable approaches to water security, food security, health and well-being. Rights of wetlands can be an important component of enlightened and holistic approaches of this kind, which see the human species as part of the ecosystem rather than apart from it. Increasing evidence suggests that land demarcated as Indigenous Lands protects the natural environment through reduced rates of wetland degradation and deforestation, less habitat conversion and lower greenhouse gas emissions compared to surrounding areas. Traditional knowledge and management practices often play a significant role in protecting crucial habitats and the socio-ecological systems they support. The United Nations Declaration on Rights of Indigenous Peoples addresses the most significant issues affecting indigenous peoples - their civil, political, social, economic and cultural rights. A declaration of wetland rights needs to fit with this philosophy, and to support the wisdom and rights of IPLCs with respect to the landscape and their relationship with wetlands. This paper sets out some key ingredients of the required approach.

Declaration on Rights of Wetlands: changing our paradigm to improve wetland outcomes;

Prof Max Finlayson[1]

[1]*Institute For Land, Water & Society, Charles Sturt University, Albury, Australia,* [2]*IHE Delft, Institute for Water Education, Delft, Netherlands*

Concurrent 4D, October 12, 2021, 1:00 PM - 3:00 PM

The loss and degradation of wetlands has continued despite the development and successes of the Ramsar Convention on Wetlands over the past 50 years. This worrying outcome has led to an investment in alternative or complementary approaches to wetland management that focus more on the active participation of people, both local communities and those from further afield. This has include seeing wetlands as settings for human wellbeing, and by linking wetlands to the extinction and climate crises. The key features of these approaches are explored and placed in the context of the developing impetus to establish a universal declaration on the rights of wetlands. As this has developed it is being seen more and more as a next step in the campaign to ensure the wise use of wetlands and not just as complementary to the noble goals expressed by established multi-lateral environment agreements. It does build on these but also raises questions about the conservatism of existing international mechanisms and the seeming weaknesses in approaches that focus on the rights of communities and the rights of nature to exist. A new paradigm is in place, and now needs impetus to fill the well identified gaps in existing mechanisms.

Notes of Struggle: Legal and Ethical Strategies to Recognize Nature as a Living Being

Ms Patricia Gualinga[1]
[1]*Tiam Foudation, Worcester, Ecuador*

Concurrent 4D, October 12, 2021, 1:00 PM - 3:00 PM

In this presentation Patricia will discuss the Sarayaku's struggle to achieve the recognition of the Amazon, including its wetlands, as a Living Forest. From grassroots organizing in the Amazon, to lobbying of legislators and meetings in the Vatican, this presentation will discuss the range of strategies the Sarayaku people have deployed to bring about the awareness of the Amazon as a Living Forest and support the creation of legislation that recognizes the right of key ecosystems, such as wetlands and forests, to exist insulated from human presence and interference. Patricia will discuss ways in which the Sarayaku have used modern communication technology to create international networks and educate and communicate with local and global publics, while staying connected to their ancestral knowledge, culture, and daily practices in the heart of the Amazon. The presentation will analyze the key lessons from successful and less successful efforts and reflect on possible new avenues for effective local to global collaboration and action. This talk will also provide fertile ground for out of the box brainstorming for effective international collaborations to make the Living Forest and the Rights of Nature, including wetlands, integral to the strategies for restoring and preserving global ecosystems.

Rights of Nature and Wetland Rights: Responding to the Scientists' Second Warning to Humanity

Ms Gillian Davies[1,2]
[1]*BSC Group, Inc., Worcester, USA,* [2]*Tufts University Global Development and Environment Institute, Medford, USA*

Concurrent 4D, October 12, 2021, 1:00 PM - 3:00 PM

The World Scientists' Warning to Humanity: A Second Notice (2017) and The Second Warning to Humanity – Providing a Context for Wetland Management and Policy (2018) outline stark warnings about the trajectory that humanity and the planet are on and specific actions that wetland scientists can take in response. Driven by human activities, climate destabilization and biodiversity loss pose existential threats to wetlands, ecosystems and society. In response to these crises, a growing global Rights of Nature movement provides a promising paradigm shift that reframes the human-Nature relationship, shifting it from one of exploitation and depletion to one based on:

- reciprocity;
- recognition of the inherent and inalienable right of natural systems to exist and to avoid degradation;
- recognition of the legal and living personhood of Nature;
- recognition of the ethical and legal responsibility humans have for ecosystems and biodiversity;
- recognition of the dependence of human health and well-being on healthy ecological function.

Rights of Nature and the living personhood of Nature have been recognized throughout human history and across cultures around the world, and particularly by Indigenous and local communities. A group within Society of Wetland Scientists proposes a Universal Declaration of the Rights of Wetlands that encompasses all wetlands as defined by Ramsar. This presentation will articulate the context for the proposed Declaration, will outline what the Declaration entails, how it differs from existing rights of Nature declarations, and how the Declaration can be utilized to further conservation, protection and restoration of wetlands globally.

The Living Forest Worldview

Ms Patricia Gualinga[1]
[1]*Tiam Foudation, Worcester, Ecuador*

Concurrent 4D, October 12, 2021, 1:00 PM - 3:00 PM

This presentation will focus on Sarayaku's Declaration of the Living Forest and highlight its relevance to the protection and restoration of wetlands. During the presentation, Patricia will discuss the Sarayaku People's ancestral knowledge of the Forest as a multidimensional ecosystem constituted by both physical and non-physical intelligences and address subtle aspects of deeper ecological damage that are not yet clearly understood. She will also discuss the moral and epistemological reasons why key ecosystems have the right to exist in perpetuity, free of human presence and interference. This novel call to consciousness and action grounded on ancestral knowledge of Nature's beingness, presents a fresh paradigm for a balanced and respectful relationship between humans and Nature and the pursuit of ecological and wetland restoration and conservation.

The Rights of Wetlands in support of a safe climate and effective wetland restoration – The charter model

Prof William Moomaw[1]
[1]*Tufts University, Medford, United States*

Concurrent 4D, October 12, 2021, 1:00 PM - 3:00 PM

Wetlands are an integral component of the global ecosystem that connects through gas exchange with the atmosphere. Wetlands sequester carbon dioxide and respire both carbon dioxide and methane. They support biological diversity including migratory birds that connect local wetlands to global biodiversity. Current attempts to declare that wetlands have a fundamental right to exist can learn from previous declarations based upon the charter model. We will examine the World Charter for Nature (WCN) (1982) and the World Charter (WC) (1999), and determine if either provides a suitable model for a declaration of the rights of nature.

WCN is a UN document that declares the value of nature and defines five principles for conserving it, but does not declare rights for nature..
The Earth Charter is a civil society initiative that has been endorsed by UNESCO and many societal groups including indigenous people and some representatives from government including mayors and other officials. It was proposed by Maurice Strong and Michael Gorbachev as the World Commission on Environment and Development was drafting Our Common Future in 1987, the report that defined sustainable development. In many ways it provides a template for more recent proposals for the Green New Deal in the United States and the Green Deal in Europe. Like those efforts, at creates a global order that links environmental conservation with socio-economic issues.
This analysis seeks to determine whether either of these two charters provide a useful structure or precedent for a Declaration of the Rights of Wetlands.

Wetlands: a necessity - not a gratuitous possibility

Prof R. Eugene Turner[1]
[1]*Louisiana State University, Baton Rouge, United States*

Concurrent 4D, October 12, 2021, 1:00 PM - 3:00 PM

The 12.8 million km2 of today's wetlands are 13% of those existing in the 1700s, and will be about 0.1 ha per capita by 2100, assuming no more losses. They are less than 10% of the inhabitable land mass, but hold one-fifth of the world's soil carbon. The rising concentrations of nitrogen, phosphorus and sulfur in air and water may compromise the climate benefits of carbon burial in wetland soils that produce 15-40% of the global methane and N2O emissions. Results from multi-year field experiments demonstrate that increased nutrient availability and higher temperatures may cause a decline in below-ground biomass, weaken soils, enhance greenhouse gas emissions, and decrease resilience to hurricanes. The global reach of wetland influences on a multitude of ecosystem attributes thus extends far beyond a regional landscape perspective and are a fertile aspirational ground for a collective global valuation that wetland conservation/restoration needs and humanity requires.

Changes in Carbon Storage in Wetlands of the United States: 2011-2016

Dr Amanda Nahlik[1], Dr. M. Siobhan Fennessy[2], Karen A. Blocksom[1]
[1]United States Environmental Protection Agency, Corvallis, United States, [2]Kenyon College, Gambier, United States

Concurrent 5A, October 12, 2021, 3:15 PM - 4:45 PM

Wetland soils contain some of the densest stores of carbon in the biosphere. However, there is little understanding of the quantity and distribution of carbon stored in US wetlands, or how these stocks change over time. Soil carbon was measured using the same protocol to a maximum depth ranging from 90 to 120 cm at approximately 1000 probabilistically selected wetland sites in each of the 2011 and 2016 National Wetland Condition Assessment (NWCA); 205 of the same sites were sampled in both survey years. Preliminary analyses of carbon density from the resampled sites show a median increase of 6.0% in the top 10 cm, while lower in the soil profile (30–60 cm and 60–90 cm), median carbon density decreased (-14.4 and -9.1%, respectively). Significant decreases in soil carbon density over time (i.e., 5 years) deeper in the soil profile parallel results from the 2011 NWCA data, where human disturbance was correlated to lower carbon densities in the deepest (60–90 cm and 90–120 cm) soil layers (Nahlik & Fennessy, 2016, NatComm:13835). We explore human disturbance and other mechanisms that may be impacting carbon stores over time. These data provide the first empirical, unbiased estimates of change in soil carbon for wetlands of the United States, and demonstrate the power of probabilistic surveys for upscaling data collected at a limited number of sites to regional and national scales. Understanding wetland carbon storage at large scales provides critical insight for the effective management of carbon stocks for climate regulation.

Human Impacts to Northern Wetlands - Scaling GHG Fluxes for Canada's National GHG Inventory

Dr Kelly Bona[1], Miss Lyna Lapointe Elmrabti[1], Dr. Miren Lorente[1], Dr. Douglas MacDonald[1]
[1]*Environment and Climate Change Canada, Gatineau, Canada*

Concurrent 5A, October 12, 2021, 3:15 PM - 4:45 PM

There is increasing need for better reporting of carbon and GHG fluxes resulting from wetland disturbance in national inventory reports. In Canada, development in the North and in the Alberta oil and gas region impacts areas with high proportion of wetlands. The consolidation of knowledge and development of tools is an important first step in the quantification of the net GHG impact of these complex disturbances on wetlands in these areas. Long-term monitoring data, with broad spatial coverage are lacking to parameterize models. Default methodologies proposed by the Intergovernmental Panel on Climate Change for calculating GHG emissions and removals from wetland disturbance have limited application to the types of complex disturbances observed in these regions. To lower uncertainty of estimates, it is important to develop country-specific methodologies that reflect the wide regional landscape variability existing in Canada. We present an analysis of knowledge for up-scaling wetland models, as well as novel approaches and lessons learned to resolve data gaps. One such approach is the Delphi consultation, a quantitative technique used to generate consensus among experts on driver-based measures when adequate empirical data are not available. Further we discuss two examples of national-scale tools (the Northern Land-Use Change model and The Canadian Model for Peatland) currently being developed to address the need to better account for GHG emissions resulting from wetland disturbance. Using the development of these tools as examples, we look at pros and cons in methodologies to parameterize large-scale GHG models.

Modeling tidal wetland carbon cycling in the USA using data from a range of spatiotemporal scales

Dr Eric Ward[1], Camille Stagg[1], Colin Daniel[2], Bronwyn Rayfield[2], Rachel Sleeter[3], Lisamarie Windham-Myers[3], Kevin Kroeger[4], Jinxun Liu[5], William Conner[6], Richard Day[1], Ken Krauss[1], Benjamin Sleeter[5], Meagan Gonneea[4], Karen Thorne[7], Kevin Buffington[7], Scott Jones[7], Bergit Uhran[8], Zhiliang Zhu[8]

[1]USGS Wetland and Aquatic Research Center, Lafayette, United States, [2]APEX Resource Management Solutions, Ottawa, Canada, [3]USGS Water Resources Mission Area, Menlo Park, United States, [4]USGS Woods Hole Coastal and Marine Science Center, Woods Hole, United States, [5]USGS Western Geographic Science Center, Menlo Park, United States, [6]Clemson University, Clemson, United States, [7]USGS Western Ecological Research Center, Davis, United States, [8]USGS National Center, Reston, United States

Concurrent 5A, October 12, 2021, 3:15 PM - 4:45 PM

We developed a model of carbon cycling in tidal wetlands of the coterminous USA with the objectives of 1) assessing baseline carbon pools and fluxes in coastal wetlands and 2) projecting scenarios of climate and land use change impacts on carbon sequestration in coastal wetlands. We adapted the Land Use and Carbon Scenario Simulator (LUCAS) model for use in tidal wetland ecosystems using both site-level carbon cycle data and remotely-sensed land use and land cover (LULC) data. LUCAS combines a state-and-transition simulation model (STSM) to predict land change with a stock and flow model to simulate carbon dynamics, within a scenario-based framework to assess major controlling processes, characterize uncertainties, and develop future scenarios. As a test case, we calibrated LUCAS for the tidal wetlands of the Mississippi River Alluvial Plain (MRAP), using measurements of carbon pools and fluxes across 24 sites, covering a range of salinity. We then assessed tidal zone carbon sequestration under current conditions with static LULC and with historic LULC changes. Our results highlight that estimates of carbon sequestration in this region are extremely sensitive to assumptions about the fate of soil carbon when coastal wetlands transition to open water with relative sea level rise. We further show how empirical distributions from calibration data can be used to estimate projection uncertainties using a stochastic Monte Carlo modeling approach. The modeling approach developed for the test case ecoregion was then extended to assess the effects of land use change on tidal zone carbon sequestration across the coterminous USA.

Scaling-up spatially-explicit to regionally-relevant estimates of wetland carbon accounting for prairie potholes

Prof Irena Creed[2], Dr Pascal Badiou[3], Mr Shizhou Ma[2], Miss Lyna Lapointe-Elmrabti[1], Dr Miren Lorente[1], Dr Douglas MacDonald[1]

[1]Environment and Climate Change Canada, 8195763802, Canada, [2]School of Environment & Sustainability, University of Saskatchewan, Saskatoon, Canada, [3]Ducks Unlimited Canada, Winnipeg, Canada

Concurrent 5A, October 12, 2021, 3:15 PM - 4:45 PM

Wetlands are a characteristic feature of agricultural landscapes in Canada. There is growing interest in preventing wetland loss and restoring wetlands to serve as biological sinks for carbon. Here, we present the results of a project that will improve understanding of wetlands as bioreactors of carbon, sequestering carbon dioxide and emitting methane. Compiling data from hundreds of studies, we improve the understanding of ecologically driven spatial heterogeneity in estimates of wetland carbon and greenhouse gas (GHG) fluxes throughout the Prairie Pothole Region of North America. We use a combination of on-the-ground and remote sensing approaches to scale estimates from sites to the entire region, and to produce a 50-year time series of these estimates based on empirical models that relate key environmental factors (i.e., climate, hydrology and soil properties) to wetland carbon and GHG fluxes. By comparing the spatially-explicit estimates of intact wetlands to drained or restored wetlands, we show the influence of agricultural intensification on the wetland carbon accounts of the region. The project will also use and refine process models, so that the relative importance of wetland contributions to carbon and GHG fluxes in agricultural landscapes can be forecasted under different climate change scenarios. This information will be used to inform a methodology compatible with methodological standards established by the Intergovernmental Panel on Climate Change for use in Canada's national GHG gas inventory. Quantifying the contribution of the human management of wetlands drainage and restoration is an important step towards carbon credits and Canada's emission reduction objectives

Spatially-explicit model of methane emissions from prairie pothole wetlands

Dr Sheel Bansal[1], Dr. Max Post van der Burg[1], Dr. Rachel Fern[1], Ms Rachel Lo[1], Dr. Owen Mckenna[1]
[1]*U.S. Geological Survey, Jamestown, United States*

Concurrent 5A, October 12, 2021, 3:15 PM - 4:45 PM

Almost half of all biogenically-produced methane emitted to the atmosphere is emitted by small lakes and wetlands. The Prairie Pothole Region (PPR) of central North America contains 5–8 million wetlands, which can influence continental and global methane budgets. However, there is considerable uncertainty of current and future emissions of methane from PPR wetlands due to a lack of landscape-scale models based on robust, empirical data. We used a bottom-up approach to develop a spatially-explicit, temporally-dynamic model of wetland methane emissions from PPR wetlands. Using a dataset of >20,000 static-chamber flux measurements, we developed a chamber-based model of methane flux and then upscaled to the landscape using GIS and remotely sensed proxies. Covariates in the chamber-based model included water-filled pore space, soil temperature, wetland size, land cover, and normalized difference vegetation index (NDVI). Proxies for upscaling included the Dynamic Surface Water Extent based on Landsat, ClimateNA, and the North American Land Change Monitoring System. Total emissions from the PPR ranged from 0.1 to 1 Tg CH4 per year during historic dry and wet years. Future warm temperature scenarios (RCP 8.5) indicate methane emissions from the PPR could increase significantly, although wetland extent is the primary driver of regional emissions.

Strategies for connecting people with wetlands

Ms Christine Prietto[1]
[1]*Hunter Wetlands Centre Australia, Stockton, Australia*

Concurrent 5B, October 12, 2021, 3:15 PM - 4:45 PM

The Ramsar Convention introduced its first education programme in 1999 at COP 7 in Costa Rica. The Ramsar Outreach Programme encouraged member countries to develop programmes to promote and educate people about wetlands. Three years later it was introduced at COP 8 as the Ramsar Communication Education and Public Awareness programme and the acronym "CEPA" came into being. Over the years CEPA has frequently come to be used as a word on its own. Useful or not as that may be, it's use is widespread. In 2008 at COP 10 in Korea, the Ramsar CEPA Programme was re-introduced as the Communication, education, participation and awareness programme.
If one unpacks the acronym, each of these four words represent different audiences, different threats and different tools. Across the 171 countries that are members of the Ramsar Convention there are many wonderful examples of how CEPA initiatives have been developed and applied. In my presentation I would like to focus on participation. I will use the story of Shortland Wetlands Centre, now Hunter Wetlands Centre to showcase how direct participation in wetland management can help people understand wetlands, love wetlands and want to conserve wetlands. I will include what has worked or not worked at site level, challenges faced and also how the site level achievements have impacted on broader conservation status for the whole of the Hunter Estuary, NSW.

Wetland centres as CEPA delivery tools

Mr Chris Rostron[1]
[1]*Wildfowl & Wetlands Trust (wwt), Slimbridge, United Kingdom*

Concurrent 5B, October 12, 2021, 3:15 PM - 4:45 PM

Wetland Link International (WLI) is a network of over 300 wetland centres across the globe. It forms part of the delivery mechanism for Ramsar's CEPA programme (communication, capacity building, education, participation and awareness). Wetland centres support a range of CEPA activities on site, leading to increased knowledge and awareness, and ultimately to behaviour change and action for wetlands. The presentation will include:

- The definition of wetland centres, their structure and common concepts (mix of conservation, education and recreation; zoned sites to enhance visitor/wildlife interaction; trained staff to deliver positive experience; wildlife-sensitive built infrastructure)
- Positive outcomes of wetland centres (raised awareness; informal and formal learning; positive action for wetlands; limit impact on wildlife).
- Challenges of wetland centres (preaching to the converted; superficial experience of wetlands with no long term benefits; negative impact on the wetland resource; exclusion of locals in 'pay to enter' wetlands; long term funding sources)
- Recommendations for a good wetland centre (do good master plans at the start; build in flexibility of design; avoid captive animal collections unless you really know what you're doing; change the offer regularly; low tech versus high tech)

Automated elevation corrections using GPS/GNSS to measure water levels in a subsiding Louisiana estuary, USA

James Fountain[1], Christopher Swarzenski[1]
[1]*United States Geological Survey, Baton Rouge, United States*

Concurrent 5C, October 12, 2021, 3:15 PM - 4:45 PM

In coastal Louisiana, where downwards VLM (vertical land movement) can exceed 1 cm per year, USGS routinely collects water-level data spanning periods of 40 or more years. Maintaining water elevations to an absolute datum considering GPS/GNSS solution variability requires innovative approaches. Staffing to collect the large number of observations traditionally needed to reconcile these VLM differences is cost-prohibitive. Instead, autonomous data collection using a minimally labor-intensive processing solution is required. To this end, low cost dual-frequency GPS/GNSS receivers were permanently deployed at data collection platforms. Data collection from these receivers consists of a twelve-hour observation, synchronized between all deployed receivers, once every seven days. The resulting data is then telemetered for further processing and evaluation. Data processing is handled through submission of observations to the US National Geodetic Society (NGS) Online Positioning User Service (OPUS). Standardized protocols continue to evolve but initial results indicate that with proper grouping of one to three months of data, relative accuracy of +/- 0.01 to 0.02 meters with 99% confidence can reliably be expected. These data can be used to correct in near real time water levels to an absolute datum that can be tracked over long periods and updated as new and improved GEOID models are developed. These data can also be adapted to develop regional subsidence models. By adapting the techniques to the rSET protocol (rod Surface Elevation Table to measure marsh elevations, an understanding of how entire coastal areas experience VLM in surface waters and adjacent wetlands may be obtained.

Estimating wetland relative sea-level rise using 20 years of SET-MH, GNSS, and tide gage data

Dr Camille Stagg[1], Dr. Christopher Swarzenski[2], Mr. Richard Day[1], Dr. Brian Perez[3]
[1]US Geological Survey, Wetland and Aquatic Research Center, Lafayette, United States, [2]US Geological Survey, Lower Mississippi Gulf Water Science Center, Baton Rouge, USA, [3]Jacobs, Baton Rouge, USA

Concurrent 5C, October 12, 2021, 3:15 PM - 4:45 PM

The persistence of coastal wetlands during periods of sea-level rise is an indicator of ecosystem resilience. As sea levels rise, resilient wetlands increase surface elevation through hydrogeomorphic mechanisms to maintain acceptable flooding conditions. Thus, the ability to accurately measure sea-level rise, and the elevation of the wetland relative to changing sea level, is critically important to assessing the resilience and persistence of coastal wetlands.
Over the last 25 years, scientists have introduced several methods for improving these estimates. The surface elevation table-marker horizon method (SET-MH) measures movement of the wetland surface relative to a stable benchmark. Further progress was made with the introduction of wetland relative sea-level rise (RSLRwet), which specifies the movement of the wetland relative to local relative sea-level rise and requires the co-location of SETs with tide gages.
Nonetheless, in coastal wetlands where vertical land movement (VLM) dominates, acquiring accurate estimates of RSLRwet is especially difficult because the benchmark itself may be moving. In this case, the use of global navigation satellite systems (GNSS) in conjunction with SET-MH and tide gage data may provide a more accurate estimate of RSLRwet. Our dataset incorporates multiple acute disturbance events including hurricanes, sudden vegetation dieback events, and major river flood events, in the high-VLM setting of the Mississippi River Deltaic Plain. We compare RSLRwet from four coastal salt marshes along a gradient of mineral supply and elevation collected using SET-MH, GNSS, and tide gages over the last 20 years at duplicate stations in each marsh.

The Implication of Vertical Land Motion on Coastal Wetlands:

Subsidence and Uplift along the Plate Boundary in New Zealand

Dr Paul Denys[1], Dr Andrew Swales[2]

[1]School Of Surveying, Otago University, Dunedin, New Zealand, [2]National Institute of Water and Atmospheric Research, Hamilton, New Zealand

Concurrent 5C, October 12, 2021, 3:15 PM - 4:45 PM

Vertical land motion (VLM) affects coastal sedimentary environments and can be, as in New Zealand, a major driver of change. The fate of coastal wetlands depends on substrate elevation keeping pace with relative sea-level rise (RSLR). Increasing sea levels due to processes such as subsidence, sediment compaction or climate warming will dictate the RSLR trend at any given location.

Continuous and campaign Global Navigation Satellite Systems (GPS/GNSS) technology have been used to measure VLM to accuracies in the order of ±4-6 mm (rms). Measuring VLM is technically challenging. Compared to horizontal deformation, vertical deformation signals are typically an order of magnitude smaller as well as being 2–4 times less precise. The challenges include biases that are difficult to either control or model including atmospheric delays, antenna-phase centre errors and ocean loading.

Here we present three case studies that demonstrate how VLM has influenced development of coastal environments. Firstly, the impact of the Mw 7.8 Kaikoura 2016 earthquake that caused uplift and subsidence of the lower North Island and upper South Island at the centimetre level; secondly how the 2010-11 Christchurch earthquakes have induced ongoing post-seismic subsidence of the Heathcoate-Avon estuary , and; lastly monitoring the subsidence of a mangrove forest (Firth of Thames) observed at Rod Surface Elevation Table benchmarks (~8mm/yr) that is consistent with sedimentary records.

While major earthquakes create an immediate and obvious impact, more gradual and less obvious slow slip events and VLM processes have a major influence on the development and fate of coastal wetlands.

Twenty years of Saltmarsh Elevation Dynamics Measured using GPS/GNSS and Water Levels

Chrisopher Swarzenski[1], James Fountain[1], Richard Day[2], Camille Stagg[2], Brian Perez[3]
[1]United States Geological Survey, Baton Rouge, United States, [2]United States Geological Survey, Lafayette, United States, [3]Jacobs, Baton Rouge, United States

Concurrent 5C, October 12, 2021, 3:15 PM - 4:45 PM

Coastal wetland sustainability requires maintaining elevation relative to long-term water level trends. The rSET (rod Surface Elevation Table) is a standard approach to clarify these relations. In areas with rapid VLM (vertical land movement), the elevation of the rod may move vertically, and other methods may be needed. In coastal Louisiana, VLM results in 0.3 to over 1 cm of subsidence per year. The US Geological Survey has tracked changes in marsh elevation at four replicated salt marshes since 2000 using repeat GPS (Global Positioning System) surveys of concreted benchmarks, laser-level surveys of marsh elevation relative to the benchmarks, and local tide gage records. The sites align along a gradient in mineral sediment availability. Accretion rates using Cs-137 dating ranged from 0.49 cm/y to 0.99 cm/yr. GPS surveys did not resolve absolute and relative changes in benchmark and marsh elevations over the 20-year study. Instead, bracketing marsh elevations to averaged daily high water and daily water levels in 2002 and again in 2020 was enough to evaluate relative marsh elevation changes. The efficacy of local water levels in assessing marsh surface elevation change over time at these delta plain salt marshes, separated by over 45 miles, is explained by the uniform water level regime. The development of low-cost pressure transducers to measure water levels needing few servicing trips as well as improved low-cost GPS receivers are tools that can complement rSET techniques, especially in areas experiencing significant VLM.

MAKING SCIENCE ACCESSIBLE: TAKING TAXONOMY TO COMMUNITY LEVEL

Miss Bindiya Rashni[1]
[1]*Naturefiji-Mareqetiviti, Suva, Fiji*

Concurrent 5D, October 12, 2021, 3:15 PM - 4:45 PM

As Fiji's NGO focal point for the Communication, Education and Public Awareness (CEPA) of the Ramsar Convention and being an integral part of Fiji's Ramsar Convention on Wetlands steering committee, NatureFiji-MareqetiViti (NFMV) has been implementing a citizen science program called 'Learn from a Scientist Series' (LSS) for the last six years which allows local experts to introduce the public to Fiji's unique biodiversity, especially keystone species. Taking into concern the almost zero advocacy then on freshwater infauna in Fiji, NFMV launched the Fiji river invertebrate spotting game (Meandering Mate Hunt game-MMH) via LSS program. The MMH game actively engages the public in sampling riverine invertebrates in their micro-habitats and identification of river health bioindicator taxa via the 'Traffic Light Bioindicator Guide (TLBG). MMH and TLBG introduces the locals to freshwater macroinvertebrate community composition across the stable instream micro-habitats, bioindicators of river health, the riparian-river relationship and catchment-river relationship. NFMV organizes and facilitates the river-invertebrate spotting game twice (wet season and dry season) annually at Nabukavesi Creek on Viti Levu Island of Fiji. In 2018, by popular demand the MMH game progressed on to Garrick Reserve and then to the only freshwater ramsar site (Upper Navua Conservation Area) in Fiji whereby the landowners witnessed the successful efforts of conservation via presence and abundance of bioindicators of excellent water quality and healthy river system. NatureFiji-MareqetiViti envisions to extend the MMH to other islands in Fiji in order to increase CEPA efforts in freshwater wetland biodiversity management and continued ecosystem services.

Emerging studies on the structure and function of coastal urban wetland ecosystems in Miami FL, USA

Dr Tiffany Troxler[1], Edward Castaneda, Daniel Chomin-Virden, Marbelys Garriga, Lukas Lamb-Wooton
[1]*Florida International University, Miami, United States*

Concurrent 5E, October 12, 2021, 3:15 PM - 4:45 PM

Wetlands are a unique type of urban ecological infrastructure (UEI) because they have ecological structures and functions that are both terrestrial and aquatic, and in human-dominated landscapes may confer ecosystem services at levels of wetlands found in “natural” environments. In South Florida, these ecosystem services can be based on high levels of productivity given the sub-tropical climate and low-lying elevation, providing unique places and opportunities for both remnant natural wetland and natural-built types of urban ecological infrastructure to emerge and persist. Mangrove wetlands are among those ecosystems with often high rates of productivity and relatively large rates of organic carbon sequestration, in addition to their potential for providing water quality regulation, storm surge protection and fisheries habitat services. The potential for natural, restored and created wetlands in urban environments to confer ecosystem services are not well understood, and cannot necessarily be inferred from natural systems in more pristine environments. To further our understanding of mangrove UEI, we are undertaking studies characterize their ecosystem structure and function in Miami, Florida. Studies include estimation of carbon stocks and sequestration between natural and restored urban mangrove wetlands, assessment of vertical accretion relative to local rates of sea level rise in natural mangrove wetlands of urban environments, and emerging studies on the role of hybrid and created mangrove shorelines in sequestering urban contaminants. These types of studies will further our understanding of the role of UEI and the ecosystem services they contribute in coastal urban environments.

Long-term trajectory of constructed (treatment) wetlands towards urban sustainability and the simplicity (or not) of it: from functions to services, from ecologists to urban planners

Dr Paul Bois[1]
[1]*Université de Strasbourg, Strasbourg, France*

Concurrent 5E, October 12, 2021, 3:15 PM - 4:45 PM

The majority of wetlands on Earth have been depleted for human purposes over a few centuries. Today, as the landscape has dramatically changed and half of the world population is about to become urban, wetlands and their anthropic constructed counterparts are reconsidered anew. From the very ecological functioning of these turquoise urban ecological infrastructures, ecosystem services are retrieved by society to achieve urban sustainability. From fieldwork achieved in the city of Strasbourg since 2012, we will discuss the significance of wetlands in the field of urban storm- and wastewater management. We will especially focus on i) the shift from ecological functions to ecosystem services and the subsequent trade-offs, ii) the transfer and adoption from scientists to urban planners and iii) the simplicity of the implemented wetlands. We will try and provide elements for a larger discussion on what makes wetland UEI useful and what still needs to be done to make the best out of it. We will thus introduce simplicity as a way to measure the gap still to be bridged towards sustainability, and long-term thinking as a way to more integrated and relevant knowledge about wetland UEI.

Nine years of long-term research on a “working” constructed treatment wetland in Phoenix, AZ, USA: An example of turquoise Urban Ecological Infrastructure

Dr Daniel Childers[1]
[1]*Arizona State University, Tempe, United States*

Concurrent 5E, October 12, 2021, 3:15 PM - 4:45 PM

Urban ecological infrastructure (UEI) is a recently revived term for “nature in cities”. As a concept, UEI is fully inclusive of the myriad ecological structures and functions found in cities. We have been quantifying a number of ecosystem-level parameters in the City of Phoenix’ Tres Rios constructed treatment wetland (CTW) since July 2011. The wetland vegetation and soils are sequestering large amounts of nitrogen. Our whole-system nutrient budgets also show considerable nitrogen uptake, but rates are not as dramatic as within the marsh proper. Plant transpiration and water budget measurements show large water deficits, particularly during the hot summer months.

Peak summer plant biomass is typically 1.5 - 3 kg dw m-2 for the five dominant species (2 species of Typha and 3 species of Schoenoplectus); Typha biomass makes up 80-90% of this. Evaporation and transpiration rates are highest during the hot summer months, with high temperatures exceeding 45°C and humidity as low as 2%. During this time, evaporation and transpiration account for roughly 90% of the water deficit; up to 75% of that is transpiration. Transpiration-driven water losses equate to a residence time of 5 – 8 days for the water overlying the marsh. We used controlled tracer studies to confirm that plant transpiration is driving a lateral “tide” that brings new water and nitrogen into the vegetated marsh, making this CTW more effective at nutrient removal than similar UEI in cooler or mesic cities. This is the first evidence of biological control of surface hydrology in a wetland.

Red listing of South African wetland ecosystems: comparing a top-down and bottom-up approach

Dr Heidi Van Deventer[1]
[1]*Council for Scientific and Industrial Research (csir), Pretoria, South Africa*

Concurrent 6A, October 13, 2021, 10:45 AM - 12:30 PM

The South African National Biodiversity Assessment (NBA) assesses the status of ecosystems at a country-wide scale, in a top-down manner, every 5–7 years. Two headline indicators are used as a standard for determining the risk of ecosystem to collapse, including the ecosystem threat status (ETS) and ecosystem protection levels (EPL). The NBA 2018 was the third country-wide assessment for rivers and second for wetlands, following the 2004 and 2011 assessments. Wetland and estuarine ecosystems were found to be the most threatened and least protected ecosystems in South Africa, with 88% of wetland area and 99% of estuarine area threatened. The Aichi Target was not reached, with only 14% of rivers and 7% of inland wetlands found to be within protected areas. Wetlands remained poorly represented, highly threatened and poorly protected. In addition, freshwater fish are the most threatened species group assessed in South Africa in 2018. One-third of South Africa's native fish species and two-thirds of endemic species are threatened. These findings are congruent with a continuous decline in the ecological condition of rivers observed in the past seven years.
A bottom-up approach was also undertaken for subtropical-temperate coastal forested wetlands, using the five IUCN criteria for red listing of ecosystems. These wetlands were found critically endangered based on habitat loss, being range-restricted and having threatened species associations. Top-down and bottom-up approaches to conservation planning both have value and complement one another. The benefits and challenges to top-down and bottom-up approaches to red listing of wetland ecosystems are discussed.

The Living Water partnership: Can DOC and Fonterra really work together? Can dairying and freshwater thrive side-by-side?

Mr Peter Savage, Dr Katie Collins[1], Nicki Atkinson[1]
[1]*Living Water, , New Zealand*

Concurrent 6A, October 13, 2021, 10:45 AM - 12:30 PM

Living Water is a 10-year partnership between the Department of Conservation (DOC) and Fonterra which aims to find game-changing and scalable solutions that will enable farming, freshwater and healthy ecosystems to thrive side-by-side. To achieve this, tools or solutions are being trialed in five regions across New Zealand, including the Te Waihora-Lake Ellesmere catchment in Canterbury. We are working with farmers, scientists, councils, mana whenua and communities to design and test solutions, and scale them across our catchments. By combining the restoration expertise of DOC and mana whenua with Fonterra's responsible dairying knowledge, this long-term commitment will deliver tangible benefits to local catchments and communities, and lessons for all New Zealand.

Design of the treatment wetland determines nitrous oxide emission

A/Prof Kuno Kasak[1], Ms Keit Kill[1], A/Prof Evelyn Uuemaa[1], Prof Ülo Mander[1]
[1]*University Of Tartu, Tartu, Estonia*

Concurrent 6B, October 13, 2021, 10:45 AM - 12:30 PM

Treatment wetlands that are planted with emergent macrophytes are widespread measures to reduce agricultural diffuse pollution. However at the same time they are also considered as a significant sources of greenhouse gases. While many experiments have been conducted to study the emission of carbon dioxide and methane, little attention has been paid for the emission of nitrous oxide (N2O). We carried out first long term N2O measurements using floating chambers from March 2019 through March 2022. Our results showed a very high variability of N2O emission: the fluxes ranged from -4.5 ug m-2 h-1 to 2674.2 ug m-2 h-1 with mean emission of 97.3 ug m-2 h-1. Based on gas samples (n=687) we saw a strong correlation (R2 = -0.38, p<0.0001) between N2O emission and water depth. The average N2O emission from sections with the water table depth >15 cm was 45.9 ug m-2 h-1 while sections with water table depth <15 cm showed average emission of 648.3 ug m-2 h-1. Water temperature that is often considered as the main driver had less effect to the N2O emission. For instance, at lower temperatures, when the emissions from deeper zones decreased, there was no temperature effect on emissions from shallow zones. Our study demonstrates that the design of the wetland can determine the magnitude of greenhouse gas emissions and water table depth is one of the key design elements to minimise N2O emission.

Implications of Emerging Contaminants on Nitrogen Removal Processes in Treatment Wetlands

Dr Tiffany Messer[1]
[1]*University Of Kentucky, Lexington, United States*

Concurrent 6B, October 13, 2021, 10:45 AM - 12:30 PM

Wetlands provide water quality treatment for a wide array of nonpoint source contaminants. However, little is known of the implications of emerging contaminants on microbial denitrification occurring in wetland environments or wetland treatment potential for water quality mixtures with evolving emerging contaminants. Over the past two years we have conducted three coupled wetland microcosm and mesocosm experimental campaigns to assess implications of water quality mixtures of emerging contaminants (i.e., antibiotics, pesticides, microplastics) on nitrate-N removal in wetlands. The goal of this study was to quantify the removal potential of nitrate-N and the emerging contaminants through microbial denitrification and bioremediation. Experiments were setup in replicates of three for each treatment and wetlands were planted with a mixture Carex comosa, Carex vulpinoidea, Asclepias incarnata, Juncus effusus, Juncus torreyi, and Iris versacolor. Throughout each experiment, grab water quality samples were taken every 1 to 3 days to measure nitrogen and carbon species along with emerging contaminant concentrations. Further, plant samples were taken pre- and post-experiments to quantify plant uptake of emerging contaminants. Significant wetland macrophyte uptake of emerging contaminants was observed. Nitrate-N removal, presumably through denitrification, was not limited, and often enhanced, depending on emerging contaminant mixture. Results from this work provide important insight to the implications of emerging contaminants on nitrate-N removal potential and bioremediation of emerging contaminants in treatment wetland systems.

Nitrogen Removal, Greenhouse Gas Emissions, and MeHg production in Wetlands Receiving Nonpoint-Source Nitrate Loads

Prof William Crumpton[1]
[1]*Iowa State University, Ames, United States*

Concurrent 6B, October 13, 2021, 10:45 AM - 12:30 PM

Wetland restoration is a promising strategy for reducing surface water contamination in agricultural watersheds and in particular for reducing agricultural nitrate loads. However, there is some concern over unintended consequences, including increased GHG emissions and MeHg production. Over the past decade, over 90 wetlands have been restored through the Iowa Conservation Reserve Enhancement Program with the explicit goal of intercepting and reducing nonpoint-source nitrate loads. We studied selected subsets of these wetlands to evaluate their effectiveness at reducing agricultural, nonpoint-source nitrogen loads, and to evaluate their effect on greenhouse gas emissions and MeHg production. Nitrogen loads to the wetlands were primarily in the form of nitrate and all of the wetlands were effective in reducing both nitrate and total N loads, with removal efficiencies ranging from 9-92%. The wetlands were highly efficient at denitrifying nitrate to N2, with fractional yields of N2O-N averaging less than 0.5% of total nitrate removal. N2O emission rates were similar to rates from cropland and CH4 emission rates were similar to rates for restored depressional wetlands in Iowa. There was very little MeHg export from the wetlands, with only slight increases during very low flow summer periods when nitrate-N concentrations fell below about 3 mg/l. Average MeHG concentrations were similar to those of the receiving streams. Our results suggest that wetlands can be managed as effective sinks for nonpoint source nitrate loads with minimal effects on GHG emissions or export of MeHg.

Quantifying field-scale performance and developing practical guidelines to accelerate uptake of constructed wetlands for on-farm nutrient management

Dr Chris Tanner[1], Mr James Sukias[1], Dr Ben Woodward[1], Dr Fleur Matheson[1], Dr Lucy McKergow[1], Dr Brandon Goeller[1], Mr Aslan Wright-Stow[2], Dr Craig Depree[2], Dr Electra Kalaugher[2]
[1]NIWA, Hamilton, New Zealand, [2]DairyNZ, Hamilton, New Zealand

Concurrent 6B, October 13, 2021, 10:45 AM - 12:30 PM

Many New Zealand farmers are in the process of identifying and implementing mitigations to reduce diffuse contaminant losses to surface waters, under regional limit-setting processes required under the National Policy Statement for Freshwater Management (NPS-FM). Constructed wetlands (CWs) are part of the toolbox of mitigation options available to meet limits. Reliable information is needed to quantify CW treatment performance so that landowners can claim mitigation benefits and regulators have confidence that CW will deliver the contaminant reductions needed to meet catchment water quality objectives. Better quantification of performance, along with provision of practical guidelines and on-farm demonstration of CWs in partnership with industry and regulatory agencies, is expected to help accelerate their adoption by landowners and facilitate regulatory acceptance. Here we outline a collaborative research programme to accelerate appropriate application by farmers. New Zealand and relevant international data on farm-scale constructed wetland performance will be reviewed, and progress to address knowledge gaps outlined.

Strategic wetland restoration and construction to improve water quality in agricultural watersheds in eastern North Carolina, USA

Dr Michael Burchell[1]
[1]*NC State University, Raleigh, United States*

Concurrent 6B, October 13, 2021, 10:45 AM - 12:30 PM

Agriculture in eastern North Carolina, USA is a very important economic driver in the region. However, most of the agricultural facilities are situated on former wetland areas and/or in close proximity to streams and rivers, which drain to our extensive estuarine system. As such, many of these lands require intense surface and subsurface drainage, which often discharge large amounts of excess nutrients to surface water, contributing to recurring eutrophication problems.
Strategic location of wetlands in the landscape to intercept excess drainage water, through either restoration or construction, have proven to help mitigate excess nutrient loss in agricultural watersheds, but are many times overlooked in favor of less effective nutrient reduction management practices. Our research and outreach group have worked for over two decades to demonstrate the effectiveness and provide guidance towards implementation of several types of wetlands practices that can be located in various landscape positions. Examples include: a) conversion of agricultural lands to forested wetlands and b) salt marsh to intercept drainage water from surrounding row-crop farms; c) constructed wetlands to treat groundwater near swine waste lagoons; d) in-stream wetlands constructed in major agricultural drainage canals; and e) large scale forested wetland restoration designed to receive pumped agricultural drainage from low-lying lands to reduce direct discharge to local estuaries. An overview of the variety of goals, development of design criteria, nutrient removal performance, and ancillary ecosystem services, will be described in this presentation.

Filamentous Algae Nutrient Scrubber for diffuse pollution mitigation

Dr Rupert Craggs[1]
[1]*National Institute of Water and Atmosphoeric Research, Hamilton, New Zealand*

Concurrent 6C, October 13, 2021, 10:45 AM - 12:30 PM

Filamentous Algae Nutrient Scrubbers (FANS) are a novel agricultural drainage treatment system that grow filamentous algae to recover nutrients for beneficial reuse.

Filamentous algal systems have been used to treat agricultural drainage in the USA, where they have also been used to treat various agricultural effluents and wastewaters.

FANS are gently sloping floways that are covered with attached filamentous algae. The water flows down the floway and over/between the filamentous algae. The water is treated through a combination of algal photosynthesis and growth (nutrient assimilation, oxygenation) and physical filtration (settling, adsorption and precipitation).

This talk will discuss the potential to use FANS systems for agricultural drainage water treatment in New Zealand and the results of on-going research in this area in which we are developing FANS for NZ conditions. Research has involved screening high nutrient affinity NZ species for nutrient recovery and algal production. Investigating options for attached algae systems either along-side or within existing freshwater bodies (streams, rivers, lakes). The programme is also investigating beneficial reuse of the nutrients that are recovered as algal biomass that are culturally acceptable to Māori (e.g., fertilizer, animal fodder).

Pilot-scale demonstration is being conducted in consultation with iwi partners who will host field-scale demonstrations in the last two years of the project. During these field-trials the habitat benefits, particularly for wading birdlife will be also assessed.

An alternative pathway to restore a wetland - the restoration story of Long Swamp (within the Glenelg River and Discovery Bay Ramsar Site), Victoria, Australia.

Mr Mark Bachmann[1]
[1]*Nature Glenelg Trust, Mumbannar, Australia*

Concurrent 7A, October 13, 2021, 2:30 PM - 5:00 PM

Building a consensus for action to restore wetlands can be a tricky business, especially when the history of a site is shrouded in confusion as a result of conflicting early accounts and fading memories, as well as a wide range of modern subsequent assumptions and interpretations which, as a result of ecological shifts, have sometimes taken on a life of their own.

This is the story of how Nature Glenelg Trust (NGT) was able to build a consensus for action, through a blended approach that used a thorough investigation of a range of historic materials (such as early maps, journals, government files and newspaper articles), in combination with the use of modern scientific tools (e.g. GIS tools and modelling), to provide a sound platform to inform restoration planning and works.

This was not simply a theoretical exercise however, with restoration trials implemented to help answer our final technical questions. This allowed NGT to propose a permanent solution with a level of confidence sufficient to gain support from the local community and government agencies with an interest in the site.

The result today, several years since NGT became involved, is that Long Swamp in Discovery Bay Coastal Park has now successfully had its hydrology permanently restored, and, thanks to local community advocacy and State Government support, is also part of Victoria's newest Ramsar site (Glenelg Estuary and Discovery Bay Wetlands).

This approach to both science communication and wetland restoration is likely to be of great value at other complex sites.

China’s Coastal Wetlands in Thirty Years: Degradation Trend, Restoration Practices and Strategies for Function Improvement

Professor Lijuan Cui[1], Dr Yinru Lei[2], Dr candidate Yin Gao[2], Dr Manyin Zhang[2]

[1]*Chinese Academy of Forestry, Beijing, 中国,* [2]*China’s Coastal Wetlands in Thirty Years: Degradation Trend, Restoration Practices and Strategies for Function Improvement , Beijing, 中国*

Concurrent 7A, October 13, 2021, 2:30 PM - 5:00 PM

Healthy coastal wetland ecosystems play an important role in guaranteeing territory ecological security and sustainable development of China, yet their changing status is largely unknown. In this paper, the current status of China’s coastal wetlands and its change during the past 30 years were analyzed based on spatially constrained manual interpretation of nationwide high-resolution images in 2017. The results showed that China’s coastal wetlands have decreased significantly as a result of continuing population growth, large-scale infrastructural developments, extensive land reclamation projects, and the ineffective control of various types of pollution. Coastal human activities in China are found to change shoreline evolution and wetland hydrology, to deteriorate soil and water quality, to alter vegetation succession, benthic animal and microbial communities, and fisheries, and to impair ecosystem functioning and services. In order to alleviate the degradation of its costal wetland, China has made grate efforts in coastal wetland conservation by implementing coastal wetland restoration projects, establishing coastal protected areas, and launching sustainable development schemes. Our interpretation demonstrates an urgent need to arrest the decline of China’s coastal ecosystem, which could be achieved by developing a multi-objective, multi-scenario, and multi-scale framework that integrate research institutes, production sectors, policy makers and users of coastal wetland resource.

Greater Wellington Regional Council's Healthy Waterways programme: Expanding our wetland management toolbox

Ms Aprille Gillon[1]
[1]*Greater Wellington Regional Council, Wellington, New Zealand*

Concurrent 7A, October 13, 2021, 2:30 PM - 5:00 PM

Greater Wellington Regional Council's Healthy Waterways programme supports landowners throughout the Wellington Region to restore and manage natural wetlands and waterways on their land. The programme has been in place since 2016. As part of this programme, Greater Wellington provides advice, assistance, and incentives to landowners for key wetland management activities including fencing to exclude stock, pest plant control, pest animal control and planting. We have recently been exploring the opportunity to add further wetland management tools to our toolbox. Over the past year we have embarked on a project to restore the hydrology of an existing natural wetland and construct a wetland for biodiversity and water quality enhancement. This presentation will introduce the programme and delve into the learnings so far from this project.

Hyperspectral Estimation of the Chlorophyll Content in Short-Term and Long-Term Restorations of Mangrove in Quanzhou Bay Estuary, China

Prof Wei Li[1], PhD candidate Zhiguo Dou[1], Dr Yinru Lei[1]
[1]*Institute Of Wetland Research, Chinese Academy Of Forestry, Beijing, China*

Concurrent 7A, October 13, 2021, 2:30 PM - 5:00 PM

The chlorophyll content can indicate the general health of vegetation, and can be estimated from hyperspectral data. The aim of this study is to estimate the chlorophyll content of mangroves at different stages of restoration in a coastal wetland in Quanzhou, China, using proximal hyperspectral remote sensing techniques. We determine the hyperspectral reflectance of leaves from two mangrove species, Kandelia candel and Aegiceras corniculatum, from short-term and long-term restoration areas with a portable spectroradiometer. We also measure the leaf chlorophyll content (SPAD value). We use partial-least-squares stepwise regression to determine the relationships between the spectral reflectance and the chlorophyll content of the leaves, and establish two models, a full-wave-band spectrum model and a red-edge position regression model, to estimate the chlorophyll content of the mangroves. The coefficients of determination for the red-edge position model and the full-wave-band model exceed 0.72 and 0.82, respectively. The inverted chlorophyll contents are estimated more accurately for the long-term restoration mangroves than for the short-term restoration mangroves. Our results indicate that hyperspectral data can be used to estimate the chlorophyll content of mangroves at different stages of restoration, and could possibly be adapted to estimate biochemical constituents in mangrove leaves.

Restoring ephemeral wetlands through community participation - a dry wetland is part of the outcome not a sign of degradation

Prof Max Finlayson[1]

[1]Institute For Land, Water & Society, Charles Sturt University, Albury, Australia, [2]IHE Delft, Institute for Water Education, Delft, Netherlands

Concurrent 7A, October 13, 2021, 2:30 PM - 5:00 PM

Ephemeral wetlands have been subject to degradation and conversion to alternative land uses, and at times unrecognised as wetlands when they are dry. Or if they have been recognised the dry phase has been seen as an unhealthy state. In Australia these perceptions have gradually been changing as communities have been engaged in restoration efforts and ongoing management. However, the issue of dry still remains a public and managerial problem - how do we convince the wider community that a wetland can be dry? And that it should be valued as such, and not seen as unhealthy? With this in mind two examples from inland Australia are examined. One is a large ephemeral lake, Lake Cowal, that sits alongside a gold mine and farming properties and has an innovative foundation in place to encourage conservation and education efforts. The other is a decommissioned irrigation reservoir that is guided by an expert scientific panel that advises the community-based management committee and holds an annual science forum. Are they successful? The answer is yes, but still the perception that dry is bad persists. What else can be done to change this ridiculous attitude? Education yes, but of whom? The wider community, the politicians and our fellow scientists and managers all need to come in from the wet and embrace the dry.

Role of governance in sustaining wetlands restoration: Learnings from experiences of Indian National Wetlands Programme

Dr Ritesh Kumar[1]
[1]*Wetlands International South Asia, New Delhi, India*

Concurrent 7A, October 13, 2021, 2:30 PM - 5:00 PM

Wetlands restoration is as much about enabling ecological conditions that sustain diverse ecosystem services and biodiversity, as well as mainstreaming wetlands within societal development agendas. Achieving a fit between institutions and governance regimes and ecosystem dynamics operating at multiple spatial and temporal scale is crucial for achieving wetlands conservation and wise use outcomes. With India becoming a party to the Ramsar Convention in 1982, a national programmatic framework aligned with wise use approach has been shaped by the Ministry of Environment, Forest and Climate Change, enabling a shift from erstwhile protected area based management approaches. Despite an increase in coverage of sites under the national programme, loss of natural wetlands has continued, outpacing the conservation and management efforts. Patch-centric management of wetlands, especially for those located within protected areas, have turned out to be of limited influence on basin-scale land and water use related drivers of degradation. Wetlands Authorities, envisaged as special purpose institutions to ensure cross-sectoral engagement in planning and decision-making for wetlands, have been successful wherein leadership and political ownership distinct and clear. Creating separate financing arrangements for wetlands restoration from central government has created an inverted incentive structure, with the uptake in state's developmental planning processes being very limited. Local community driven wetlands restoration initiatives, on the other hand, have been relatively successful in addressing degradation and mobilizing citizen action. There is an urgent need to scale up wetlands restoration from a handful of sites to a pan-India coverage, taking into account the differences in governance settings.

Constructed wetlands with subsurface flow for nitrogen removal from tile drainage

Prof Jan Vymazal[1], Dr. Adam Sochacki[1], Dr. Petr Fučík[2], Dr. Michal Šereš[3], Dr. Markéta Kaplická[2], Dr. Tereza Hnátková[3], Dr. Zhongbing Chen[1]

[1]Czech University Of Life Sciences Prague, Praha, Czech Republic, [2]Research Institute for Soil and Water Conservation, Praha, Czech Republic, [3]Dekonta, a.s., Dřetovice, Czech Republic

Concurrent 7B, October 13, 2021, 2:30 PM - 5:00 PM

In 2018, three experimental constructed wetlands with horizontal subsurface flow were built to treat tile drainage from 15.73 ha watershed. The wetlands have a surface area of 79, 90 and 98 m2 and were planted with Phalaris arundinacea and Glyceria maxima in parallel bands. The substrate in the first two wetlands is gravel (4-8 mm) mixed with birch woodchips (10:1 volume ratio). In one of those wetlands, the water level is kept 10 cm above the surface, in the second one the water is kept below the surface. The third wetland has 20 cm layer of birch woodchips on top of gravel. The monitoring started in August 2018 and in this abstracts results are reported until February 2020. The mean inflow total nitrogen concentration of 13.6 mg/l was reduced to average concentrations of 4.9, 4.6 and 3.8 mg/l, in wetlands 1, 2 and 3, respectively and the respective average removal efficiencies amounted to 64%, 66% and 72%. The average load removals amounted to 0.47, 0.33 and 0.37 g N m-2 d-1 or 1715, 1193 and 1362 kg ha-1 yr-1 in wetlands 1, 2 and 3 respectively. The plant uptake and nitrogen sequestration in aboveground biomass contributed only marginally to the overall nitrogen removal. Among the three variants, the one with shallow water on the surface has exhibited the highest removal of nitrogen from tile drainage so far.

Doubling the extent of wetlands on dairy farms – what will it take?

Mr Aslan Wright-stow[1], Dr Electra Kalaugher[1], Dr Craig Depree[1], Dr Chris Tanner[2], Dr Fleur Matheson[2]
[1]Dairynz, Hamilton, New Zealand, [2]NIWA, Hamilton, New Zealand

Concurrent 7B, October 13, 2021, 2:30 PM - 5:00 PM

More than 90% of New Zealand's wetlands have been drained to increase land available for primary production over the last 150 years. Between the early 2000's and approximately 2015 the number of dairy cows increased from around 3.5 to 5 million and with the increase in production, associated contaminant losses have been observed in many locations. Under the Dairy Tomorrow Strategy, the dairy sector has committed to leading efforts to improve the health of our rivers and streams and protecting and enhancing biodiversity. Given that much of the loss of wetlands occurred on land that is now under dairy production, dairy farmers have the opportunity to play a significant role in reversing wetland loss, and with that improve water quality outcomes. We will outline the dairy industry's approach to increasing the extent of wetlands. We will outline our efforts to date to see wetlands effectively recognised by regulatory processes so that farmers are incentivised to increase their spatial extent. We will also discuss perspectives on 'pollution swapping' associated with the interception and denitrification of nitrate in wetlands, which can generate a small amount of nitrous oxide. Considering the potential 'contraindications' of a water-based mitigation action on greenhouse gas emissions is critical to facilitate increasing the spatial extent of wetland in dairy landscapes.

Faecal indicator removal and generation (?) in agricultural wetlands

Dr Rebecca Stott[1], Mr James Sukias[1], Dr Adrian Cookson[2], Dr Rob Davies-Colley[1], Dr Lucy McKergow[1], Dr Chris Tanner[1]

[1]National Institute Of Water And Atmospheric Research (niwa), Hamilton, New Zealand, [2]AgResearch Limited, Hopkirk Institute, Massey University, Palmerston North, New Zealand

Concurrent 7B, October 13, 2021, 2:30 PM - 5:00 PM

A constructed wetland treating episodic (rain event driven) dairy pasture subsurface drainage was found to be a net exporter of the faecal indicator bacterium, Escherichia coli. Monthly monitoring of farm drainage to the wetland during the wetter months of the year indicated a relatively low median inflow concentration of 23 E. coli/100mL increasing to 98 E. coli per 100mL in the outflow. This is a surprising finding given that constructed wetlands treating steady-flow wastewaters usually achieve net removal of E. coli. Investigating if the increase in E. coli was an artefact of sampling biased towards flow recession after rain events entailed considerable flood-chasing work using time-based and flow-proportional sampling to calculate inflow and outflow fluxes (cfu/s) and loads (cfu/event and cfu/yr). Testing this "hypothesis" concluded that the wetland was indeed a net exporter of E. coli with increases in E. coli export ranging from 2 to 34-fold. Subsequent work has sought to understand if the export of E. coli is due to environmental "naturalized" populations of this bacterium that may survive and grow in the wetland. Further investigation into the diversity of E. coli isolates collected from water, sediment, soil and faecal material from the constructed wetland and adjacent pasture, found evidence of naturalised cryptic clades of Escherichia species phenotypically indistinguishable from faecally-derived E.coli but divergent at the genetic level. This raises interesting questions regarding the microbial ecology of E. coli and interpretation of E. coli-based water quality in relation to waterborne disease and health risk downstream from wetland environments.

Mitigating the potential for constructed wetlands to release dissolved reactive phosphorus

Dr Ben Woodward[1], Dr Chris Tanner[1], Dr Fleur Matheson[1]
[1]*National Institute Of Water And Atmosphtere, Hamilton, New Zealand*

Concurrent 7B, October 13, 2021, 2:30 PM - 5:00 PM

Constructed wetlands (CWs) are one of the tools being utilised to mitigate agricultural diffuse pollution losses to waterways. However, in some situations they may be sources rather than sinks of dissolved reactive phosphorus (DRP). This is likely due to their creation on drained, fertilized areas where local, carbon rich top-soils have been added to the wetland to increase rates of denitrification and increase initial macrophyte growth rates. Draining of swampy soils for agriculture increases the rate of organic matter mineralisation and the conversion of organic phosphorus into DRP. This DRP can bind to soils in forms that are unavailable to pasture grasses and crops in aerated soils but can be mobilised if these soils become inundated and anoxic, through Fe and Mn reduction. Here we investigate the risk of DRP release following inundation for gley soils, an often-drained soil type that is common to lowland agricultural regions of New Zealand. To assess DRP release risk we have; 1) measured degrees of phosphorus saturation (DPS) in a range of gley soil types with different total P concentrations and chemical characteristics indicative of DRP binding potential, and 2) conducted assays to measure DRP release after inundation and subsequent de-oxygenation 3) tested a range of potential mitigation measures. We have identified a critical DPS threshold for DRP release from gley soil and identified some potentially effective mitigation measures.

Multi-ecosystemic services provided by artificial wetland receiving agricultural subsurface drained water

Dr Laura Seguin[1], Dr Julien Tournebize[1], Mr Cedric Chaumont[1], Mr Francois Birmant[3], Mr Guillaume Letournel[1], Ms Laetitia Perrier[4], Dr Kaido Soosaar[4], Prof. Ulo Mander[4], Ms Mathilde Bonifazi[1], Dr Fabienne Barataud[2]

[1]University of Paris-Saclay - Inrae, Antony, France, [2]Inrae, Mirecourt, France, [3]AQUI'BRIE, Melun, France, [4]Institute of Ecology and Earth Sciences, University of Tartu, Tartu, Estonia

Concurrent 7B, October 13, 2021, 2:30 PM - 5:00 PM

Agricultural watershed suffers from a misbalance between crop activities and environmental protection. Exceed fertilizers or synthetic products ended in surface water bodies, especially in context of subsurface drainage degrading dramatically water quality for aquatic life. Additionally to best management practices at farm scale, buffer zones help by intercepting drained water to reduce non point source pollution. Those mitigation zones nevertheless provide other ecosystemic services.

We present ecosystemic services assessment of an artificial wetland receiving the drained water from a 400ha watershed in conventional agriculture in Paris suburb at Rampillon (CW; 5600m²; 2600m3), built in 2010, France, corresponding to a surface ratio of 0.15% with upstream connected watershed.

Flood mitigation is strongly limited due to the weak storage volume. Pollutant mitigation due to mainly microbial activities led to reduce 12% of annual nitrogen by denitrification, and 30% of total pesticide annual fluxes. Regulation services strongly depends on seasonal and pesticides properties. GHG and carbon balances were calculated to be less than 0.03% for N2O emitted from denitrification, and emit 1005 kg/ha of CO2eq. Based on biodiversity surveys (8 taxonomic groups), the 0.5ha of artificial wetland supports about 60% of local species compared to regional survey. These field results were transferred to local stakeholders by implementing an educational path supporting the recreation services. In parallel to the upscaling approach, involvement of stakeholders was stimulated by testing participatory approach based on perception of biodiversity, prospective scenario, and roleplay in order to manage better a socioeconomical territory coupling agricultural production and environmental protection.

Saturated and integrated buffer zones as novel drainage mitigation measures in Denmark

Dr Dominik Zak[1], Dr Mette Carstensen[1], Mrs Sofie van't Veen[1], Dr. Rasmus Petersen[1], Prof. Dr. Brian Kronvang[1]
[1]*Arhus University, Silkeborg, Denmark*

Concurrent 7B, October 13, 2021, 2:30 PM - 5:00 PM

Vegetated buffer strips (VBSs) along watercourses have been introduced in many European countries to mitigate impacts on water quality and ecological quality of watercourses by reducing inputs of sediment and nutrients from surface runoff on intensively managed agricultural land. However, the effectiveness of VBSs was proven to be low for the retention of dissolved nutrients (NOx, PO43-), especially when agricultural drainage water was directly discharging to streams via tile drainage pipes. Therefore, two new drainage mitigation measures namely saturated and integrated buffer zones (SBZs and IBZs) have been implemented at test sites and studied during the last five years in Denmark for their retention efficiency for nitrogen and phosphorus. Tile drain pipes were disconnected at the sloping field margin to the riparian zone by diverting drainage water either to a buried, lateral distribution pipe running parallel to the stream (SBZ) or charging a pond combined with a sub-surface flow infiltration zone planted with vegetation (IBZ). Altogether, six sites were intensively monitored over a period of 2-5 years to evaluate the nutrient removal efficiency of SBZs and IBZs. Depending on the water inflow, physical soil characteristics, water saturation of soils and dominant vegetation type, a substantial fraction of the water can infiltrate the soil before reaching the watercourse. While the results on total nitrogen removal were promising for both systems with mean removal efficiencies between 31% and 76 % of the load, a risk of phosphorus release occurred at higher summer temperatures or if the buffer zone had organic soils.

Surface flow treatment wetlands support native biodiversity in intensified agricultural landscapes

Dr Brandon Goeller[1], Mr James Sukias[1], Dr Simon Woodward[1], Dr Beverley Clarkson[2]
[1]National Institute for Water and Atmospheric Research, Hamilton, New Zealand, [2]Manaaki Whenua - Landcare Research, Hamilton, New Zealand

Concurrent 7B, October 13, 2021, 2:30 PM - 5:00 PM

Wetland drainage to convert land for agriculture has contributed to declines in water quality, biodiversity, and ecosystem services globally. Remediation options include constructing surface flow treatment wetlands (CTW) to intercept and treat agricultural runoff to improve water quality and biodiversity. To inform biodiversity management in surface flow CTW, we surveyed the vegetation and fauna assemblages in five established CTW in a lowland, pastoral landscape in the central North Island, New Zealand. The CTW had been established for between 3-19 years, planted with a restricted variety of native plant species, and fenced to exclude livestock access. Larger wetlands hosted significantly more plant and mammal species. However, other than wetland size, we found few other significant relationships between wetland habitat, landscape characteristics, and measures of biodiversity (total species, proportion of native species, and number of specialist or rare/threatened species). We recorded 113 plant, 20 bird, 5 mammal, 85 terrestrial invertebrate, 47 aquatic invertebrate, 6 fish, and 2 amphibian species inhabiting CTW. Native species comprised 96% of the total aquatic invertebrate fauna identified. Otherwise, native flora and fauna accounted for half or less than half of all species identified: 53% terrestrial invertebrate, 50% fish, 45% bird, 32% plant, 0% amphibian and mammal species. Few wetland specialists (aquatic or wetland-adapted) and rare or threatened native species were detected. CTW supported native biodiversity, but further enhancement may require active management of exotic and pest species, followed by native species re-introductions to overcome limiting biotic factors such as competition and predation.

Serious multidecadal declines in aboveground biomass of the keystone salt marsh species, Spartina alterniflora, are related to climate change in coastal Georgia, USA

Dr John Schalles[1], Dr. Christine Hladik[2], John O'Donnell[3], Nicholas Nealy[1], Thomas Pudil[1]
[1]Creighton University, Omaha, USA, [2]Georgia Southern University, Statesboro, USA, [3]Burns and McDonnell, Omaha, USA

Concurrent 8A, October 14, 2021, 10:15 AM - 12:15 PM

We studied multidecadal (35 y) above-ground biomass dynamics and spatial distributions of Marsh Cordgrass, Spartina alterniflora, covering 933 square kilometers within nine tidal watersheds (Wassaw Sound to Cumberland Sound) in the coastal zone of Georgia, USA. This keystone species accounts for 98% of the aerial extent of salt marshes in Georgia and represents about 1/3rd of all salt marsh habitat on the U.S. Western Atlantic Coast. Geospatial techniques were used to scale up in situ biomass measurements within our Georgia Coastal Ecosystems LTER research domain in the Central Georgia Coast to broader landscape scale estimates using > 350 Landsat 5, Landsat 8, and Sentinel 2 imagery dates between 1984 to 2020. Climate and hydrological variables explained much of the plant biomass dynamics. Overall biomass declines were linked to increased drought severity and frequency (primarily since 2000). Importantly, S. alterniflora biomass production was greatest in areas closest to larger discharges of freshwater. Nine of the watersheds had overall biomass declines of 11.0 - 28.5%, while the Altamaha River watershed, with by far the largest discharges, had an increase of 9.6%. Marsh pore-water salinization is the major stressor. Long-term declines averaged 20.6%, representing ~ 157,000 MT in average annual aboveground live carbon biomass. Root declines may be comparable. This decline in salt marsh production could significantly reduce nutritional support to food webs and carbon biogeochemical cycling, and commercial fish and shellfish harvests in adjacent estuarine and offshore waters. We conclude that protection of freshwater river discharges are vital to salt marsh health.

Wetland Connectivity Influences Nutrient Delivery to Downstream Waters

Scott Leibowitz[1], Ryan Hill[1], Mark Weber[1], Mark Rains[2], Irena Creed[3], Jana Compton[1], Chas. Jones[4], Jay Christensen[5], Rebecca Bellmore[6], Henry Lee[1], Heather Golden[5], Charles Lane[5]

[1]US EPA, Center for Public Health and Environmental Assessment, Corvallis, United States, [2]University of South Florida, School of Geosciences, Tampa, United States, [3]University of Saskatchewan, School of Environment and Sustainability, Saskatoon, Canada, [4]Affiliated Tribes of Northwest Indians, Corvallis, United States, [5]US EPA, Center for Environmental Measurement and Modeling, Cincinnati, United States, [6]Southeast Alaska Watershed Coalition, Juneau, United States

Concurrent 8A, October 14, 2021, 10:15 AM - 12:15 PM

Hydrologic connections between wetlands and downstream waters influence surface water quality across watersheds. However, large-scale studies showing this are lacking – approaches to classify hydrologic connectivity of wetlands for large spatial extents do not exist. Here we developed a hydrologic connectivity classification system for 6.7 million wetlands to 2.6 million downstream stream segments across the conterminous US (CONUS). This first of its kind study found that wetlands occupy 5.4% of the CONUS but intercept 24.6% of the area. Yet there is a spatial mismatch between where nitrogen inputs and wetlands that can intercept nitrogen occur. Wetlands in the watershed with low connectivity generally reduced stream nitrogen concentrations, and those with high connectivity increased stream carbon concentrations. High connectivity riparian wetlands, however, increased nitrogen and reduced carbon stream concentrations. Quantifying where and how wetland connectivity occurs at watershed scales is important for safeguarding surface water quality – both across the CONUS and globally.

Wetlandscape Change Information Database (WetCID): A novel database for wetlandscapes and their changes around the world

Dr Navid Ghajarnia[1], Georgia Destouni[1], Josefin Thorslund[1], Zahra Kalantari[1], Imenne Åhlén[1], Jesús A. Anaya-Acevedo[2], Juan F. Blanco-Libreros[3], Sonia Borja[1], Sergey Chalov[4], Aleksandra Chalova[4], Kwok P. Chun[5], Nicola Clerici[6], Amanda Desormeaux[7], Bethany B. Garfield[8], Pierre Girard[9], Olga Gorelits[10], Amy Hansen[11], Fernando Jaramillo[1,12], Jerker Jarsjö[1], Adnane Labbaci[13], John Livsey[1], Giorgos Maneas[1,14], Kathryn McCurley[15], Sebastián Palomino-Ángel[16], Jan Pietroń[1,17], René Price[18], Victor H. Rivera-Monroy[19], Jorge Salgado[20], A. Britta K. Sannel[1], Samaneh Seifollahi-Aghmiuni[1], Ylva Sjöberg[21], Pavel Terskii[22], Guillaume Vigouroux[1], Lucia Licero-Villanueva[23], David Zamora[24]

[1]Department of Physical Geography, Bolin Center for Climate Research, Stockholm University, Stockholm, Sweden, [2]Facultad de Ingeniería, Universidad de Medellín, Medellín, Colombia, [3]Instituto de Biología, Facultad de Ciencias Exactas y Naturales, Universidad de Antioquia, Medellín, Colombia, [4]Faculty of geography, Lomonosov Moscow State University, Moscow, Russia, [5]Department of Geography, Hong Kong Baptist University, Hong Kong, Hong Kong, [6]Department of Biology, Faculty of Natural Sciences and Mathematics, Universidad del Rosario, Bogotá, Colombia, [7]School of Natural Resources and Environment, University of Florida, Gainesville, USA, [8]Department of Geography and Anthropology, Louisiana State University, LA, USA, [9]Centro de Pesquisa do Pantanal, Cuiabá, Brazil, [10]Zubov State Oceanographic Institute, Moscow, Russian Federation, [11]Civil, Environmental and Architectural Engineering Department, University of Kansas, Lawrence, USA, [12]Baltic Sea Centre, Stockholm, Sweden, [13]Department of Geology,Faculty of Science of Agadir, Ibn Zohr University, Agadir, Morocco, [14]Navarino Environmnental Observatory, Messinia, Greece, [15]Department of Soil and Water Sciences, University of Florida, Gainesville, USA, [16]Facultad de Ingeniería, Universidad de Medellín, Medellín, Colombia, [17]WSP Sverige AB, Gothenburg, Sweden, [18]Department of Earth and Environment and Southeast Environmental Research Center, Florida International University, Miami, USA, [19]Department of Oceanography and Coastal Sciences, College of the Coast and Environment, Louisiana State University, LA, USA, [20]Departamento de Ciencias Biológicas, Universidad de Los Andes, Universidad Católica de Colombia, Bogotá , Colombia, [21]Department of Geosciences and natural resource management, CENPERM - Centre for Permafrost, University of Copenhagen, Copenhagen, Denmark, [22]Faculty of geography, Lomonosov Moscow State University, Moscow, Russian Federation, [23]Master student in Landscape Ecology and Nature Conservation, University of Greifswald, , Germany, [24]Civil and Agricultural Department, Universidad Nacional de Colombia , Bogotá, Colombia

Concurrent 8A, October 14, 2021, 10:15 AM - 12:15 PM

Wetlands contribute more than 20% of the total value of global ecosystem services while covering only 4-9% of the global land surface. Geography and associated hydrological, hydroclimate and land use conditions and their changes determine the states and dynamics of wetlands and their ecosystem services. The influences of these controls are not limited to just the local scale of each individual wetland, but extend over larger landscapes that integrate multiple wetlands and their total hydrological catchment – the wetlandscape. However, the data and knowledge of conditions and changes over entire wetlandscapes are still scarce, limiting the capacity to accurately understand and manage critical wetland ecosystems and services under global change. To address this need and support studies at wetlandscape scale, we have created a novel database called Wetlandscape Change Information Database (WetCID) for 27 wetlandscapes around the world, combining survey-based local information with gridded datasets of hydroclimate and land-use conditions and their changes. The survey-based information depicts general characteristics of each wetlandscape and its associated geographical, hydrological, climate, and land use conditions and their observed/perceived changes. The database also contains 30-year time series of monthly precipitation and temperature data, and annual land use conditions in both gridded and aggregated forms for each wetlandscape. WetCID can support site assessments, cross-regional comparisons, and scenario analyses of the roles and impacts of land use, hydroclimatic and wetland conditions and changes on whole-wetlandscape functions and ecosystem services with possibilities of extension to include more sites with small time investment as new information become available.

Wetlandscape size thresholds for multiple ecosystem service delivery

Mrs Imenne Åhlén[1], Professor Peter Hambäck[2], Ph.D Josefin Thorslund[1], Associate Professor Andrew Frampton[1], Professor Georgia Destouni[1], Professor Jerker Jarsjö[1]
[1]Stockholm University, Stockholm, Sweden, [2]Department of Ecology, Environment and Plant Sciences, Stockholm University, Stockholm, Sweden

Concurrent 8A, October 14, 2021, 10:15 AM - 12:15 PM

Wetlands are increasingly considered as nature based solution as they provide valuable services and functions to the society and environment. While land use and climate change have been affecting the functions and service of these ecosystems, it has become important to study the large-scale behaviour of wetlands in the landscape. Consequently, previous studies have suggested to study wetlands within wetlandscapes, defined as catchments containing networks of several wetlands, in order to understand large-scale functions of wetlands and their response to land-use and climate changes. This emphasizes the ecohydrological interactions of wetlands rather than having focus of individual wetlands. However, as the concept of wetlandscape is new, its governing properties have not been systematically quantified.

In this paper, we quantify ecohydrological properties of individual wetlands in multiple wetlandscapes, typical for northern Europe, that may impact biodiversity and modulate nutrient flows as well as characteristics of the whole wetlandscape in terms of their large-scale processes and functions. We also investigate possible systematic differences between wetlandscapes of different size. Results show that large wetlandscapes generally contained features to support different ecosystem services compare to smaller wetlandscapes. More specifically, results indicated that small wetlandscapes have a poor ability to route water through their wetlands which was in contrast to large wetlandscapes. This implies that large wetlandscapes have a higher potential for large-scale retention of nutrients and contaminants. Present result support the importance of wetlandscape studies and the priority of a wetlandscape focus in future management programs for instance targeting regions with large-scale pollution issues.

Incorporating fishery supply and demand into offsets for mangrove and seagrass loss

Mr Deqiang Ma[1], Professor Jonathan Rhodes[1], Professor Martine Maron[1]
[1]*The University of Queensland, Brisbane, Australia*

Concurrent 8B, October 14, 2021, 10:15 AM - 12:15 PM

Less common are approaches for mitigating losses of ecosystem services. Offset rules, such as how near an offset must be to an impact site, may help ensure biodiversity offsets also counterbalance losses of ecosystem services. We explored how different rules for siting offsets change net impacts to a provisioning ecosystem service: fishery resources in Queensland, Australia. A spatially-explicit model incorporating supply, flow and demand of fishery resources was developed to simulate contributions of offset sites to commercial fisheries. We simulated offset benefits for losses due to 63 real projects that damaged mangroves and 14 projects damaging seagrasses. We compared outcomes for commercial fisheries from scenarios based on two offsetting rules – 1) offsetting in close proximity to impact sites, and 2) offsetting without restrictions on proximity. For seagrass and mangrove offsets, the percentage of species suffering net negative outcomes for the whole commercial fishery increased from 68% and 42%, respectively, when offsets were located close to impact sites, to greater than 85% when there were no restrictions on offset location. All fisheries for seagrass offsets suffered net economic losses under both scenarios; for mangrove offsets, net economic losses were prevented only for net, line and trawl fisheries when offsets were nearer to impact sites. Overall, offsets in close proximity to impact sites were important for mitigating impacts on fisheries. This was most notable for less-mobile species. Our model helps identify net outcomes for species and fisheries under different offsetting rules, which helps inform design of policy for fishery habitat offsets.

How certification of Professional Wetland Scientists can improve wetland practice around the world

Dr Matthew Simpson[1]
[1]*35percent, Stroud, United Kingdom*

Concurrent 8F, October 14, 2021, 10:15 AM - 12:15 PM

The Society of Wetland Scientists was formed to promote understanding, conservation, protection, restoration, science-based management and sustainability of wetlands. The Society developed a program in 1994 for certification of wetland science training and experience to meet the needs of professional ecologists, hydrologists, soil scientists, educators, government agency professionals, consultants, and others who practice wetland science.

The program is aimed at serving the public and governments' need to identify qualified individuals to assess and manage wetland resources. It provides a comparable professional certification system to other professions such as engineering, architecture and landscape architecture and is internationally recognised.

Certification signifies that the academic and work experience of a Professional Wetland Scientist (PWS) meets the standards expected by her or his peers of a practicing wetland professional and provides acknowledgment of adherence to standards of professional ethics with regard to the conduct and practice of wetland science. Certification enhances the recognition of wetland science within other disciplines, especially in multi-disciplinary work environments.

Wetland Professional in Training (WPIT) is considered a preliminary step for people who meet the basic educational requirements but do not yet have the experience requirements.

This presentation discusses the benefits of PWS accreditation, gives straightforward guidance of how to apply and considers why the PWS program supports the raising of professional standards internationally, how it recognises the importance of a career in wetland science, how it raises the profile and importance of wetlands and how the program enables more effective wetland conservation and protection around the world.

Introducing the concept of a global School of Wetland Conservation

Dr James Robinson[1]
[1]*The Wildfowl & Wetlands Trust, Gloucester, United Kingdom*

Concurrent 8F, October 14, 2021, 10:15 AM - 12:15 PM

Global wetland conservation needs skilled and experienced people to effectively deliver the range of tools required to 'bend the curve' of wetland biodiversity loss and maximise the ecosystem services wetlands provide. We also need wetland leaders able to garner the support of others to ensure we move from small-scale, ad hoc interventions to more widespread activity that achieves results at a far greater scale.

The Ramsar Convention, amongst others, have produced a plethora of guidance, tools, handbooks, reports, and briefs on the wise use of wetlands. Focal points, committees and representatives internationally, regionally and nationally have been established to support the aims of the Convention and dissemination of this information.

Despite this, wetland conservation is still lagging, with a lack of individuals able to implement existing resources and guidance. With the imminent changes to targets established by the Convention on Biological Diversity and the Sustainable Development Goals focusing more on water and wetlands, we believe the need for more support to those charged with delivery has never been so great. WWT believes this 'implementation gap' bottleneck is a major barrier to seeing improvements in wetland conservation on the ground.

In this workshop, we will explore what the professional wetland community thinks about this concept, asking questions about the audience for it, priority areas and disciplines it should focus on, how it could be delivered, interest in supporting it, including how it might be financed, and how we could measure its impact.

Climate Change Assessment Framework: An approach for assessing environmental risk in hydropower catchments

Ms Rebecca Sheldon[1], Dr Carolyn Maxwell, Mr Greg Carson
[1]*Hydro Tasmania, Hobart, Australia*

Concurrent 9A, October 14, 2021, 2:45 PM - 5:00 PM

Hydro Tasmania is Australia's largest generator of hydropower energy. Climate change projections predict increased variability and long-term drying in our catchments.
Hydro Tasmania manages 52 lakes, 33 rivers and numerous land parcels. Identification of how risks to our ecosystems will change as climate change intensifies requires a structured approach. We developed a climate change assessment framework to identify priority risks for mitigation and adaptation planning. The proposed approach assesses risk in two-stages:

- Stage 1 - Potential impact (unmitigated risk): identification of the scenario, assessment units, drivers and potential impacts (these will be ranked for each site using standard risk assessment systems).
- Stage 2 - Realised impact (mitigated risk): explores the ability to build resilience and adaptive capacity (i.e. reassess risk in consideration of potential adaptation actions to determine whether identified environmental risks can be effectively mitigated or reduced).

Application of the framework will result in the assessment of unmitigated (potential) and mitigated (realised) environmental climate change risk at various scales. It will enable the identification and prioritisation of adaptation strategies across multiple sites. It will also identify sites which may have a high risk but no practical adaptation or mitigation options.
The assessment will ensure a seamless integration of environmental climate change risks into existing business risk registers. The approach will ensure that risk is regularly reviewed to account for improvements in uncertainties or change in risk profile due to variation in knowledge or operations.
Uncertainties highlighted throughout the process will become the focus of monitoring and research.

Detecting regional trends in river flows whilst accounting for climate change

Dr Doug Booker[1]
[1]*NIWA, Christchurch, New Zealand*

Concurrent 9A, October 14, 2021, 2:45 PM - 5:00 PM

Many aspects of river flow regimes are considered important for river flow management due to their influence on ecological, cultural or social values. River flow regimes are driven by climate conditions and local catchment characteristics. Climate conditions are important because they determine precipitation and evaporation. Catchment characteristics are important because they influence water fluxes, but these fluxes are also influenced by anthropogenic activities such as abstraction, damming, diversion, landcover change and drainage modification.

This work demonstrates a systematic approach to quantifying temporal changes in river flows associated with water management practices whilst accounting for temporal patterns in climatic conditions. Median seasonal flows were investigated as they relate to flow management and environmental flows. River flow time-series were obtained and matched to climate data for each catchment from NIWA's Virtual Climate Station Network (VCSN).

Statistical models were trained to predict river flows that would be expected given concomitant and antecedent weather conditions. Models were trained to data from an early period within each flow record, and therefore included the likely effects of any flow altering anthropogenic activities operating on-average over that period. Residual flow time-series were calculated by subtracting model predictions from observed values beyond the model training period. Residual flows represent deviation in observed flows away from those that would have been expected. Trend analyses were applied to quantify the confidence with which it can be stated that each flow time-series has been decreasing in absolute terms that include climatic influences, and whilst accounting for inter-annual changes in climatic conditions.

Carbon conservation in an age of climate and land-use change

Dr Beth A Middleton[1]
[1]*Us Geological Survey, Lafayette, United States*

Concurrent 9B, October 14, 2021, 2:45 PM - 5:00 PM

Best practices of hydrologic management may be an important tool for carbon conservation in public lands, especially in future droughts predicted by the Intergovernmental Panel on Climate Change. In addition, increasing human demand is having a major impact on freshwater supply to inland and coastal wetlands. Hydrology is an important regulator of carbon stocks within publicly-managed wetlands, because of its direct relationship to primary production, decomposition and soil carbon. Therefore, hydrologic remediation by maintaining minimum flows during drought may be an important aspect of maintaining wetland carbon stocks in the future. Soil carbon stocks are regulated by hydrology through the balancing of processes including production and organic matter decomposition. Emerging research along the Mississippi (US) and Murray Rivers (Australia) suggest that even short periods of freshwater flow improve production. Similarly, mega-flooding events related to Hurricane Harvey and Irma freshened groundwater along the Gulf Coast of the United States. Precipitation and flooding gradients were negatively related to leaf and wood litter decomposition rate in the MRAV. Woody T. distichum detritus had a half-life of up to 300 years in the MRAV, which suggests the important role of wood in the maintenance of inland “teal” soil organic carbon. In the MRAV, soil organic carbon increased southward with increasing precipitation and air temperature (30-year climate normal). Other studies demonstrate that public lands harbor large amounts of carbon stocks across the US, suggesting that managers consider hydrologic remediation to maintain carbon stock in the future conservation of these wetlands.

Carbon cycling in the Supratidal Forested Wetlands of Australia: insights from understudied coastal ecosystems with significant restoration potential

Dr Jeff Kelleway[1], A/Prof Kerrylee Rogers[1], Dr Fernanda Adame[2], Prof Neil Saintilan[3]
[1]University of Wollongong, Wollongong, Australia, [2]Griffith University, Nathan, Australia, [3]Macquarie University, Sydney, Australia

Concurrent 9B, October 14, 2021, 2:45 PM - 5:00 PM

The supratidal zones of Australia's estuaries support ecosystems exhibiting a diversity of vegetation structures. Of these, Supratidal Forested Wetlands dominated by the genera Melaleuca and Casuarina (SFWs) have broad geographic distributions across tropical, sub-tropical and temperate coastlines. There is growing interest in understanding SFW ecosystem functions, vulnerability to climate change, and their potential for inclusion in coastal management strategies. The development of carbon trading mechanisms for Australian coastal wetlands may present a significant opportunity to redress historic losses (up to 75 to 90 % of pre-European extent in some catchments) of SFW to clearing, draining and flood mitigation works over the past two centuries.

We present new data showing carbon stocks and surface accumulation rates in SFWs are within the range of 'blue carbon' estimates in Australia and globally, and in many cases are higher than adjacent saltmarsh and/or mangrove. Through the use of a standardised litter bag experiment we show that organic matter preservation is higher in SFWs than in ecosystems situated lower in the tidal frame. Preliminary estimates also show soil-atmosphere fluxes of methane are negligible in the settings tested.

On the basis of water logger data collected across multiple sites, we propose that infrequent tidal inundation in the supratidal zone produces biogeochemical conditions similar to more widely recognised blue carbon ecosystems. Our research suggest SFWs should be considered within emerging coastal restoration initiatives and carbon accounting frameworks. Our findings also provide a foundation for future research into supratidal zone ecosystem function, in Australia and elsewhere.

Enhancing Carbon Storage in Mangrove Ecosystems of China through Sustained Restoration Actions

Prof Luzhen Chen[1], Dr. Hangqing Fan[2], Dr. Zhinan Su[2], Ms. Qiulian Lin[1], Mr. Yancheng Tao[2]
[1]Xiamen University, China, Xiamen, China, [2]Guangxi Mangrove Research Center, Guangxi Academy of Sciences, Beihai, China

Concurrent 9B, October 14, 2021, 2:45 PM - 5:00 PM

Mangrove forests are facing the challenges of continual losses and unsustainable use globally. How to conserver and wise-use of mangrove forests are still hot issues nowadays. In this study, a scheme to transfer traditional shrimp ponds to mangrove wetland eco-farms and restore mangroves for carbon accumulation was developed. In Shijiao Station of Guangxi, the conversing of unused aquaculture ponds increased about 3.85 MgC a-1 (with 0.87 MgC a-1 of vegetative C and 2.98 MgC a-1 in soil) in the total 1.95 ha restored mangrove forests in underground aquaculture system of eco-farm. The net C stock change rates were 0.445 MgC ha-1 a-1 in vegetation and 1.53 MgC ha-1 a-1 in soil. The eco-farm in Shijiao Station has been run for 10 years, and the aquaculture products ranged 675 ~ 1 125 Kg ha-1 a-1. The running of this underground aquaculture would gain 92 ~ 154 million Kg aquaculture products if the one fourth of the unused ponds in south China recovered as the same scheme. Beside the multiple ecological roles as a health mangrove ecosystem, this approach can compensate local economy from land use change. Mangrove eco-farm in Guangxi of China provides a new and sustained approach to restore mangroves.

Hydrarch Succession Pattern of Coastal Wetlands in the Yellow River Delta area: implications for carbon sequestration.

Ms Siyuan Ye[1,2], Ms Jin Wang[1], Dr Lei He[1], Dr Guangming Zhao[1,2], Ms Xigui Ding[1], Dr Hongming Yuan[1], Dr Edward A. Laws[3]

[1]Key Laboratory of Coastal Wetland Biogeosciences, Qingdao Institute of Marine Geology, China Geological Survey , Qingdao, China, [2] Laboratory for Marine Geology, Qingdao National Laboratory for Marine Science and Technology, Qingdao, China, [3]College of the Coast & Environment, Department of Environmental Sciences, Louisiana State University, Baton Rouge, USA

Concurrent 9B, October 14, 2021, 2:45 PM - 5:00 PM

In the classical view of succession, deltaic wetlands are considered transient stages in the hydrarch development of a terrestrial climax community from offshore marine area. The important driving force for this hydrarch succession is brought about by rivers or externally caused environmental changes as opposed to the plant community itself. This study links a quantitative analysis of hydrarch succession to carbon sequestration in the Yellow River Delta area. Seven ~30-m-long cores were taken from this delta for sedimentary characteristics, lithology, mineral components, geochemistry, the benthic foraminiferal, ages determined by accelerator mass spectrometry (AMS) 14C, carbon concentrations and bulk density to document deltaic progradation process, which transforms from aquatic system (prodelta), shallow sea wetland (delta-front), tidal flat wetland to upper delta plain wetland. The results shows the hydrarch succession from prodelta-delta front to a climax terrestrial system could significantly alter the rates of carbon sequestration, which can be up to 1020.35 g C m−2 yr−1 for organic carbon, and 5202.24 g C m−2 yr−1 for inorganic carbon in the delta-front wetland, nearly 350 times and 640 times higher than those in the aquatic sediment (shelf deposit), respectively. The biggest contributor in the hydrarch successionally mediated differences of carbon sequestration rates is accretion rate, or the negative covariance between accretion rate and carbon concentration when accretion rate is lower than 1 cm/year. The implication is that human activities that affect delta progradation and hydrarch succession would profoundly affect the dynamics of carbon burial in coastal wetlands. Wise land/shoreline managements are therefore recommended.

Land Management Strategies Influence Soil Organic Carbon Stocks of Prairie Potholes

Dr Sheel Bansal[1], Mr. Brian Tangen[1], Dr. Robert Gleason[1], Dr. Pascal Badiou[2], Dr. Irena Creed[3]
[1]U.S. Geological Survey, Jamestown, United States, [2]Ducks Unlimited, Stonewall, Canada, [3]University of Saskatchewan, Saskatoon, Canada

Concurrent 9B, October 14, 2021, 2:45 PM - 5:00 PM

The Prairie Pothole Region (PPR) is home to millions of wetlands nested in an agriculture–grassland matrix. Soil organic carbon (SOC) stocks in these wetlands are highly variable due to natural variation in biota, soils, climate (e.g., hydrology), and topography. Land-use history (cropland, grassland) and land-management practices (drainage, restoration) also affect SOC stocks. We conducted a region-wide assessment of wetland SOC stocks using data from the Canadian and U.S. portions of the PPR that cover a range of management types. Natural wetlands with no disturbance history had considerably greater SOC stocks than wetlands surrounded by cropland, especially those that were drained. Hydrologically restored wetlands did not show significantly greater SOC stocks than drained wetlands, and wetlands surrounded by restored grasslands did not show significantly greater SOC stocks than those surrounded by croplands, likely due to high variability attributable to several environmental factors within the region. We conclude that avoided loss of natural wetlands from drainage and avoided loss of native grasslands from cropping have the most benefit for preserving wetland SOC stocks. Robust PPR SOC models that incorporate multiple abiotic, biotic, and land-use factors are required to determine where and when restoration is most effective for SOC sequestration.

Paludiculture: wetland plant cultivation for carbon sinks, for the climate, and for the future

Dr Brian Sorrell[1], Dr Franziska Eller[1], Prof Hans Brix[1]
[1]*Aarhus University, Aarhus, Denmark*

Concurrent 9B, October 14, 2021, 2:45 PM - 5:00 PM

Drainage of wetlands, especially those with peat soils, is one of the most climatically destructive of all human activities. Drainage oxidises peat and causes large greenhouse gas emissions; peatlands drained for agriculture are responsible for 30% of all global agricultural emissions, with rates of carbon emission that rival industrial sources. Restoring peat wetlands is therefore essential in combatting climate change, but this can be difficult to achieve given the demand and pressure to retain agricultural activities in landscapes with drained wetlands. Paludiculture – wet agriculture and forestry on rewetted peatlands – allows continued biomass production with reduced emissions and other environmental benefits such as nutrient removal. We have been comparing wetland macrophytes for their suitability for paludiculture, using their photosynthesis-leaf nitrogen responses to compare preferences over the range of nutrient availability found in drained agricultural peat. For maximum nutrient removal, Typha species have superior responses to N, with a photosynthesis-N slope of 10.4 µmolCO2 g-1N s-1 in European Typha latifolia, vs. 6.5 µmolCO2 g-1N s-1 in the standard bioenergy crop Arundo donax. New Zealand raupo (T. orientalis) is even more responsive, with a slope of 12.1 µmolCO2 g-1N s-1. These findings have coincided with increased interest in Typha as a biofuel feedstock and construction material, suggesting that paludiculture could provide unique environmental and commercial benefits for wetland restoration. New Zealand harakeke (Phormium tenax), with a photosynthesis-N slope of 7.2 µmolCO2 g-1N s-1, is also highly suitable for paludiculture that can compete with normal agriculture.

Citizen science to investigate and reduce plastic pollution in river catchments

Dr Luca Marazzi[4, 3], Prof. Steven Loiselle[1,2], Ms. Debbie Winton[1]
[1]Earthwatch Europe, Oxford, United Kingdom, [2]University of Siena, Siena, Italy, [3]Florida International University, , , [4]Thames21, ,

Concurrent 9D, October 14, 2021, 2:45 PM - 5:00 PM

Single use plastics are a major concern for the public, regulatory and business worlds. In recent decades, people's excessive reliance on single use plastics has contributed to widespread impacts on terrestrial, freshwater, and marine ecosystems across the globe.
I will summarise findings from various ongoing studies using novel methods to monitor and manage plastic use and resulting pollution. Through an in-depth review of recent studies, we identified the "top ten" single use plastic items that are present in European freshwater ecosystems and evaluated the most impactful actions that consumers can take to reduce their contribution to macroplastic pollution. We also developed an online plastic footprint calculator of people's use of plastic items on-the-go and identified blockers to a more sustainable plastics use. Finally, we developed a series of citizen science methods to determine the sources and sinks of macroplastic pollution in river catchments. To reduce plastic pollution in freshwater ecosystems, findings from these projects will be used to increase people's awareness and improve decision making from the personal and community levels to the catchment governance level.

Engaging K-12 classrooms and community partners to test the effects of saltwater intrusion on organic matter processing in coastal wetlands

Prof Nicholas Oehm[1,2,3], Dr. John S. Kominoski[2,3], Ms. Andreina Contreras[2,3], Dr. Cristina Ugarte-Whelan[3,4], Mr. Christopher Rizzie[2,3], Ms. Jennifer Diaz[5], Ms. Terri Phelan-Reyes[6], Dr. Evelyn E. Gaiser[2,3,8], Ms. Carole St. Hilaire[4], Mr. Ethan Holladay[4], Ms. Alicia Gonzalez[4], Ms. Kelly Uzquiano[4], Ms. Jennifer Tisthammer[7,9]
[1]STEM Transformation Institute, Florida International University, Miami, United States, [2]Department of Biological Sciences, Florida International University, Miami, USA, [3]Institute of Environment, Florida International University, Miami, USA, [4]BioTECH@Richmond Heights 9-12, Miami, USA, [5]Everglades Foundation, Miami, USA, [6]Felix Varela Senior High School, Miami, USA, [7]Deering Estate/Miami Dade County Parks, Miami, USA, [8]Deering Estate Foundation, Miami, USA, [9]Department of Earth and Environment, Florida International University, Miami, USA

Concurrent 9D, October 14, 2021, 2:45 PM - 5:00 PM

Citizen and participatory science are important for creating collaborations across academic institutions, NGOs, and government agencies to inform and promote the wise use of wetlands. The FCE LTeaER project is modeled after the Tea Bag Index study and is used to engage participants in a long-term decomposition study examining the drivers of organic matter (OM) transformation in the Florida Coastal Everglades (FCE). In this study, we quantified breakdown rates of fast (green tea) and slow (red tea) decomposing OM in two major drainage basins of the FCE. We compared breakdown rates in the deeper, peat-dominated, higher phosphorus Shark River Slough (SRS) wetlands with the shallower, marl-dominated, lower phosphorus wetlands of Taylor Slough/Panhandle (TS/Ph). Green and red tea were deployed in both SRS and TS/Ph, retrieved after two and ten months, and used to calculate percent mass loss. After two months, mass loss was consistently higher in green tea and freshwater marshes. After ten months, mass loss was higher in mangrove sites of SRS and freshwater marshes of TS/Ph. Our results suggest that both saltwater intrusion and shallower water depths can increase OM breakdown in highly nutrient limited coastal wetlands. Higher OM mass loss in shallower freshwater marshes could be driven by higher temperatures, and OM mass loss is higher in mangroves with higher nutrient availability. These results are being used for: professional development; student, teacher and undergraduate presentations; and by researchers to generate new questions about how saltwater intrusion differentially affects OM processing along freshwater-to-marine gradients in coastal wetlands.

Living Bung Yarnda - Developing an environmental stewardship program for Lake Tyers, East Gippsland

Dr Jess Reeves[1], Mr Pat Bonney[1]
[1]*Federation University Australia, Gippsland, Australia*

Concurrent 9D, October 14, 2021, 2:45 PM - 5:00 PM

Bung Yarnda (Lake Tyers) is a drowned river ICOLL on Krauatungalung country in East Gippsland, part of the Ramsar-listed Gippsland Lakes. The fires of 2019-20 lapped around the margins of the catchment, so the lake and its surrounding forest has become a refuge for local wildlife. The area is home to the Lake Tyers Aboriginal Trust and site of the former mission, a large artistic community and passionate recreational fishers. Lake Tyers is also a place that tourists visit year round. All of these communities are connected by their love for this beautiful corner of the world.

We have developed a multi-proxy monitoring program for Bung Yarnda (Lake Tyers) and its catchment to record the observations that people are passionate about: a community science program that incorporates community expertise, local knowledge and science. This includes regular monitoring of birds, fish, water quality, vegetation and aquatic invertebrate communities, as well as artists drawing, writing about and painting the vistas around them and visitors' photopoint snaps. It also captures people's lived experience and knowledge of place. The data gathered will be integrated into a geospatial database, which we can use to track change over time and also data-mine to answer questions of concern. The project aims to develop a community-led environmental stewardship plan to improve the health of the lake and surrounds, increase awareness around threats, and deepen environmental connections to this majestic place – for locals and visitors alike.

Summary of the strengths and challenges of using a citizen science approach

Mr Chris Rostron[1]
[1]*Wildfowl & Wetlands Trust (wwt), Slimbridge, United Kingdom,* [2]*World Wetland Network, Slimbridge, United Kingdom*

Concurrent 9D, October 14, 2021, 2:45 PM - 5:00 PM

Ramsar signatory governments formally report on wetlands every three years. However, Ramsar Information Sheets (RIS) are largely out of date, and government officials are often not in close touch with wetlands. A 2014 WWN survey of civil society groups found that relations between local groups and government focal points was not very positive, and that governments are often not sufficiently resourced or focussed on wetland protection.

The World Wetland Network (WWN) was set up formally at Ramsar COP10 (2008) and has an active committee of seven NGO representatives from across the world, with 200 active members. WWN plays an active role at COPs, supporting and coordinating NGO/CSO input to discussions on resolutions and promoting the role of civil society through side events and informal networking with contracting parties. WWN also encourages citizen science approaches to support wetland monitoring such as the Global Citizen Science Survey on Wetlands completed with SWS and WWT.

Local people know their wetlands best and often take practical action to improve the state of their wetlands. Citizen science activities can link community wetland knowledge to government reporting and decision making. This paper will present examples from WWN members to demonstrate how local CSOs work to protect their wetlands and raise awareness amongst local people.

Using Citizen Science to Assess Status of Waterbirds in India

Dr Ritesh Kumar[1], Mr Dhruv Verma[1], Dr Asghar Nawab[1]
[1]*Wetlands International South Asia, New Delhi, India*

Concurrent 9D, October 14, 2021, 2:45 PM - 5:00 PM

Initiated in 1987 the Asian Waterbird Census is the longest running citizen-science programme providing information on status of waterbirds and wetlands. Jointly coordinated by Wetlands International South Asia and Bombay Natural History Society in India, the census has resulted in an extensive record on status and trends in waterbirds. During 2006-2015, over 1400 volunteers conducted waterbird counts at 1409 wetlands of 23 States and 3 Union Territories. The Census recorded presence of 170 waterbird species (85% of total waterbird species in India), including 142 migratory species (84% of total migratory waterbird species in the country) from 1409 wetlands (0.18% of the total number of wetlands in the country). Two hundred seventy-two wetlands were noted to support 1% or more of the bio-geographic population of at least one species of waterbird and qualify as Wetlands of International Importance under criterion 6 of Ramsar Convention. Sixty-five wetlands supported 20,000 or more waterbirds during at least one year of the assessment period. In five Ramsar sites which were counted at least five times during 2006-2015, the population of Cranes, Gulls, Terns and Skimmers reported a declining trend. The population of one in every four waterbird species recorded in the census, for which trends in the Central Asian Flyway are known, is declining. Reviews of population estimates and population trends of waterbirds, especially migratory waterbirds using the Central Asian Flyway, needs urgent attention as this information is outdated or is of poor quality.

Using Indigenous and local community knowledge for wetland monitoring, management and decision making in Guyana, South America

Dr Matthew Simpson[1], Professor Jay Mistry[2], Dr Andrea Berardi[2], Mr Sean Mendonca[4], Dr Deirdre Jafferally[2], Ms Grace Albert[3], Ms Rebecca Xavier[3], Mr Bernie Robertson[3]

[1]35percent, Stroud,, United Kingdom, [2]Cobra Collective, Englefield Green,, United Kingdom, [3]North Rupununi District Development Board, Rupununi, Guyana, [4]Environmental Protection Agency, Georgetown, Guyana

Concurrent 9D, October 14, 2021, 2:45 PM - 5:00 PM

Indigenous and local community approaches to management and decision making can result in effective biodiversity conservation and the maintenance of important natural resource benefits. The integration of this knowledge within wider decision making requires novel approaches. The Community Owned Solutions approach was developed with Indigenous communities in the Guiana Shield region of South America but has been adapted to be used to engage communities around the world. The approach helps create an environment of mutual respect that can make stakeholder engagement and knowledge sharing more effective. It empowers the community to take control of how they wish their community to develop and face up to current and emerging challenges. This approach identifies and shares solutions to sustainability challenges such as climate change adaptation, biodiversity loss, natural resources depletion, lack of governance, health emergencies and cultural loss. The identification of these solutions allows communities to share best practice in how to monitor and manage their natural resources. The approach is fundamentally transdisciplinary and holistic, and has been used by people working in the fields of development, nature conservation, health, natural resource management, social welfare and education. This paper demonstrates, through case studies related to natural resources, protected area and mental health management, how the core approaches of a system viability assessment and participatory visual methods build capacity in monitoring and management strategies empowering communities to actively share and communicate their issues, experience and knowledge with other communities, governments and policy makers helping contribute to more effective decision making.

Wetland citizen science: Hard facts or fake news?

Mr Robert Mcinnes[1], Professor Nick Davidson[2], Dr Matthew Simpson[3], Mr Christopher Rostron[4], Professor Max Finlayson[2]

[1]RM Wetlands & Environment Ltd, Littleworth, United Kingdom, [2]Institute for Land, Water and Society, Charles Sturt University, Albury, Australia, [3]35percent Ltd, Stroud, UK, [4]Wildfowl & Wetlands Trust, Slimbridge, UK

Concurrent 9D, October 14, 2021, 2:45 PM - 5:00 PM

Citizen science is increasingly recognised as a valuable approach to improve the knowledge and understanding required for robust environmental management. We report on the results of a citizen science survey conducted on the status and trends of over 500 wetlands from across the globe. Whilst many wetlands were reported as being in fair or good ecological character state, many (particularly those already in a poor state) were reported as deteriorating. Although designated Ramsar Sites were reported as currently having a slightly better state than other wetlands, widespread deterioration of Ramsar Sites as well as other wetlands was reported. Significant regional differences were reported on the state of wetlands and their extent of improvement or deterioration. Large wetlands, particularly in Africa but also in Latin America and the Caribbean, were reported to be in a worse, and increasingly deteriorating, state than smaller wetlands in North America, Europe and Oceania. Numerous drivers are contributing to degradation and loss of wetlands. However, our data suggest that positive outcomes can be delivered where local community awareness, implementation of conservation measures, cultural values/traditions, tourism and forestry are proactively integrated in order to achieve the wise use of wetlands. Future plans to replicate and expand the citizen science survey approach will also be discussed.

Wise Development: Approaching Wetland Through Community Participation

Dr Aparna Phadke[1], Mr. Nikhil Gawai[2], Mr. Kapil Ashtekar[3], Dr. Smita Geedh[4], Mr. Nandkumar Tandel[5], Mr. Pradeep Kulkarni[6], Mr. Vaibhav Patwardhan[7]

[1]University Of Mumbai, Mumbai, India, [2]University of Mumbai, Mumbai, India, [3]Birla College, Kalyan, India, [4]Independent Archeology, Karjat, India, [5]Independent, Karjat, India, [6]Independent, Khopoli, India, [7]Independent, Neral, India

Concurrent 9D, October 14, 2021, 2:45 PM - 5:00 PM

Western Ghats, the biodiversity hotspot of the world, witness a very unique flora and fauna that flourishes in basalt dominated lithology. The basalt being largely nonporous leads to formation of a variety of terrestrial and coastal wetlands, vital in providing water to the erstwhile biodiversity even in dry seasons. The five districts of the state of Maharashtra known as Kokan are integral part of the Sahyadri Ghat biodiversity reserve. The Wetland Brief Documentation Committees (WBDC) formed in all these districts by the district collectors on the instructions of honourable High Court, Mumbai are the best efforts of community participation the wetland brief documentation work by the voluntary services provided by the experts.

The wetland brief documentation emerged with the research methodology that involved people's science approach, barefoot botanists, use of Open Data Kit application, marking HFL line, no development buffer zone and habitat mapping. In the two tehsils of Raigad District, Karjat and Khalapur, a geographical database was created by using several inputs like maps, satellite images and photographs to emerge with comparative analysis and change detection. Community participation by merging the local knowledge with the advance technology to promote wise development has been initiated. It also aimed at encouraging and training various communities and local administrative bodies to participate actively in managing their own natural ecosystems, developing green infrastructure in urban and rural landscape for maintaining sustainability through wetland preservation.

The proposed research paper aims at discussing the model focusing on community-centric pattern of wise development of wetlands.