Mangaroa Peatland – falling between the cracks.

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

This presentation offers a community perspective on current, ongoing efforts to protect the largest remaining domed peatland in the lower North Island, New Zealand (NZ), from subdivision and development. Mangaroa Peatland is unique in size and character in the Wellington region, covering over 300 rural hectares in Upper Hutt. The rare, domed peatland extends across several parcels of land and is mostly under pasture, criss-crossed with drains. This vulnerable ecosystem is at high risk of continued deterioration, fragmentation and development due to a number of factors including the activities of the land owners, local and regional councils; historical documentation and a lack of data; and shortcomings in existing legislative tools for wetland protection.

In the context of global climate change and the importance of peatlands in storing carbon and providing services, it is highly desirable that this peatland be protected and restored, however peatlands are often subject to contradictory policies. This presentation will introduce Mangaroa Peatland, give a brief account of its history, and describe ongoing community efforts to protect and eventually restore Mangaroa Peatland. Key stumbling blocks to these efforts will be identified and explored, including issues with the protection of wetland ecosystems on private property and the wetland definitions currently used by the Resource Management Act and regional and local councils, which are allowing this degraded peatland to 'fall through the cracks'.

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

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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?

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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

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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.

High genetic potential of nitrogen cycling processes result in low N2O fluxes in a surface flow constructed wetland treating polluted agricultural runoff

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Microbial communities are the drivers of the removal of excessive nitrogen from polluted water in constructed wetlands, however, factors affecting the composition and abundance of microbial communities are still unclear. The aim of the study was to evaluate the genetic potential of different nitrogen cycling processes and determine the environmental factors affecting the key genes of those processes and relate them with nitrous oxide (N2O) and nitrogen (N2) gas emissions in a constructed wetland (CW; 5300m²; 2500m3; est. 2010) treating polluted agricultural runoff in Rampillon, France.
N2O emissions were measured in situ during campaigns in May and November 2014, March and October 2015 and May 2017 using QCLAS-connected automated chambers and manual chambers. Sediment samples were analysed for potential N2 and N2O fluxes (He-O method), physical-chemical characteristics and qPCR-determined genetic parameters.
Average annual N2O flux from the whole CW (inflow: 0-15L/s; 0-12 mgNO3-N/L) was 0.49 kgN2O-N while vegetated patches contributed 57% of it; 525 kgNO3-N was denitrified; 1.75kg dissolved N2O-N was flowing through; N2O/N2 emission ratio and N2O/NO3- (denitrifried) constitute 1.0% and 0.039%, respectively. According to the nosZI+nosZII/nirK+nirS gene ratio, denitrification was likely the main source of N2O from the CW. Nitrification (archaeal and bacterial amoA genes) and dissimilatory nitrate reduction to ammonia (DNRA; nrfA gene), which show lower genetic potential than denitrification, also contributed to N2O emissions. The genetic potential of ANAMMOX (specific 16S rRNA gene hszA) was higher in deeper inflow and outflow areas, while N-DAMO (specific 16S rRNA gene nod) was detected only from the inflow.

Implications of Emerging Contaminants on Nitrogen Removal Processes in Treatment Wetlands

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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

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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

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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

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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.

Biodiversity Conservation in Freshwater Management: Case Studies from Te Papa Atawhai'

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

The Department of Conservation (DOC) received a significant funding boost in 2018 of $181.6 million over four years. This is one of the biggest funding increases that DOC has ever received, and it will benefit New Zealand's native plants, wildlife and natural landscapes. $76 million of this funding is for biodiversity initiatives across land, freshwater and marine ecosystems, which means that DOC's freshwater programme is expanding. To create real impact with this funding boost, DOC have been investing in a renewed strategic pathway for freshwater. We have invested in an outcome focussed approach to achieving our big hairy audacious stretch goal, 50 freshwater ecosystem restored mountains to sea. This is changing the way that DOC is approaching our freshwater work with a particular emphasis on enabling and co-designing with others for better freshwater outcomes for biodiversity.

Filamentous Algae Nutrient Scrubber for diffuse pollution mitigation

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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.

Mass mortality events in New Zealand freshwater and estuarine ecosystems

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Mass mortality events involve the large-scale death of organisms over a short period, and they can be caused by natural and human-induced disturbances. Species affected by mass mortality events in aquatic environments range from invertebrate taxa, such as freshwater mussels, to vertebrates, such as fish. In New Zealand, mass mortality events in freshwater and estuarine ecosystems have been attributed to various causes, and there is growing concern that with climate change mass mortality events may become more frequent. The responsibility for investigating and reporting on mass mortality events usually sits with regional councils, while the Ministry for Primary Industries also investigates mortality events when it is considered a biosecurity issue. However, the scale, significance, and causes of mass mortality events have not previously been investigated at a national scale. In this presentation, we describe the results of a review of mass mortality events in New Zealand freshwater and estuarine ecosystems. The review involved collecting data on mass mortality events from regional councils, government departments, and non-government organisations, with a focus on events that have occurred within the last 10 years. Our review identifies commonalities around the causes of mass mortality events and the species affected, looks at the efficacy of the investigation and reporting process following mortality events, and makes recommendations for how such events can be avoided and better managed.

Relationships in ecological health between connected stream and estuary ecosystems

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Estuaries are the endpoints of rivers, yet few tools are available to link the health of estuaries to their upstream sources. We examined relationships between the ecological health of streams and their receiving estuaries over a wide geographic scale in New Zealand. Macroinvertebrate biotic indices known to respond to key physico-chemical stressors (fine sediment, organic enrichment and metals) were used. Significant positive correlations (rho = 0.30–0.78, catchment-scale data) were detected between many of the stream and estuary indices responding to fine sediment and (either) organic enrichment. Correlation strength tended to increase with increasing survey time difference (usually up to at least a decade), indicating a temporal lag in ecological health between streams and estuaries. Correlation strength also varied across estuary type and was moderate for three types representing a variety of geomorphological characteristics. Linear mixed models (using site-scale data) indicated that relationships between stream and estuary indices were influenced by estuary site location and volume, and survey time difference. For spatially integrated management purposes, our results are a step towards demonstrating that macroinvertebrate indices could be used to set ecological thresholds for streams and that also consider protection of estuary health from impacts of fine sediment and organic enrichment.

Time after time: Detecting annual patterns in stream bacterial biofilm communities

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The recent increase in the number of studies to recognise temporal patterns in bacterial communities offers new insights into the freshwater stream ecology and its dynamics. Several statistical tools facilitate predictive model development or otherwise improve the ability to quantify regular or irregular patterns among complex bacterial community data. Stream bacterial communities are highly sensitive and respond quickly to environmental disruptions and seasonal changes leading to compositional community differences. However, despite the advent of high throughput sequencing technologies, overarching questions such as investigation of temporal patterns in stream bacterial community dynamics in relation to environmental and climate changes remains statistically challenging. To address this gap, we developed statistical models to capture those differences from stream bacterial communities exposed to environmental change and characterise significant community variations such as bloom events with seasonal patterns. Using Illumina MiSeq 16S rRNA bacterial gene sequencing, we demonstrated the existence of temporal and repeatable seasonal patterns dividing biofilm bacterial taxa into three ecological groupings: linear, bloom/troughs and seasonal trends. A broad range of physicochemical factors was correlated with observed differences/patterns in community diversity. These models provide evidence of significant annual trends in bacterial community data in response to changing environments. We propose an extended and testable conceptual model integrating ecological assembly processes with environmental heterogeneity. This model may help to determine how temporal environmental changes cause shifts in the community assembly as well as to guide the selection of appropriate statistical models to capture community response to climate disruptions into the future.

Building a wetland community of practice: Learnings from global initiatives

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

Conserving wetlands, both for their ecosystem services and for the benefit of our own and future generations, should rank extremely high as a priority for all of us. Building a wetland community of practice and coordination and sharing of wetland knowledge are essential building blocks for the promotion of wetland sciences, conservation and management. Initiatives from other countries can serve as valuable guidance for the development of a more integrated and coordinated approach for New Zealand. Here, we present a summary of the key initiatives undertaken in South Africa in building a wetland community of practice along with some observations regarding wetland management in Alberta, Canada. In South Africa the scarcity, value and threatened status of wetlands was recognised in 2011 and much energy was directed into developing national management policies in the last four decades. The adoption and implementation of national wetland management policies played a crucial role in supporting these initiatives. Initiatives in South Africa included the facilitation of improved wide spectrum involvement, enhanced access to information, standards setting, improved quality control, professional development, representation of the scientific and technical disciplines required, capacity building and the encouragement of best management practice. It is important to acknowledge that these initiatives also come with their own challenges such as balancing wetland protection enforcement (prioritisation and penalising of transgressions), meaningful stakeholder engagement (trust-building) including dealing with scientific complexity (understanding multiple wetland aspects) and inter-linkages of wetlands (how different factors affecting wetlands are interrelated).

NGĀ AWA RESTORATION RESEARCH, TO SUPPORT 'COLLABORATIVE RIVER RESTORATION THAT IS ENDURING, CATCHMENT-SCALE AND ENHANCES CLIMATE CHANGE RESILIENCE'.

Dr Sue Clearwater[1], Rosemary Miller[1]
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Concurrent 6D, October 13, 2021, 10:45 AM - 12:30 PM

The Department of Conservation's (DOC) Ngā Awa programme supports restoration in 14 river catchments around New Zealand. The ambitious goal of the programme is to 'collaboratively implement river restoration that is enduring, catchment-scale and enhances Climate Change resilience'. Ngā Awa employs a River Restoration Coordinator (RRC) or 'river ranger' in each of the rivers to work with catchment stakeholders, particularly mana whenua, to develop and implement restoration plans, and/or complement any initiatives already underway. This approach aligns strongly with Te Mana o te Taiao (the Aotearoa New Zealand Biodiversity Strategy 2020) and the National Policy Statement for Freshwater Management (2020). The RRC's are backed up by a multi-disciplinary DOC team and a research strategy that has 4 themes: 1. incorporating Climate Change resilience into river restoration; 2. using riverine geomorphology to promote enduring restoration (i.e., work "with" the river); 3. using socio-economic knowledge to inform collaborative catchment management; and 4. best practice river monitoring for adaptive management.
Ngā Awa has commissioned a geomorphological evaluation of a subset of our rivers, an environmental economic valuation for three Te Tai Tokerau (Northland) catchments, and developed a framework to incorporate Climate Change resilience into our restoration activities. We are also funding research on fine sediment dynamics in a braided river, and development of a monitoring programme for 'Jobs4Nature' projects in Ngā Awa waterways. We will examine how these analyses have influenced our restoration programme and the research needs that are emerging as Ngā Awa develops momentum.

Traditional & anticipated wetland management In Aotearoa farmscapes

Ms Di Lucas[1], Millan Ruka[2], Ben Smith[3]
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Replenishing the Kete of Kai
Millan, Ben and Di work complementarily at the flaxroots exploring rural management issues and nudging land managers toward improved futures. They address freshwater management as a key recipient of and cue to farm management issues, and a focus for innovative solutions.
Rather than addressing only a narrow range of factors, the integrated farm management that is encouraged addresses the full complexity of the landscape, including aquatic and terrestrial ecosystem health, the nutrient and sediment losses, greenhouse gas emissions, landscape integrity and social well-being.
Integrated Farm Plans (IFP) are developed with farmers to identify options and methods for transitioning a farm toward Carbon Zero whilst addressing a raft of environmental issues.
With a long history of associations between cattle and wetlands, they plan transitions in production from monocultures to mosaics, and their work identifies methods to enable sustainable ecosystems, low greenhouse gas emissions, and a lived-in landscape that responds to local natural, cultural and social nuances.
The IFP provide an innovative tool for farm managers to comprehend their situation and respond responsibly through application of a range of solutions.

WAIKANAE KI UTA KI TAI – A TREATY HOUSE PARTNERSHIP APPROACH TO FRESHWATER RESTORATION

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

A partnership developed in 2019 is building a long-term platform to maintain and improve the cultural and ecological values of the Waikanae river situated on the Kāpiti Coast.

Waikanae ki Uta ki Tai, is an expression of Iwi to work alongside its government partners and the community to take a coordinated approach to catchment and funding, all drawn from DOC's priority rivers programme, Ngā Awa.

Te Ātiawa ki Whakarongotai, Kāpiti Coast District Council, the Greater Wellington Regional Council and mandated community champions have entered into a commitment to a Treaty House partnership. This requires government to actively interact together with their Treaty partner.

As a foundation document, the Kaitiakitanga Plan of Te Ātiawa ki Whakarongotai expresses traditional values, including the importance of mātauranga Māori to freshwater restoration. This has inverted previous planning approaches to focus more on exploring traditional approaches such as identifying shared iwi and community values, priority objectives before discussing implementation.

This unique partnered approach is being tested to endure into the future. A key Treaty House challenge is for Crown agencies to better align their often conflicting and exhausting demands on iwi and communities. Nevertheless project success hinges upon continued meaningful engagement, community education and how this programme and its many learnings can influence future decision-making.

What's happening with Aotearoa New Zealand estuaries - connecting people, science and management.

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

New Zealand has about 300 estuarine systems ranging in size from a few hectares to 15,000 hectares. However, an estimated 90% of New Zealand's natural wetland areas have been lost since pre-human times. The remaining sites are home to a great diversity of species, including many rare and threatened plants and animals. Growing numbers of New Zealanders are coming together to promote, protect and enhance their estuaries in local care groups – central and local government agencies are also investing in estuary restoration and management.

The Department of Conservation has a leadership role for coastal management and a strong commitment to partnerships and enabling communities. For estuaries, an online hub has been set up where local care groups, including indigenous communities, can connect with each other and gain visibility.

This talk will present an overview of estuary science and engagement in New Zealand. It will introduce the Our Estuaries hub, present some best practice examples, and challenges, for restoration efforts, protected area management, integrated 'mountains to sea' policy, national and regional state of the environment reporting, and climate change mitigation and adaptation.

Freshwater scientists need to convince communities their wellbeing depends on sustainable water use

Dr Anne Jensen[1]
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Concurrent 6E, October 13, 2021, 10:45 AM - 12:30 PM

There is an urgent need to link sustainable water use and community wellbeing in water issues, with a focus on the consequences of failure to achieve sustainability.

Scientists across the world have been reporting decline and threats to rivers and wetlands for decades. We know how to moderate impacts so that river and wetland ecosystems can survive while still supporting dependent human communities. Mass published materials describe how to manage natural resources sustainably but the message is not getting through.

Australia's mismanagement of its landscapes and resources rates is among the worst among civilisations which failed to manage natural resources sustainably (Diamond 2005). Sustainable management only occurred in communities which suffered the impacts of mismanagement themselves.

Australia could make a major contribution to limiting the global effects of climate change through revegetation of marginal lands, paying farmers to recover perennial native vegetation while extracting carbon from the atmosphere (Bastin et al. 2019). Australia's failure to plan for the effects of climate change and to implement the Murray-Darling Basin Plan as legislated is placing Australian communities in jeopardy (MDBA 2020).

Freshwater scientists need to describe in detail the consequences of insufficient flows in river systems, including threats to quality and quantity of regional town water supplies, more fish kills and algal blooms, and increasing salinity in river systems. Innovative use of modern media is required to engage a community audience and the voters who influence political will to make the hard decisions about water sharing.

Nexus between EIA and ECDs – not all Ramsar sites are within protected areas

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Many sites listed by signatory countries under the Ramsar Convention describe wetlands within mixed-use landscapes. Some of these are part of a protected estate, others coexist with major cities and ports, extraction activities and other anthropogenic stressors. Maintaining a wetland's ecological character (typically as at the time of listing but this is a matter for debate) is a key expectation for a listed site. A framework has grown around the development of an Ecological Character Description (ECD) for a listed wetland, which describes the key elements that comprise the wetland ecosystem in a concise and meaningful manner. Within the ECD framework developed by the Australian Government, one of the key outcomes is the derivation of Limits of Acceptable Change. When used to assist in management of a wetland, this entire process is synonymous with an Environmental Impact Assessment (EIA). We believe there is merit in integrating the ECD framework within an EIA for developments involving wetlands (not just Ramsar wetlands). We present case studies where we have used this approach in assessing impacts related to Floating Photovoltaic (FPV) arrays, a relatively new but growing source of renewable energy with increasing popularity.

Returning economic activities of Lake Condah to achieve traditional uses.

Mr Denis Rose[1], Mr Gavin Prentice[2]
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Restoration of water to Lake Condah, a key site of Budj Bim National Heritage Landscape, was a long-held vision for Gunditjmara Traditional Owners. Lake Condah was drained in 1954 against the wishes of the Gunditjmara and surrounding landholders. Drainage of the lake damaged the 'heart of Budj Bim', and further injured fragile relationships between Indigenous and non-Indigenous communities of far south western Victoria.

To Gunditjmara, the seasonal rising and falling of water in Lake Condah was likened to the beating heart of the Budj Bim landscape. As waters rose with autumnal rains, so too wetlands along the Budj Bim landscape filled, and the eel 'farming' that enabled Gunditjmara people to establish a sustainable, sedentary community (amongst the first people in the development of human history to do so), continued.

After 40 years of effort, construction of a weir restoring the lake in 2010 brought healing to the Gunditjmara landscape. The achievement was made possible through the Lake Condah Sustainable Development Project, an initiative of Traditional Owners that led a process of extensive community engagement and partnerships to develop and implement the Restoration Business Plan.

This project represents an important extension of "Western" management approaches that aim to conserve biodiversity in modern landscapes by "adjusting economic activities". In this case, "adjusting economic activities" is to return traditional wetland management approaches to promote the restoration of cultural values and connection with Country as well as biodiversity values. This is achieved through empowerment of Traditional Owners to lead and catalyse participation with stakeholders.

The only free drink for a hundred miles: temporary freshwater rock-holes provide an accessible resource to vertebrates of conservation interest in arid Australia

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

The granite rock-holes (referred to as gnammas by the Noongar Aboriginal people of Western Australia) throughout the Gawler Ranges, South Australia, are a unique ephemeral freshwater system. This system harbours a complex but understudied community of invertebrates, and provides a source of accessible freshwater to vertebrates in the area. Due to projected drying over the next 100 years, the security of ephemeral freshwater habitats in southern Australia is uncertain. We investigated the degree to which this freshwater resource is utilised by local vertebrates, some of which are of conservation priority. Motion-triggered camera traps were deployed at a number of rock-holes, and vertebrate visitation to rock-holes was recorded over a period of 12 months. Freshwater environmental DNA (eDNA) samples were collected from a subset of these rock-holes. Samples were processed in the field, then extracted in the lab. These were then sequenced for vertebrate eDNA, and metabarcoding was undertaken to identify taxa. Species identification was compared to that identified by camera trap data. Preliminary results show visitation by a broad range of vertebrate species, including wombats, kangaroos, echidnas, and various bird species. A number of introduced and pest species were also detected, with camera trap data suggesting that feral goats are frequently present. This study highlights the role of the rock-holes in the Gawler Ranges region in relation to vertebrate usage, and provides a basis for management recommendations for ephemeral freshwater systems, involving the protection and restoration of these habitats.

Wetlands of the oceanic islands of French Polynesia (South Pacific): ecosystems at high risk !

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The wetlands of French Polynesia are spread across 120 subtropical and tropical oceanic islands divided in 5 major archipelagoes (Austral, Gambier, Marquesas, Society, Tuamotu), and are probably the most threatened and the least valued ecosystems of this South Pacific French overseas territory. They are mainly found at low elevation on coastal areas of most high volcanic islands and in some low-lying atolls, with a few high elevation habitats in the largest island of Tahiti (ca. 1045 km², 2241 m elevation). These wetlands undergo intense and continuous stress derived from multiple human pressures which are direct (urbanization, pollutions, drainage, dams, overfishing of some freshwater species) or indirect (invasive plants and animals, climate change impacts such as sea-level rise and strong swells). We first describe the different wetlands and freshwater habitats, their plant and animal communities (including the introduced mangrove Rhizophora stylosa), and their current conservation status, with examples from different French Polynesian islands. We then highlight their ecological but also scientific importance as windows to the past (through paleoecological and paleoclimatic studies recently conducted in Tahiti and the Austral Islands), and raise the urgency to protect, conserve or restore these unique ecosystems and their associated biota.

Co-development of Final Effluent Wetlands Guided by Māori Knowledge to Lessen the Cultural Impact of Treated Wastewater Discharge to Receiving Waters

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Māori consider direct discharge to water of even highly treated wastewater to be a culturally repugnant practise that degrades Te Mana o te Wai (the holistic well-being of freshwater) by negatively impacting the mauri (life force) and health (hauora) of the water and the wider environment (taiao) and people (tangata) supported by it. Traditionally all waste was disposed to land where passage through Papatūānuku (mother earth) revitalised the mauri of the water.

Te Mana o te Wai is integral to New Zealand's freshwater management legislation under the NPS-FM while the RMA requires that Māori cultural concerns are addressed when consenting wastewater discharges. However, many current wastewater discharges have not adequately addressed Māori values. Rock-lined, so called, Papatūānuku channels have been installed on several NZ WWT plant discharges but these fail to revitalise the mauri of the water and alleviate cultural concerns.

This presentation will outline the initial co-development of Final Effluent Wetlands (FEW), to meet the needs of iwi communities for cleansing of highly treated wastewater and FEW co-development has been guided by tikanga and Mātauranga Māori integrated with current scientific knowledge of native planting as well as soils/rocks and landscaping to help revitalise the mauri of the wastewater. Provision of habitats for colonisation by taonga (treasured indigenous) specieswill We are working in partnership with 6 hāpu/iwi trusts to provide holistic, effective and affordable WWT and welcome additional collaboration to further our understanding of Mātauranga Māori and the specific needs and concerns of hāpu/iwi to further develop this concept.

Constructed Wetlands to treat wastewater for marae (NZ Indigenous communal dwellings): from theory to practice

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Marae are the traditional dwelling of NZ Māori. While few Māori still live on marae, they remain important locations for cultural activities such as tangi (funerals) and hui (meetings). Thus at a single marae, occupancy can vary from 0-5 people, and then be hosting up to 500 people for a 2-3 day tangi. Thus sizing of any treatment system is a challenge. NIWA engaged with 10 marae to measure water use/wastewater generation criteria. This was then used to develop sizing for constructed wetlands on two marae. Each site brought different challenges to implementation associated with engagement with the local community, dealing with council regulations and physical construction. These, along with water quality outcomes will be presented.

Ecological restoration of two spring-fed urban waterways in Christchurch

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It is well known that waterways are often subjected to a myriad of human impacts that can influence their ecological health. Restoration of waterways is often carried out to return these water bodies to a more ‘natural' state. However, it is often not clear if restoration results in more than just a change to the aesthetics of a waterway. We assessed the restoration success of two urban waterway restoration projects in Christchurch, New Zealand. The first was the realignment of the Kā Pūtahi Creek to avoid the installation of two large motorway culverts, resulting in the creation of 350m of stream habitat. The second was the enhancement of the Ōtākaro - Avon River, as part of the Christchurch earthquake rebuild. Repeated monitoring has shown improvements in some restoration elements of both projects, but not all. Works have improved and diversified stream habitat, resulting in changes such as lower sediment cover and depth, and an increase in fish abundance. However, there are additional urban impacts that are likely limiting restoration success, such as increasing sediment levels, contaminated discharges and a lack of species source populations. This has resulted in no significant changes in certain monitoring elements, such as the macroinvertebrate community. This monitoring has also given us some lessons learned, in terms of how best to design and carry-out projects, such as creating effective habitat features to achieve the goals of restoration.

Urban constructed wetlands-designing to get it right

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As communities across Aotearoa, and abroad, grapple with the degradation of freshwater resources, the impetus to mitigate this is ever increasing. Constructed stormwater wetlands provide a valuable tool for Councils, developers and communities to reduce contaminants, buffer changes in water chemistry and moderate flowrates. The achievement of these objectives, however, requires a well informed and considered design which facilitates both the internal processes and ongoing wetland management.

This presentation will explore common design issues which can reduce the efficiency and effectiveness of constructed stormwater wetlands and how these issues can also potentially reduce the appeal of urban constructed wetlands. Through an understanding of these issues, the presentation will explore solutions to these common shortfalls to ensure that constructed wetlands achieve long term water quality benefits in addition to providing high quality public amenity, enhanced urban ecology and community connections to wetlands.

The presentation will cover diversion strategies, sediment pre-treatment, wetland bathymetry, impermeable liners, plant selection, hydraulic controls and accessibility. Each of these design attributes has a direct influence on velocities, residence time and hydraulic efficiencies and are considered vital to support the complex mix of physical, biological and chemical processes required to achieve the intended performance over a realistic life-cycle within the constraints of the site.

What has a greater impact on stream health, riparian vegetation structure or the presence of non-native riparian vegetation?

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The deleterious effects of human activities have pervaded aquatic ecosystems worldwide. Riparian zones (the area adjacent to rivers and streams) display high levels of non-native vegetation recruitment. Non-native vegetation is symbolic of degradation and is often the result of anthropogenic activities. Research shows that vegetation structure is essential for maintaining river health, however the effects of vegetation species composition (including the presence of non-native species) are less clear. The aim of this research was to determine the relative effect of vegetation structure and species composition on in stream health. To achieve this, a comprehensive, regional ecosystem health monitoring data set was analyzed. Constrained ordination methods revealed that vegetation structure at the catchment scale was driving macro-invertebrate health metrics, while local scale riparian cover influenced in-stream metabolism. The presence of non-native riparian vegetation was not identified as a driving factor. Riparian vegetation cover at the site, reach and catchment scale explained macro-invertebrate assemblage composition at the family level. Non-native riparian vegetation had no effect on macro-invertebrate family level distributions. The results of this study suggest that vegetation structure is primary to in-stream health, particularly at large spatial scales. Our results also suggest that non-native vegetation may improve ecosystem health through its contribution to increased structure. Moreover, our findings suggest that non-native vegetation may function as a basal food source and habitat for macro-invertebrates, however this requires further investigation. This study has wide ranging implications for the restoration and health of aquatic ecosystems particularly those heavily influenced by human perturbations.