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

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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

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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

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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

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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.

Ecological restoration in Te Hiku, Aotearoa/NZ as a means to oranga (wellbeing)

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The various projects in Te Hiku (the Far North of Aotearoa, New Zealand) that we have been involved with over many years are guided by the “tiakina te taiao, tiakina te iwi" kaupapa Māori approach – look after the environment and so too will the people be looked after. This is very much based on traditional concepts of whakapapa (genealogy) and us as tangata whenua (people of the land) both connecting us to the whenua and all that exists, and creating a relationship of responsibility and obligation. An integral part is building the capability and capacity of our taitamariki (young people) and local communities alongside maintaining strong relationships with a wide range of people, projects and organisations. So ensues a strong commitment to sustainable resource use, protection, enhancement and restoration of environments to lift wellbeing throughout Te Hiku.

We will draw on several projects to demonstrate our approach; the restoration of three (of approximately 50) dune lakes within the area, a long-term project to restore elements of a lake and wetland area (once the largest in the Southern Hemisphere) which was drained for farm development 100 years ago, our marae-based noho taiao programme for taitamariki that is embedded in local tikanga and uses local environments as places of learning and teaching, a climate change project with three small rural communities, and a hapū (sub tribe) farm environmental restoration project. The key themes, learnings and challenges across the projects will be shared.

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

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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.

Ngā Pou Mataara Hau: restoring mauri and reconnecting tangata whenua with the Tukituki Awa

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The Tukituki Awa (River) flows for 117 kilometres from the Ruahine Ranges to enter the sea near Heretaunga (Hastings), Hawke's Bay, Aotearoa New Zealand. Ngāti Kahungunu and Rangitāne hapū (sub-tribes) have ancestral connections (whakapapa) to the Tukituki Awa and in 2013, in response to their (tangata whenua) concerns, a Board of Inquiry included policy in the regional plan requiring the development of a mauri monitoring framework for the Tukituki.

Phase 1 began in 2017 and meetings (wānanga) were held at marae along the Tukituki. Hapū with whakapapa and historic connections to the Tukituki Awa shared their knowledge of mauri and the awa using a locally-developed kaupapa Māori approach. This co-development process ensured that local knowledge and relationships were reflected in the whole-of-catchment framework. Phase 2 is ongoing using the same kaupapa and process to populate the framework with tohu (indicators) and develop hapū monitoring protocols and capacity.

We describe the benefits to hapū wellbeing identified on the journey to develop and populate the mauri monitoring framework. It is clear that the journey is as important, if not more so, than the 'outputs'. Connection and reconnection were dominant themes across all Tukituki hapū. In physically and spiritually reconnecting tangata whenua with their awa, using the project as a catalyst, hope, awareness, history, relationships, love for and duty to the awa have been rekindled, reiterating the interdependencies between restoration of the mauri of the people, and of the awa.

Stream restoration… lessons learnt from attempting to turn around the fortunes of a lowland stream.

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Many of our lowland streams have been highly modified and turning their fortunes around is a massive undertaking. The Snake Creek project used a number of interventions, such as plantings, sediment traps, bank reforming and stream feature creation over three kilometres of waterway.
The ecological data and lessons learned from this project will be discussed. As will the rain on grid run-off mapping that was undertaken to better understand why some of the results have been less than expected. The talk will also discuss how this technology may be used to better inform farm environment plans.

Tuia ngā repo me ngā tāngata: Reconnecting communities with their wetlands

Ms Yvonne Taura[1], Mrs Cathy Buntting[2], Mrs Greta Dromgool, Mrs Andrea Soanes , Mrs Pauline Waiti[3]
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Tuia ngā repo me ngā tāngata: Reconnecting communities with their wetlands is a project funded by MBIE Unlocking Curious Minds initiative to broaden the visibility and accessibility of Te Reo o Te Repo – The Voice of the Wetland (2017, 2020) among kaiako (teachers), tauira (students), and whānau (families and communities). As a cultural wetland handbook, Te Reo o Te Repo acknowledges the cultural significance of wetlands for Māori and showcases the restoration efforts underway by whānau Māori throughout Aotearoa New Zealand. It resulted from a collaboration between Manaaki Whenua – Landcare Research and Waikato-Tainui. To broaden the reach and impact of this mahi (work), Tuia ngā repo me ngā tāngata enabled the development of a suite of bilingual, multimedia wetland educational resources on wetland ecology and restoration, reflecting both mātauranga Māori (Māori knowledge) and western science perspectives. These resources were guided by Te Marautanga o Aotearoa (Māori curriculum) to ensure that the resources supported the learning environment of kura kaupapa Māori (Māori medium schools). These resources were shared with five kura kaupapa across Aotearoa through a series of wānanga, where participants engaged with wetland experts (scientists and kaitiaki) and educators at local wetland sites. This process assisted with refining the resources before being published for wider audiences on the Science Learning Hub website (sciencelearn.org.nz). This presentation will introduce the wetland resources, discuss how they were developed, and share responses from wānanga participants. The presentation will appeal to those interested in sharing wetland conservation and restoration practices with wider audiences.

wet_land: a study of the Hikurangi Repo - an art exhibition that brought a community together to consider its environmental, social history and its future

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Art is a tool that can bring people together. Similar to science, it is research-based, driven by questions and curiosity. These disciplines share a common desire to make sense of the world and to communicate this understanding – to join the dots – to connect.
For two years visual artist Lisa Clunie and sound artist and historian Thorsten Hoppe investigated their local area- the Hikurangi Repo. Known locally as 'the Swamp' to townsfolk, farmers, the media, and disaster tourists; te Repo to mana whenua; floodplains to scientists.

The artists' journey began by paying closer attention and engaging with their community to learn of their different understandings and perspectives on this special place. Through photography and sound recordings- both ambient soundscapes and extensive interviews- the artists created an exhibition about one of Aotearoa's largest former wetlands. The exhibition wet_land brought their community together to consider their shared histories and futures together: farmers, council workers, townsfolk, mana whenua, and scientists.

The artists recognised through their research the similar ways in which farmers, environmentalists and mana whenua talked about the land and the river. Those who work with the land and the river, they feel it, even though they are sometimes portrayed as being in different camps. This presentation will share the artists experiences', and their exhibition wet_land as a model for bringing a community together to envision a future sharing limited environmental resources.

An IoT Sensor Network for Detailed Spatial and Temporal Investigations of Mobilised Contaminants in Catchments

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Currently, regional councils operate environment monitoring networks throughout New Zealand optimised for large scale monitoring, rather than efforts to resolve the detailed spatial and temporal mobilisation of contaminants. Catchment investigation networks designed around discrete water quality sampling can improve our spatial understanding of contaminant sources, and high frequency in-situ sensor technology can capture important in-stream events that are traditionally missed. However, resource costs and logistics are prohibitive, often leading to inadequate datasets and poorly informed land management advice. We present a low-cost Internet of Things (IoT) sensor network approach using an Arduino Mayfly board. The Mayfly is a low-cost microcontroller with the ability to interact with professional quality sensors, designed specifically for IoT applications. The board integrates with an Xbee LTE modem, sending data at regular intervals over a mobile network to an IoT server, where data can be made available to researchers and the general public. A basic telemetering station can cost less than $300 when fully assembled, and we believe there are opportunities to couple sensors ranging from DIY level to professional level, depending on context. We propose that conventional regional council monitoring networks could be enhanced using integrated networks of low-cost Mayfly stations. Derived data could provide insight into: biogeochemical hotspots and hot moments, contaminant hysteresis patterns and source origins, activation of hydrological pathways, and even the effectiveness of mitigations. These networks also have the potential to significantly improve estimates of loads exported to sensitive receiving environments, while providing more detailed information on load origin.

Developing a catchment scale monitoring design tool to measure the freshwater benefits of riparian buffers

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New Zealand currently faces declining aquatic biodiversity and water quality. Riparian management has long been recognized as a practical action that can lead to improvements in waterway health, especially in the longer-term, and if implemented at scale. In New Zealand, there has been considerable, renewed interest in riparian management, for example via Central Government initiatives such as Jobs for Nature.

The Our Land and Water National Science Challenge has recently initiated a project to outline and design a Mitigation Effectiveness Monitoring Framework to enable a holistic and more certain understanding of freshwater outcomes resulting from land management actions taken within a catchment or a freshwater management unit (FMU). The three Working Groups were tasked with: 1) Designing an environmental monitoring system, 2) Defining what technologies are available to measure holistic freshwater values, and 3) Incorporating Māori knowledge systems.

As a sub-group of Working Group 1, our team has worked to develop a tool to identify locations in a catchment where monitoring is most likely to detect the water quality and ecological benefits of riparian buffer implementation, with emphasis on early detection. The tool has been developed by drawing upon existing NZ and international riparian buffer literature and guidance materials. This presentation will describe and demonstrate the tool.

In-Lake Biodiversity Monitoring & Ecological Response Metrics - A Step Toward Integrated Ecosystem Monitoring

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Lake health assessments are typically based solely on water quality metrics. The use of water quality as a proxy for ecosystem health has limitations and, in some cases, can portray a false representation of current ecosystem state. Water quality trends could be indeterminate/insignificant, yet loss of biodiversity and ecosystem functions may still occur. Thus, water quality alone lacks the diagnostic power to detect ecosystem scale changes. Currently in-lake biodiversity/ecology is not regularly monitored and reported on by regional councils. We are testing several tools and survey methods to develop a suite of standardized approaches to using in-lake biodiversity/ecology to refine our assessments of lake ecosystem health. We are using molecular techniques as broad scale biodiversity and pest screening. We are monitoring keystone species and developing correlative relationships between their population/extent metrics and aspects of ecosystem degradation. We are investigating macrophyte indices that can reflect changes in ambient water quality and in some cases be used as a standalone proxy for lake condition. Tracking benthic attributes are being trailed as key lakebed health indicators. We are undertaking active pest fish removal and will be using these metrics to assess the associated ecosystem benefits. Our initial findings have highlighted the potential uses and research gaps associated with using in-lake biodiversity to track ecosystem health. Once these ecological response metrics are refined, they will compliment water quality monitoring and provide a better understanding of lake ecosystem health and restoration effectiveness.

Kia titiro whakamuri, ka tere whakamua. Implementing an impactful wai partnership between Tauranga Moana and ESR. Learnings to date and the journey ahead.

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Tauranga Moana is a beautiful and diverse place, from its beautiful beaches and flowing rivers to lush bush and fertile lands. The iwi and hapū of Tauranga Moana are defined by their environment, a place in which their whakapapa is embedded. They are intertwined with their environment to such an extent that they are identified by it and known as Tauranga Moana, the only tribal grouping in Aotearoa identified in such a manner.

“ko WAI mātou”
“We are descended from water itself”

The science system is not working for Tauranga Moana and Māori across Aotearoa. Approaches to partnership with Māori are often transactional, do not make the space for Māori to lead, are often not focused on responding to the aspirations of Māori, and can be detrimental to the growth and uptake of mātauranga Māori.

ESR, in partnership with Ngāi te Rangi iwi me ngā hapū o Tauranga Moana, have actioned a programme of work (He Wai Māpuna) which makes the space for whānau of Tauranga Moana to lead and shape wai-related research which best responds to their long-term aspirations.

This is a new way of working for ESR. We are learning from the past, evolving our operating model, and evaluating how our knowledge and expertise can best be engaged and harnessed alongside the knowledge and expertise of whānau to make long-term, enduring impact for Tauranga Moana.

“Kia titiro whakamuri, ka tere whakamua”
“I walk backwards into the future with my eyes fixed on my past”

What drives spatial and temporal patterns in cotton tensile-strength loss in rivers and streams in New Zealand?

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The cotton strip assay (CSA) is a functional indicator of stream health that measures cellulose decomposition potential and therefore reveals how fast streams can process carbon. In NZ, the CSA has been applied at >535 river and stream sites since 2008. We collated CSA data and demonstrated a significant relationship between watershed landcover and cotton tensile strength loss per day (CTSL/d; 0.01% to 13.1%) or per degree day (CTSL/dd; 0.001% to 0.786%). In a subset of the data, where CSA had been repeated monthly for 16 months at 12 sites, CTSL dd-1 showed divergent seasonal patterns among sites and an overriding influence of land cover on cellulose decomposition potential. Characterisation of bacterial communities on the cotton strips from the 12 sites using metabarcoding showed strong seasonal variation in bacterial composition associated with temperature and dissolved nutrient concentrations. Similarly, DIN, DRP and water clarity had positive effects on CTSL dd-1. Significant positive relationship between DRP, DIN and CTSL dd-1 and were also observed at 115 sites nationally. There was a weak relationship between CTSL dd-1 and benthic macroinvertebrate indicators of stream health suggesting a lack of redundancy among structural and functional indicators, as observed regionally. Collectively these analyses support the inclusion of a CSA as a simple yet informative tool to i) provide an integrated assessment of stream health and ii) inform nutrient limit setting to support healthy stream function.

Luxury nutrient uptake by periphyton and diel variation in dissolved oxygen and instream nutrient concentrations

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Nuisance and toxic periphyton growth pose great threats to human and ecosystem health, with Microcoleus making headlines by causing dog deaths. Predictive attached algae models are developed to synthesize science and provide credible advice to ecosystem managers. However, the predictive capacity of those models is often poor when growth is simulated solely as a function of extracellular nutrient concentrations. The objective of this work is to demonstrate that observed diel variations in instream nutrient and dissolved oxygen concentrations can be represented by a simple model when luxury nutrient uptake, i.e., excess internal nutrient storage, is included as a model mechanism. Droop kinetics consider the effect of internal nutrient stores (the cell quota) on nutrient uptake rates, where high stores suppress uptake and low stores enhance uptake rates. The Droop formulation was applied to enhance the Delta method (Chapra et al. 1991), a simple approach for estimating primary production, respiration, and reaeration in streams, to now also simulate instream nutrient concentrations. The model was calibrated and confirmed using hourly measurements of dissolved nutrient concentrations, conductivity, pH, temperature, and dissolved oxygen in New Zealand rivers. This work supports the need for inclusion of a luxury nutrient storage mechanism in primary production models of streams.

Micro-Investigators: lessons learned from the implementation of a waterway microplastics citizen science programme in Southland, New Zealand

Dr Christine Liang[1]
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Microplastics – tiny plastic particles that are smaller than 5 mm – have been found in our food, water, and even in the most remote places on Earth like Antarctica and Mt Everest. The majority of literature on plastic pollution is focused on the marine environment, but only a handful of studies in New Zealand have quantified microplastics present in waterways despite evidence suggesting that rivers contain the highest concentrations of plastic pollution. This is where the Micro-Investigators project comes in: a citizen science programme investigating concentrations of microplastics in Invercargill waterways. Throughout 2020 and early 2021, the programme was implemented in local schools across the Southland region (South Island, NZ) in coordination with nationwide initiative Enviroschools and with support of local councils (Environment Southland, Invercargill City Council). The school students (many from lower decile schools) collected samples during a field session that included interactive and culturally informative activities, which were then analysed by high school students in the chemistry lab, and finally the microplastics count was done by tertiary students. Students from all levels of education and all walks of life were able to take part in this important mahi – they were able to learn about microplastics in their local freshwater environments and could teach their whānau in turn. Raising awareness of microplastics across multiple aspects of the community through education increases the visibility of this otherwise "invisible" pollution. Only when people are aware will they begin caring and take action towards reducing microplastic pollution in the environment.

Saving fish from the jaws/bucket of an excavator

Mr Duncan Law[1]
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The Auckland Region is currently undergoing a period of sustained growth with a number of large infrastructure and residential developments under construction. Furthermore, there are many more projects in the pipeline with $3.48 billion dollars of future transport projects funded within the region. As these projects extend into greenfield areas, they are likely to require streamworks activities that will require the capture and relocation of native fish species as a part of the approach to effects management. The NX2 Consortium on behalf of Waka Kotahi NZ Transport Agency is currently constructing the Pūhoi to Warkworth motorway extension that will extend the four-lane Northern Motorway (SH1) 18.5km from the Johnstone's Hill tunnels to just north of Warkworth. The project crosses two catchments and has 48 culverts that have required fish relocation as a condition of consent. Over 25,000 native fish, 3,000 koura and 2,000 kākahi have been salvaged and relocated from the construction footprint using electric fishing, netting/traps, dewatering and excavators. We will discuss the range of fish salvage methodologies used on the Pūhoi to Warkworth motorway extension and other projects in the Auckland Region. We will discuss the novel approaches we have used and the benefits and negatives we find with each method to provide guidance and lessons learned.

UNDER COASTAL WETLANDS - PROTECTING FRESHWATER AQUIFERS FROM SALINE INTRUSION

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As in many parts of the world, New Zealand's coastal fresh groundwater resources are increasingly susceptible to saline intrusion from land use changes, over-abstraction and sea level rise. There are options available to mitigate adverse effects, but their efficacy is not always clear, in particular under coastal wetlands. Investigation and modelling tools can help assess the scale of the saline intrusion problem and identify mitigation strategies.

NZ's fresh groundwater resources are well-established and mostly present in either narrow river valleys or large bays and low-lying coastal plains that all have similar climate and hydrogeological settings. Researches demonstrate that a large range of factors such as groundwater abstraction, land use change, sea-level rise, inundation, erosion and contamination have contributed to saline intrusion. Competition for urban development, agricultural land and natural or restored habitats is already debated as population in most coastal city centres increase and the suitable type of land available to grow food also is needed. The quality and quality of freshwater resources is already impacted by those activities while adaptation and mitigation of saline intrusion constitute a challenge.

We have reviewed case studies and specific saline intrusion processes in which a sophisticated approach and modelling tools are used to show an increase in salinity of freshwater resources as a result of land use changes, drainage of wetlands / coastal lagoons and sea-level rise. We can also demonstrate how modelling tools can be used to develop sustainable solutions to protect further salinization or mitigate existing issues using nature-based wetland restoration.

Understanding the impact of LED streetlight conversions on flying freshwater insects

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Artificial light at night is thought to negatively affect terrestrial and aquatic ecosystems and reduce night sky visibility globally. Across New Zealand, 370,000 streetlights (predominantly yellow high-pressure sodium lamps) are currently being replaced by energy-efficient, blue-white light-emitting diodes (LEDs). While the economic benefits of conversion are significant ($millions/year operational costs), the potential cultural and environmental impacts of the increased blue light emitted by LEDs are unclear. Healthy urban waterways provide important ecosystem services and contribute to cultural wellbeing, but their health is declining globally. Ecological light pollution likely alters the behaviour of emerging adult aquatic insects and may contribute to poor ecosystem functioning in urban waterways. We aim to investigate the potential ecological impacts of LED conversions on the adult flying stage of urban aquatic insects and develop recommendations to minimise the ecological impacts of large-scale streetlight conversions on urban waterways.

Using data from experimental field trials along urban waterways, we will discuss how flying freshwater insects are attracted to different streetlight types. Understanding potential changes in the behaviour of adult insects under different lighting types will help planners prioritise critical areas for alternative lighting solutions and aid in the design of ecologically-sensitive streetlighting.

Using PCR and field data to inform water quality interventions

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The National Policy Statement 2020 aims to increase the number of freshwater sites which comply with the criteria for freshwater recreation over the next 20 years. Substantial investment will be required for interventions that manage faecal contamination at 20% of sites across New Zealand, in order to achieve that target. As well as ensuring that the pathogen and faecal indicator bacteria data (FIB) that underpin the risk assessment is current, characterising the faecal contaminants is also needed. PCR tools, such as data faecal source tracking (FST) markers and whole genome sequencing have been used to characterise faecal inputs in samples collected over two bathing seasons (2020-2021) and autumn 2021. Comparisons between 2020 and 2021 data, showed that the dominant FST markers, the prevalence and concentrations of pathogens differed. Samples from sites, which in 2020 were all dominated by wildfowl only, had human and ruminant faecal source markers in 2021. Mitigation measures that target human contamination will differ from measures to manage bird and ruminant contamination. Land use and field conditions, such as rainfall, also have an impact on pathogen types, concentrations and prevalence. The results show that field and faecal contamination data needs to be collected over a range of conditions to inform interventions.

Applying Bayesian Belief Networks to palaeoecological records to improve understanding of floodplain wetland ecosystem change

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Palaeoecology offers a potentially powerful approach to both understand ecosystem dynamics and the effects of multiple anthropogenic stressors on wetland ecosystems because of its capacity to extend temporal records of ecosystem condition back in time for centuries and even millennia. However, attempts to use palaeo-approaches to derive long-term ecological records and make general inferences about ecological processes are often hampered by focus on a single site, or a limited number of sites, which means that records incorporate idiosyncratic site-specific responses that cannot be used to infer representative responses to broad-scale drivers or generalizable ecosystem dynamics due to a lack of replication. Conversely, attempts to synthesize records from multiple studies at a regional scale are often hampered inconsistent methods, uncertain chronologies and spatial variation in the underlying character of the studied systems and in the intensity and nature of the stressors that affect them. This study reports on the development of a Bayesian Belief Network (BBN) to predict the impacts of catchment disturbance and flow regulation on floodplain wetlands. The approach conceptualizes wetland ecosystem response as dependent on underlying physical character (depth, hydroperiod) and on the nature and intensity of the proximal stressors arising from distal drivers (principally catchment disturbance and river regulation) that combine to form a dynamic 'driver surface'. The nature of this relationship is then tested and refined by the development of a BBN and comparing the outcome with changes observed in palaeoecological records from billabongs of the floodplains on rivers in the southern MDB.

Do temperature and water depth influence microcrustacean hatching responses from floodplain wetland sediments

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Microcrustaceans in ephemeral wetlands produce dormant eggs to escape prolonged dry conditions. Upon re-inundation, dormant eggs can hatch from the egg bank. However, not all eggs will hatch together. Incomplete hatching can reflect bet-hedging strategies, but also the presence or absence of environmental cues to stimulate hatching. Effective environmental cues should 'predict' the suitability of conditions created by inundation for survival and recruitment. Environmental change is likely to influence the presence of appropriate environmental cues and how well cues 'predict' suitable conditions for hatched microcrustaceans. This study examines the effects of environmental cues likely to change for wetlands in the future – temperature and water depth.

Surface sediments were collected from dry anabranches of the Macintyre River floodplain subject to flooding frequencies ranging from ~4 to 0.5 pa. Samples were inundated under two temperature regimes (warm and cool) in mesocosms of two depths (shallow and deep). Hatched microcrustaceans were sampled weekly for six weeks.

Microcrustacean abundance and assemblage composition varied by temperature during the trial. While the total numbers hatched were greater under warm conditions, the effects of temperature varied over time. Numbers hatching early in the inundation period were greater under warm conditions, but by weeks 5 and 6, numbers hatching under cool conditions exceeded those under warm conditions. Thus, changes to temperature during inundation periods arising from global climate change or river flow regulation are likely to influence the number and assemblage composition of microcrustaceans hatching from flooded sediments in floodplain wetlands.

Keywords: Microcrustaceans, eggbank, temperature, water depth.

Plant responses and nutrient uptake following relocation of a constructed floating wetland from a construction site into an urban stormwater retention pond

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This study compared plant growth, nutrient partitioning and total nutrient uptake by tall sedge (Carex appressa) plants in large-scale Constructed Floating Wetlands (CFWs). Two CFWs with a total area of 2,088 sqm were installed in a 2.6 ha man-made urban lake to treat stormwater runoff during the construction phase of a 45-ha residential development. After 12 months of operation, parts of the CFWs, with a total area of 147 sqm, were removed from the urban lake and relocated into a well-established 0.127-ha stormwater retention pond at another site. Biomass and nutrient concentrations of C. appressa shoots above the floating mat and roots below the mat were analysed at both sites 12, 16 and 25 months after initial planting. Plants at the urban lake maintained an extensive root network but there was no increase in total plant biomass at 16 and 25 months after planting. In contrast, the relocated plants in the stormwater pond showed extensive shoot growth but a significant decline in root biomass. C. appressa at the pond removed and sequestered significantly more nutrients than the plants at the urban lake during 12 and 25 months after planting. The study demonstrated that C. appressa adapted rapidly to changes in nutrient availability. The implications are interesting as nutrient levels can be low in constructed lakes during the initial phase of urban developments but can increase rapidly as the development progresses. The study demonstrated that CFWs have multiple benefits for stormwater treatment in ponds or lakes.

The many faces of wetland vegetation: multi-spatiotemporal and trait responses help to maintain diversity, structural complexity and function at landscape scales

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Wetland and floodplain vegetation are critical components of river-floodplain ecosystems. They provide habitat for a large array of animals and support a wide range of ecological functions. Floodplain wetlands in Australia's Murray-Darling Basin support a tremendous diversity of plants and vegetation communities. The composition and structural complexity of understory plant communities within floodplain wetlands continually changes in response to availability of surface water, soil moisture and other environmental cues. This results in unique assemblages of plants across different wetlands at any given point in time, creating shifting habitat mosaics at landscape scales. Basin-scale monitoring and research projects are providing insights into just how diverse, unique and complex wetland plant communities are at a landscape scale. There are, however, challenges in terms of scaling up field-based data, relating heterogeneous outcomes to practical management applications and decisions around watering actions, and reporting outcomes to a wide range of stakeholders. This research presents a framework of hierarchical vegetation responses across four levels of ecological organisation – from individual plants to vegscapes, and across three types of trait responses – compositional, structural and process-oriented. The influence of nested flow-regimes on different temporal scales is highlighted as is the role of non-flow drivers and stressors. By unpacking the levels within the framework, practical guidance can be given to water managers to help inform environmental watering actions as well as prioritisation processes through articulation of the functions and values supported by different vegetation responses. Identification of knowledge gaps and uncertain relationships can also inform future research.

Towards upscaling the effects of flow on river gross primary production

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Patterns of streamflow in river ecosystems are undergoing change due to human activities. Current understanding of ecological responses to environmental flows largely comes from small-scale monitoring of discrete events. However, flow-ecology assessments at larger spatial and temporal scales are required for management decisions, making the upscaling of observations a pressing research challenge. We developed time-series and hierarchical linear models with the aim of predicting the effect of hydrology and other environmental variables on gross primary productivity, a fundamental ecosystem process. These models incorporated the temporal autocorrelation and spatially nested structure of the productivity estimates, which were measured over five years as part of the Long Term Intervention Monitoring program in Australia's Murray-Darling Basin. Water temperature explained a large proportion of the strong seasonal variation. Productivity was positively associated with its lagged values, likely reflecting that past productivity increases producer biomass. Increases in flow negatively affected the rate of productivity per litre of water but increased total system productivity due to the higher flow volume. We envisage that these models will be valuable for forecasting the effect of flow on primary productivity at unsurveyed times and locations across the landscape.

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

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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

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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.