The impact of storm pulses on DOM concentration and composition in Australian Alps peatlands

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Peatlands are important sources of dissolved organic matter (DOM) for shaping freshwater ecosystems. Extreme events (e.g. storms) can alter the composition of DOM derived from peatlands, which is likely to impact the downstream aquatic ecosystems. However, the exact impact of heavy storms on the composition of peatland-derived DOM is largely unknown in the Australian Alps. The objective of this study is to assess the impact of storm pulses on the quality and quantity of DOM in peatlands present on the Bogong High Plains, near Falls Creek, Victoria, Australia. The characterization of DOM via fluorescence excitation emission scans followed by PARAFAC modelling revealed presence of 2 humic-like (C1 and C2) and 2 protein-like (C3 and C4) components. The results showed that storm driven high flows increases dissolved organic carbon (DOC) concentration by up to three-fold (from 1.0 mg L-1 to 3.7 mg L-1) in stream water. The proportion of terrestrial, humic-like components was higher during high flows. The relative aromaticity of the DOM as determined using absorbance spectroscopy indices (specific absorbance coefficient @ 340 nm(SAC340), and 254nm (SUVA254)) did not exhibit any specific trends, however, relative molecular weight as indicated by the spectral slope (0.0006 to 0.0015) and fluorescence index values (1.35 to 1.55) increased indicating the presence of a higher amount of more labile autochthonous DOM during high flows. This research provides important insights into how DOM may change in response to expected hydrological events and implication for peatland management in the context of a changing climate.

Ecological Engineering, EcoScience, and Eco-Art to Enhance Ecological Restoration Research and Communication – a review of an interdisciplinary symposium in INTECOL 2017

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The presentation reviews and summaries the goal, the activities, and the lessons learned from a special symposium organized on interdisciplinary collaboration among science, engineering, and art for ecosystem restoration research and its communication. The symposium was part of the 12th INTECOL conference held in Beijing, China in 2017. The symposium showcased the collaboration between art and science on ecological literacy and sustainability, and ecosystem science communication through the works of US-based, eco-artists and ecologists as speakers, funded by US National Science Foundation (NSF). Due to the venue being in China, the symposium provided > 3,000 attendants from about 70 countries with opportunities of sharing thoughts and experiences between East and West as well. The paper describes the background and the rationale of the symposium with thoughts on the next step to incorporate art as part of the further development of ecosystem science and restoration practices, which will contribute to the improvement of restoration outcomes and its communication. Art incorporation or collaborating with artists in ecosystem restoration practices art will enable us to integrate cultural, social, historical, and geographic contexts in any kind of ecosystem restoration work to facilitate much needed engagement and participation of local communities.

Responses of planted wetland macrophyte community and soil physicochemistry to a two-year nitrogen addition after five growing seasons in created mitigation wetlands: a mesocosms study

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We investigated responses of plant communities (percent cover, morphological features, and aboveground biomass (AGB) production) and soil carbon (TC) and nitrogen (TN) to (1) a gradient of PR, and (2) a two-year (2017 and 2018) nutrient enrichment in which granular N fertilizer was applied to half of the mesocosms (unfertilized (NF) n=17; fertilized (F) n=17) after five growing seasons for which the wetlands were fed only by rainwater lacking in nutrients (i.e., oligotrophic condition). Plant measurements were taken during the growing seasons; AGB and soil sampling occurred in August 2018. After two years of fertilization, the top 10 cm of mesocosms hosted 1.54 ± 0.58 kg·m-2 to 3.04 ± 1.31 kg·m-2 TC, and 0.12 kg·m-2 to 0.21 ± 0.07 kg·m-2 TN. Differences in TC and TN between fertilization levels (NF, F) were marginal ($p > 0.10$), but fertilization significantly affected plant attributes measured, including percent cover ($\bar{x}_{NF}$ =34.7%; $\bar{x}_{F}$ = 54.9%) ($p < 0.05$). Polycultures saw significantly larger increases in TC and TN between NF and F treatments ($p < 0.05$), and produced significantly more AGB, than monocultures ($p<0.01$); neither plant nor soil attributes differed between monoculture NF and F treatments ($p>0.10$). The PR=4 group had similar TC and TN to PR=1,2, and 3 groups ($p>0.15$), but fertilized PR=4 mesocosms included some of the highest percent cover, TC, TN, and AGB values. The outcomes of the study has its implication on the design and wise use of mitigation wetlands for treating urban runoff loaded with nutrients.

A study on the status of knowledge, science and conservation practices of coastal wetlands of international importance for migratory waterbirds across boundaries

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There is an increasing need for better science communication and broader impact activities to both effectively conserve and wisely use coastal wetlands globally. Despite the environmental and socio-economic importance of wetlands, more than 64% of the world coastal wetlands were destroyed in the twenties century. Their loss and environmental degradation are projected to be worse in the next years as the impacts on coastal wetlands will intensify due to climate crisis, especially with regard to sea level rise. Coastal wetland habitats in East Asia, in particular, are a center of one of the most important waterbird migratory routes, yet they have experienced many challenges in recent decades due to habitat degradation and destruction due to development activities. Population of migratory waterbirds in the EAAF that stage in the Yellow Sea have shown large, and continuing, declines with several species listed as “endangered” or “critically endangered”. This presentation reports the current status of knowledge, science, and management practices of coastal wetland habitats for their ecology, policies, governance structure, and international relations in three major regions along the Flyway. The project brings together perspectives and knowledge from multiple disciplines (i.e., environmental science, public policy, global affairs, and conflict resolution and analysis). The outcome of the project provides insights for future management that would better facilitate the wise-use of coastal wetlands, from the perspectives of not only environmental science and nature conservation but of international relations and policy-making efforts to be made when involving developing countries.

Consequences of Landlocking in Paraki/Common Smelts in New Zealand

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A large proportion of freshwater fish species are diadromous in New Zealand. Among 19 diadromous fish species, 7 fish species can form landlocked populations in lakes. Common smelt, Retropinna retropinna is one species that is widespread all over New Zealand including Rēkohu (Chatham Island). Fish may become landlocked due to anthropogenic as well as natural barriers creating a different habitat for formerly migratory fishes. This may cause evolutionary and/or environmentally induced changes in their body shape, ecology, and even in their life history. The main objective of this study was to determine the consequences of landlocking in paraki/common smelt with regard to morphological and genetic changes. I hypothesized that landlocked populations would show different morphological traits than their migratory counterparts along with increased genetic structure. I sampled paraki from different lakes and coastal sites on Chatham Island as well as some parts of South Island and North Island. Landmark-based geometric morphometric analysis was conducted to compare body shapes. From those analysis, I found that body shapes of landlocked populations were highly variable and statistically distinct from the migratory populations. Genetic analysis using genotyping by sequencing is underway, and will characterize the degree of genetic divergence between diadromous and landlocked populations. The outcomes of this study have several implications for the management and conservation of common smelt as an important customary fishery. The results will also clarify the taxonomic status of common smelt along with their history of colonisation and translocation.

Addressing the role microbial communities play in producing ecosystem services in restored wetlands

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Wetland soils clean water, reduce peak flood volume, store carbon, and support mahinga kai and species' habitats. These ecosystem services are produced, in part, by interactions among wetland plants and microbes. Wetland restoration aims to re-establish these interactions primarily through revegetation, which often promotes native plant species diversity. However, the interactions among plant and microbial diversity that affect ecosystem services are poorly understood. In the Wairarapa, New Zealand, ~98% of wetlands have been lost, primarily through conversions to agriculture. Converted wetlands are characterised by reduced plant biodiversity, soil compaction and increased soil nutrients, which have implications for the size, structure and function of soil microbial communities. We explore the role wetland restoration plays in re-establishing ecosystem services affected by soil microbes, we ask: 1) Does wetland revegetation promote microbial diversity? 2) What is the relationship between microbial properties (biomass and community structure) and ecosystem service production? We sampled 36 restored and unrestored privately owned wetlands within the Wairarapa to quantify the effects of restoration on biodiversity and ecosystem services. We established 20 x 20 m Whitaker plots, where we identified all plant species and sampled soil to quantify soil organic carbon, flood abatement, and phosphorous retention. We will also quantify microbial lipids as a proxy for microbial biomass and diversity. We found that restoration significantly increased ecosystem services in wetlands, and we will further explore linkages among microbial diversity, plant diversity, and ecosystem services to shed light on how these important interactions can facilitate better restoration outcomes.

Density-related dispersal of newly hatched caddisfly larvae (Hydrobiosidae): a field experiment across 10 riffles

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Recruitment of insect larvae via egg-laying is understudied in streams. Egg-laying can be limited in a density-dependent way by densities of rocks that protrude from the water and provide egg-laying habitat. Riffles with more 'emergent rocks' may receive more egg masses but this may not result in higher densities of larvae if rates of egg mortality, larval mortality, or larval dispersal are also density-dependent.

To test whether egg-laying limits local larval densities we conducted a large field experiment in Taggerty River, Victoria, Australia. In 10 riffles we manipulated the density of emergent rocks to manipulate supply of eggs and prospective larvae entering riffles.

Densities of eggs in each riffle were compared with densities of neonate larvae in the riffle and in the run (no egg-laying habitat) immediately downstream, to determine whether neonates remain in natal riffles or disperse to areas downstream. To measure drift dispersal we collected concurrent samples of neonates drifting into and out of each riffle.

Similar patterns were observed for two common genera. Neonates of Apsilochorema were most abundant in riffles with highest densities of eggs, but they were also present in significant numbers in riffles lacking egg-supply. Ulmerochorema spp. were most abundant in riffles with middling densities of eggs. Neonates of both genera were present in the drift and, for Ulmerochorema, high rates of drift away from riffles may suggest density-dependent dispersal away from sites with high densities of eggs.
These findings offer new insights into factors limiting the initial densities and distributions of aquatic insects.

SAVE THE FISH – Fish removal from non-wadeable brackish waters

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Sediment removal from the Woolston Cut, in the lower reaches of the Ōpāwaho/Heathcote River in Ōtautahi/Christchurch was undertaken by Citycare as part of a wider Christchurch City Council river management programme. The Woolston Cut is a 500m section of river that acts as a flood defence structure, bypassing the Ōpāwaho/Heathcote River's natural channel to provide a shorter discharge route during times of elevated flow. Located 3km from the river mouth it is within the zone of tidal and saltwater influence.

Fish rescue work was undertaken by EOS Ecology as part of this programme. With high salinity excluding electrofishing, other methods such as drag netting, Gee minnow trapping and fyke netting were implemented. Given the deep water and location of upstream and downstream tide gates, the area was first sectioned off at low tide and pumps used to drop the water level, causing fish to be concentrated into a smaller area and thus helping facilitate their effective removal. Sectioning off of the channel also meant that once fish were removed there was no chance of them being able to re-enter the site.

A total of 6,940 fish were removed, including yellow-eye mullet, common smelt, estuarine triplefin, common bully, giant bully, shortfin eel, inanga, and black flounder. This fish removal work showed the importance of using a combination of fish removal methodologies specific to the habitat and fish present, to maximise the removal of all fish from an area where they were at risk of injury or death.

Plant responses to inundation in semi-arid floodplain wetlands, western NSW, Australia

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Riparian and wetland plants have specific reproductive characteristics, growth forms and dispersal mechanisms that enable them to flourish and persist within certain conditions. Thus assemblages of plants vary in space and time with antecedent conditions, and seasonal and annual weather patterns. This paper reports observations of groundcover vegetation responses to a range of different weather and inundation conditions experienced in semi-arid floodplains and wetlands across the Lower Lachlan Catchment NSW, Australia. Thirteen sites were monitored between 2014 to 2019, a period which encompassed vastly different weather and hydrological conditions. In the first- and fifth-year conditions were dry, with no inundation of floodplains and wetlands. The second year was wetter resulting in short-term inundation of low-lying wetlands. The third year of monitoring presented the fourth largest flood on record with widespread inundation continuing into the fourth year of monitoring when the system was drying. More than 170 species were recorded over the 5-year period. Distinct annual and inter-annual temporal patterns in species assemblages were observed. During dry periods, the species were dominated by terrestrial groundcover species, mainly annuals and short-lived perennial chenopods, brassicas and grasses with recent rainfall influencing interannual variation. Many of these species were also present following periods of short-term inundation but were absent following extensive flooding. Flooding produced a distinct successional response in the vegetation beginning with the appearance of aquatic and amphibious plants and transitioning through to less flood tolerant terrestrial species, with time since inundation the major factor influencing interannual variation.

Towards more integrated restoration: Utilising conservation authority data and community interactions to inform freshwater mussel restoration in the North American Great Lakes

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Freshwater unionid mussels contribute numerous ecosystem functions and interact with all trophic levels of a food web, organic matter, algae, invertebrates and fish. To date research on mussel species interactions has focused on mussel-host fish relationships and early life-stage (i.e., glochidial) processes. However, improved understanding of interactions across trophic levels could be critical in addressing declines in many unionid species. We explored community interactions between different mussel species, benthic macroinvertebrates and water quality indicators across the Sydenham River watershed in Ontario, Canada. Through partnerships with federal and local conservation authorities, we conducted a survey in the 2020 summer using a hybrid timed search/quadrat approach to quantify freshwater mussel communities and co-occurring macroinvertebrate taxa. Partnering with conservation authorities also allowed access to existing biomonitoring and species at risk data. This was combined with field survey data to expand the utility value of data collected during routine monitoring. Patterns of species co-occurrence were found across multiple gradients, with differences across sites and with waterway size. Some common mussel species were nearly ubiquitous, while other species were limited to few sites, including federally listed species at risk. Combining efforts across agencies bolstered existing datasets and added insight into species coexistence and potential indicator species. As these interaction types are infrequently considered in conservation, this will aid future freshwater mussel management efforts across multiple scales.

Urban Riverscapes: Reconnecting Urban environments with the river landscape

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New Zealand has beautiful unique waterways that pass through urban environments. These waterways are a fundamental component of our landscape, culture, history and identity. However, due to the flood protection measures in place, they are disconnected from the urban environment and no longer hold a significant presence in our growing urban environment.

Current flood protection measures, such as stop banks are static structural elements which do not respond to the differences of rivers and urban environments in a way necessary for the two environments to coexist. Growing urbanisation and increasing magnitude and frequency of rainfall events due to climate change is only putting more pressure on flood protection infrastructure. Urban environments are requiring a larger level of flood protection than what the infrastructure can provide. Constructed wetlands are soft infrastructure flood protection measure which also provide social and ecological values to the urban landscape.

Through the analysis of the Waiwhakaiho River in New Plymouth, the Waikanae River in Kapiti and the Waipoua River in Waiarapa, this work investigates the reasons for disconnection between the urban and river environments of New Zealand medium sized towns. The design concepts explore methods of increasing the presence of water and water bodies throughout the flood plains of urban environments with a focus on wetlands as the primary method for flood protection. The implemented wetland systems can then be utilised as a means for reconnecting people with the river landscape through enhanced spatial experience and creating place identity.

A model for nurturing evidence-based community ecology programmes

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Introducing interested members of the public to scientific methods – including the importance of long-term monitoring and the use of data – is vital in building robust and useful participatory science programmes. Developing programmes that are target audience appropriate and engaging is an art form, but the outcomes from these programmes should unequivocally be scientifically robust.

Our poster visualises a participatory science programme development and implementation model that leads to schools/community groups being able to gather and analyse accurate and useful data that can be used to make/contribute to making strategic, evidence-based ecological improvement decisions for the future.

It includes all the thinking and overarching goals that are involved at the start of the development process. We use a current school programme (Nature Agents) to illustrate an educationally and scientifically robust programme and all the facets that entails – including: resources/components required, what teachers/community organisers need, how scientists are integral to the programme, how data is collected, what happens to data once they have it and what they can do with the story their data is telling.

Providing schools with a well supported and resourced programme leads to improved...1. awareness of their local environment, and 2. empowerment to plan/take action. Not only do students learn new scientific skills , but they are contributing valuable information while conversing with the community and local authorities about achieving positive environmental change.

A proposed structural complexity index and its application in tracking of post-disturbance recovery in mangroves

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The concept of "complexity index" (Ic) has been conventionally used to assess the vegetation structure of the mangrove ecosystem. It is a rapid characterization of forest stands using tree height, basal area, stem density, and species richness. However, there is a unique mangrove characteristic that is excluded from the current concept. In this study, we proposed a modified structural complexity index (Icm) and described its application as an indicator of post-disturbance recovery. Our proposed method included canopy diameter (CD) and use the mean values for all other parameters. The method was applied for two post-disturbance sampling periods in three mangrove stands damaged by typhoons: natural and planted stands in Bani, Pangasinan (northwest Luzon), and natural stands in Calapan, Oriental Mindoro (southwest Luzon). Our results showed high Icm variability across stands and time. The computed Ic for two periods (2.03 ± 1.73 and 1.55 ± 0.70) showed a 24% decrease, while the Icm documented a 23% change (16.80 ± 9.40 and 12.95 ± 4.41). Looking at Icm values, the added factors contribute significantly to quantifying the post-typhoon changes in the structural complexity of the mangroves. Icm is more sensitive to changes because of the contribution of CD that is easily affected when disturbed by a typhoon (e.g., from complete defoliation to gradual refoliation). Moreover, it was sensitive in detecting "lag effect" or slowed recovery which is otherwise unnoticed if Ic is used. Our proposed modification can be used as reference to track the recovery trajectory of typhoon-disturbed mangroves in the country.

Use of earthworms for processing mixtures of sludge and old plants biomass from constructed wetlands

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Constructed wetlands as well as reed-beds produce sludge, which should be treated using suitable processes. Simultaneously, dead plant waste biomass is produced every year or during refurbishment of constructed wetlands and reed-beds. Both of these resources can be composted using earthworms (vermicomposting) which is environmentally friendly. The advantages of vermicompost are the high content of high-quality humic substances, nutrients, enzymes, and plant growth hormones. Vermicompost is able to increase nutrient uptake, soil humus level, and water holding capacity, while reducing runoff and erosion exposure.

The aim of the study was to evaluate the viability of earthworms in terms of:

I. effect of ammonia nitrogen concentration in sewage sludge, pH, and the resulting toxic effect of volatilized ammonia.

II. potential positive effect of straw pellets addition to sewage sludge, with the aim to limit the toxic effect of chemical compounds contained in the sludge.

Our results indicate that the threshold limit for earthworm survival was 1500 mg $N\text{-}NH_4+$ / kg dry matter and 10 mg NH_3 / kg dry matter at pH = 7, respectively. With increasing pH, these values decreased because more NH_3, which is toxic to earthworms, was released. The proportion of wet straw pellets in the sludge mixture was at least 50% weight for successful earthworm development.

Based on our results, vermicomposting of sewage sludge and old plants from wetlands seems to be a suitable method for their treatment.

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‘Working with nature’ in multi-hazard prone coastal settlements.

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Aotearoa New Zealand (NZ) could be described as the ‘high island’ home of a distinctively coastal nation, where the majority of settlements are prone to blue-edge related multi-hazards. In this context, environmental planners, managers and communities need to be able to evaluate and utilise as many tools as are available and effective for addressing the challenges faced when people intersect with physically dynamic and ecologically rich coastal and riverine environments. This paper evaluates ‘working with nature’ tools in terms of their applicability and usefulness in a multi-hazard coastal settlement context. Multi-hazards occur where two or more hazards interact in space and/or time such that the sum of their interactions produces different effects to the combined effects of the same hazards operating independently. For example, coastal inundation hazards can vary when likely interactions are considered with the effects of erosion, wildfires, atmospheric extremes, seismic disturbances, pollution, ecosystem perturbations, and infrastructure failures, to name a few possibilities. ‘Working with nature’ responses to urban challenges, including green infrastructure, ecosystem-based approaches, blue-green city approaches, and soft engineering, are known for their multifaceted benefits, combining ecological, climate change mitigation, urban amenity, health and economic benefits. This review paper finds that there is significant potential for adopting ‘working with nature’ solutions to reduce exposure, and/or increase resilience, to coastal city multi-hazard challenges.

Does overseas surrogate species test data protect native New Zealand species in regulatory chemical evaluation?

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The Native and Surrogate Species Project was established in 2016 by the EPA in response to concerns from Te Rūnanga o Ngāi Tahu, a Māori tribal authority from the South Island of New Zealand. In a series of workshops, the project, a collaborative initiative involving hazardous substance regulators, manufacturers, users and sector groups, and Māori, explored the extent to which test data from overseas can be used to assess potential risks to New Zealand native species when evaluating agrichemicals.

The project consisted of a commissioned literature review, which concluded there is insufficient empirical data on the relative sensitivity of New Zealand native species. In 2017, a stakeholder group was formed to develop a list of culturally significant species (native and exotic) and to identify surrogate species for particular culturally significant species. The EPA and industry members independently found that the surrogate species provide reasonable coverage for many culturally significant species in New Zealand, and identified gaps in relation to reptiles, amphibians and mushrooms. This gap exists internationally, requiring us to use a combination of assessment factors and conservative assumptions regarding exposure assessment.

This project was successfully concluded with the technical questions being answered. Equally important outcomes included the development of a collaborative process for the project and the building of a good working relationship between all parties involved.

A constructive critique of the natural wetland delineation protocol: an international perspective

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A recent policy shift introduced within the National Policy Statement- Freshwater Management (2020) NPS-FM (2020) focuses the attention on conserving residual wetland extent within New Zealand. The implementation of this policy will have material implications for land use and this will invariably result in competing outcomes between wetland conservation and development. A key measure in managing this conflict (and meeting the objectives of the policy) is a standardised and scientifically robust delineation protocol. To address this need a wetland vegetation (2013) and hydric soil guideline (2018) have been adopted from the US Army Corps of engineers. The NPS-FM (2020) requires the implementation of the afore mentioned tools to determine the extent of natural wetlands, however it also specifies three exclusions related to pasture dominance, geothermal and artificial wetlands. Several technical notes have been published to guide the implementation of the wetland provisions within the NPS-FM (2020). However, a few practical issues persist. In this review we classify the main issues into five broad categories including: definitions, classification (aquatic ecosystem context), NPS-FM (2020) natural wetland exclusions, scale and assessment of wetland ecosystem services. In each instance we reflect on international practices while considering local differences. We present several practical solutions that will aid in wetland identification, delineation and assessment, while conceptualising some key questions to guide future investigations.

Working with local Runanga to deliver a restoration plan for the Taiari - a unique and complex New Zealand catchment.

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As part of Te Papa Atawhai's te maunga kit e moana (Department of Conservation from mountains to sea initiative), the Taiari awa was selected as a Ngā Awa project. The catchment represents many unique ecosystems and biodiversity values for Aotearoa, including the Maniototo Scroll Plains, Waihola/Waipouri wetland complex and non-diadromous Galaxias species. The 288 kms of non-dammed river also provides important passage for tuna, kanakana, kōkopu and kōaro. The catchment has high value to local rūnanga for kai mahinga and spiritual purposes whilst providing resources for significant dairy and forestry operations, power generation and a vibrant tourism sector. Working alongside Te Rūnanga o Kāi Tahu, the Ngā Awa project will develop and implement a restoration plan for the catchment with the goal of enhancing the cultural and biodiversity values of the catchment and ensuring they are protected, enhanced and future proofed. The programme will achieve these goals through effective engagement with partners, stakeholders and local communities. As the catchment is over 5,700 km2 in area, this programme will need to bridge diverse geographic settings and various stakeholder interests to deliver an effective restoration plan. This presentation will showcase our up-to-date efforts at building this plan for the Taiari.

nzffdr: An R package to query the NZ Freshwater Fish Database

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The New Zealand Freshwater Fish Database is a nationally significant repository of freshwater fish observations collected from around New Zealand. Records on the database, hosted by the National Institute of Water and Atmospheric Research (NIWA) are available to end users via a portal where queries can be submitted, and results downloaded in two different file formats.
R is a programming language and free software environment for statistical computing which is widely used by scientists in Aotearoa and internationally. A strength of R is its open source nature and the ability of users to create add-on packages which extend the functionality of the software. Here I present a small R utility package – nzffdr, which allows users to submit queries to the NZFFD directly from R. Additionally, the package provides a set of functions which assist in cleaning imported NZFFD data and adding missing information such as genus and species names and threat classification status among other variables. This package provides a quick and easy tool for researchers to import and tidy their NZFFD data, simplifying the analysis pipeline.

The relationships between belowground diverstiy with ecosystem multifunctionality in salt marsh

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Salt marshes are highly productive intertidal wetlands located in temperate climatic zones, in which marine-to-terrestrial transition significantly influenced microbial life. Numerous studies have indicated the important coupling between microbial diversity and ecosystem function in terrestrial ecosystem, however, whether the coupling could be identified in coastal ecosystem was unknown. Here, we studied the shifts of microbial communities and ecosystem multifunctionality (EMF) along the salinity gradients in salt marsh, and construct relationships between them. The succession of plants was observed along the salinity gradient from mud flats to Phragmites australis. The EMF was characterized by including 16 functions of soil and plants, and the EMF in the zone of Scirpus triqueter and Phragmites australis were significantly higher than that in the mud flat. Linear regressions showed that the fungal richness not bacterial richness was significantly and positively correlated with the EMF in the mud flat. However, both of the fungal and bacterial diversity was not positively correlated with EMF in the zone of Scirpus triqueter and Phragmites australis. For both bacterial and fungal communities, there were big differences between the zone of Phragmites australis and mud flat, and those in the zone of Scirpus triqueter showed similar with mud flat. Random forest showed that the 65% of the variation of microbial communities could be explained by environmental factors, and most important predictors were salinity, pH, and Na+. Taken together, our study lays the basis for a better understanding of the relationships between belowground microorganisms and ecosystem functions in salt marshes.

Wetland and its Scientific Management

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1. The concept "wetland" is selected as a starting point for wetland research. Wetlands existed earlier than humans. Human cognition of wetlands is gradual. In the 12th century, "moor" and "peat" appeared in human life and writing. In the 14th century, the word "Marish" appeared. In the 15th century, "bog" and "swamp" appeared. The word "wetland" appeared in 1743. Reading through the printed literature from 1890 to 2009, in the middle of the 1800s, we can see the spelling (not in all of the literature) changes in the concept of "wetland" in literature, from ancient times to the present.
Research on wetlands and wetland science can be divided into three stages:
(1) Pre-wetland science stage.
(2) Wetland science creation stage.
(3) Stage of pan-wetland science. The study further explores the progress of wetland cognition during the wetland science phase in the past ten years from 2010 to 2019.

2. The new concept “wetland flooding aquatic circle” is established as a new indicator for further refining the wetland concept.

3. According to various wetland definitions, the basic type of wetland and its extended type are classified.

4. Hierarchical confirmation of rights , administration from different aspects , interdependence, and more scientific management of various wetlands are put forward in the study .

5. Research purpose: acknowledge wetlands, and make the concept of wetland more scientific, and the management of wetlands is optimized.

How do storm driven pulses of dissolved organic matter from alpine peatlands influence associated headwater stream biofilm community composition and function?

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Biofilms underpin many aquatic food webs and play an important role in cycling dissolved organic matter (DOM) and nutrients within aquatic ecosystems. Peatlands release DOM into streams, but the release of DOM into streams can be dynamic over time, particularly in response to weather events such as storms. During intense storm events, pulses of DOM from headwater stream associated peatlands can enter stream systems, altering DOM concentration and composition, which may influence biofilm community composition and function. Very few studies have investigated how DOM dynamics influence aquatic biofilm communities in alpine peatland associated headwaters. This study aimed to determine if alpine peatland stream biofilm community composition and function changes in response to a storm driven DOM pulse. Biofilms were collected and DOM concentration and composition were measured at four sites, before, during and after two separate storm events. Biofilm samples were analysed using metagenomic techniques to determine if biofilm community composition and function changed in response to storm driven changes in DOM dynamics. Storm events were shown to increase DOM concentration and alter the composition of DOM. Biofilm community composition was site dependent, however storm events did appear to contribute to shifts in community composition at most sites. Such changes are likely to cause a shift in overall function of the biofilm, which may affect the role biofilms perform in aquatic food webs.

How landlocking can cause genetic differences in an amphidromous fish

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Kōaro, Galaxias brevipinnis, are small, amphidromous fish in New Zealand and southeastern Australia. The aim of this study was to evaluate genetic variation among kōaro populations in coastal stream and lake environments. Genetic variation can show how rapidly and by what mechanisms divergence among populations takes place which is valuable for evolutionary and conservation studies.
I hypothesized that the genetic divergence of a lake population from the ancestral coastal population would increase with distance from the coast and with the presence of connectivity barriers. Additionally, I hypothesized that the genetic diversity of lake populations would increase with lake size. I extracted DNA from 174 individual kōaro sampled from seven lakes, three coastal sites and two offshore islands on New Zealand's South Island and used genotyping-by-sequencing (GBS) to obtain genetic markers. This yielded >18,000 single nucleotide polymorphisms across the kōaro genome. Genome-wide FST analysis showed that other than the remote islands, there may be little genetic differentiation amongst coastal kōaro populations. All lake populations were genetically divergent from coastal populations. The extent of divergence is broadly consistent with post-glacial ages of most lakes, but southern Fiordland lake populations are more distinct and might constitute a separate ancient landlocking event. Genetic diversity analysis also showed that southern Fiordland lakes appear to have lower genetic variation than other populations.
Kōaro is culturally and economically essential as part of the whitebait catch, so understanding their genetic diversity and capacity to adapt to changing situations has implications for the sustainable management of these populations.

Floristic diversity in Kopački Rit Nature Park (Danube River floodplain, Croatia)

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The floodplains and wetlands of the Danube River basin in Europe hosts significant habitat and species diversity. Along the section of the Middle Danube reach in Croatia, a large fluvial-marshy floodplain has been formed around the confluence of the Danube and the Drava River. Due to its biological and ecological values, this area has been protected as Kopački Rit Nature Park in 1999. Since July 2012, it makes an integral part of the UNESCO Transboundary Biosphere Reserve Mura-Drava-Danube. The frequency and intensity of floods, and duration of drought periods drives the diversity and distribution of habitats and plants. An intensive field floristic surveys were done over a ten-year period (2010 to 2020), combined with monitoring of rare and threatened plants and habitats. An important achievement is an updated flora check list and broadened knowledge on overall flora and habitats. The current floristic diversity of Kopački Rit Nature Park comprises a total of 594 taxa, representing the major taxonomic groups: liverworts (9 taxa), bryophytes (31), pteridophytes (9), and angiosperms (545). Among the vascular plants, the most numerous families are: Asteraceae (47 taxa), Poaceae (45), Lamiaceae (37), and Cyperaceae (30). The most diverse genera are: Carex (17 taxa), Ranunculus and Veronica (10 each), and Potamogeton (9). Invasive alien species are represented by 26 taxa. The floristic diversity of Kopački Rit Nature Park is threatened by fluctuations in flooding of the Danube River, lack of rainfalls, prolongation of dry season, heat waves, accumulation of bedload and natural succession of the wetlands.

Human-nature interactions in built environments: Dynamics governing solutions to mitigate environmental challenges

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Urban areas increasingly face challenges associated with dynamic interactions between human and nature systems which can be addressed by sustainable management of coupled human-nature systems in built environments. In this context, wetlands, as green-blue infrastructures, integrate natural and anthropogenic processes and help cities adapt to changes by enhancing their resilience to social, environmental and economic challenges. In addition, systematically evaluating the interactions between sustainable development goals (SDGs) can support more coherent policies for sustainable urbanization as well as wetland management. This research develops an integrated understanding of human-nature interactions, by investigating wetland values in Stockholm region, as a European densely populated urban area. The research design is based on the systems thinking approach to address the interlinkages and feedback structures among different components of the human-nature systems. A participatory approach is applied for combining local and scientific knowledge to address the following questions: (i) What are the system dynamics and interactions between urbanization and wetland ecosystem services? and (ii) How do these dynamics affect synergies and trade-offs in achieving SDGs? The research focuses on involving relevant actors to develop a causal loop diagram which includes key components and drivers of the system and provids actor-specific perspectives of interactions and feedback structures. The effectiveness and roles of wetlands in the study region have also been examined through fuzzy cognitive mapping. The results provide insights on wetland contributions to attaining SDGs in urban areas, as well as potential transition pathways toward sustainable development by identifying opportunities and barriers for the study region.

Do wetland or denitrifying bioreactor systems designed to remove nitrate lead to pollution swapping?

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The use of wetlands (natural and constructed) and denitrifying bioreactors within agricultural catchments can reduce nitrate losses (Schipper et al. 2010). A potential unintended consequence of using these systems is that N2O emissions may increase, given that the process of nitrate removal (denitrification) is also a pathway for N2O production. We undertook a literature review to collate data of N2O emissions from these systems. Emission factors of N2O from wetlands and denitrifying bioreactors were compared with the N2O emission factor values used in global and national methodologies for estimating N2O emissions. The Intergovernmental Panel on Climate Change (IPCC) and the New Zealand Inventory recommend an emission factor (EF5) for N2O emissions from waterbodies of 0.75% (IPCC 2006), although a recent revision of international greenhouse gas inventory guidelines has suggested an EF5 of 1.1 % (IPCC 2019). This emission factor includes three components: EF5g, EF5r and EF5e representing emissions from groundwater and surface drainage, rivers and estuaries, respectively. Natural wetlands had the lowest N2O emissions, with EF5g values ranging from 0.08 to 0.55%, followed by constructed wetlands from 0.003 to 1.15% and denitrifying bioreactors with EF5g values ranging from 0.003 to 1.4%. However, when estimating an overall EF5 (g+r+e), the lowest emissions were from constructed wetlands with values ranging from 0.004 to 1.5%, followed by natural wetland, ranging from 0.14 to 0.94, and bioreactors, ranging from 0.15 to 1.6%. Our review results suggest that the potential for pollution swapping in wetlands and denitrifying bioreactors is unlikely.

Effects of fiddler crab bioturbation on mangroves on the northeastern Florida coast

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Along the northeastern coast of Florida, mangroves are moving to higher latitudes into areas that are currently dominated by salt marsh grasses due to a decrease in freeze events. Fiddler crabs have the potential to alter the growth of coastal vegetation by burrowing into the soil, which is an example of bioturbation. Fiddler crab burrows have been found to increase decomposition, salinity, redox potential, and nitrogen cycling in some systems, but it is debated to what extent burrows alter mangrove productivity. To address these research gaps, I will observe vegetation growth and soil properties along a fiddler crab burrow gradient at two different sites near St. Augustine, Florida, USA. With these data, I aim to (1) discern the effects of fiddler crab bioturbation on the growth of mangroves and (2) investigate the mechanisms by which these fiddler crabs influence coastal plants using a structural equation model. Preliminary results indicate that decomposition does not differ across the fiddler crab gradient, suggesting that the presence of fiddler crabs may not alter the growth of mangroves. With further investigation into soil and water properties during the early summer of 2021, my results will help determine if the presence of fiddler crabs can facilitate growth and the expansion of mangroves in higher latitude ecosystems in the context of climate change.

Features of a successful re-established wetland

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Wetland re-establishment is an increasingly common tool used to combat the loss and degradation of wetland habitats. At the Waiau River mouth in Southland is one such re-establishment project, created by diverting water from a river side braid through a series of channels and ponds. An investigation into the fish and invertebrate community of this pond system was undertaken over the course of two summers. Invertebrate community composition varied significantly between ponds, and appeared to be driven by hydrological connectivity and nutrient levels within the system. Ponds further from the systems main water intake had lower dissolved nitrate levels, indicating that the wetland has successfully reproduced the filtering ability of a natural wetland. During the course of the study a drought occurred, drying much of the pond system, and creating an opportunity to observe how the system recovered. A deep channel running through the system provided refugia for eel species, allowing them to disperse throughout the system after it refilled. Smaller species (Gobiomorphus and Galaxias spp.) were not found near the refuge channel, and took longer to reappear in the system. Overall, this study has identified traits that have aided in making this project a success; and that may benefit future projects.

Restoration and management of degraded peatlands: A review

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Poster presentations, October 11, 2021, 8:00 AM - 4:00 PM

Peatlands are recognised by the United Nations Environment Programme as the world's largest terrestrial organic carbon stock, containing twice as much carbon as in all the world's forests. There are various management techniques for restoring degraded peatland back to a near natural state, thereby supporting important ecosystem services such as improving biodiversity and water quality, carbon storage and aiding water retention. This comprehensive review provides a global synthesis of research surrounding peatland restoration and management across diverse regions and countries. A systematic review was conducted using the 2009 PRISMA guidelines to search for research articles on peatland management and restoration. A total of 391 research articles were assessed for the review and >200 articles were used within the meta-analysis. The research was mapped out to show the location of peatland research on an international scale. Detailed analyses of the data were then completed to determine any differences within peatland management, together with the successfulness of different management types taking account of latitude, local climate and a range of ecosystem services. The data showed the frequency of research papers published from 1999 to 2021 had an upward trend for peatland restoration, highlighting the global increase in concern regarding these fragile environments. The ecosystem services that were most commonly quoted in the recent years were hydrology, reducing greenhouse gases, increasing carbon storage and improving the water chemistry.

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Kenya is a food insecure country, weather patterns are drastically changing and people are losing livelihoods and earnings when their lands dry, water for domestic supply lacks and livestock die further frustrating livelihoods of the poor. This paper briefly discusses Fencing of lands as prerequisite to biodiversity protection and faster water retention mechanism, through tree planting, enhancing sequestration as trees, shrubs and vegetation's find suitable environment to grow. The present paper illustrates that Fencing of lands improves agricultural land management practices, biodiversity growth increased soil carbon sequestration.These two notable counties have varying agro-climate zones needing varying conservative interventions. These agro zones contrast in relationships to soil moisture index, precipitation, plant life and agriculture patterns. Temperatures have average of 22.9c and an average rainfall is 450-900mm with evaporation rates of 1650-2300mm.Survival depends on the inflows from rivers originating from the humid hill slopes of the drainage basin (World Lakes Database-ILEC). These mainly suitable for livestock farming (mostly cattle and sheep and key food crops (maize, beans and wheat) (Kabara 2015).Climatic variations affect crop and livestock systems both directly and indirectly and could have severe socio-economic impacts such as shortages of food, water, energy and other essential basic commodities, as well as long-term food insecurity.literature between a cor-relationship between Climate Change and food security in Kenya.This paper tries to resolve the underlying gap.The general objective of this study is to investigate the relationships between climate change and food Security in Kenya, by studying Climate change Resilience, promoting biodiversity regeneration and land fencing.

ASSESSING THE IMPACT OF SEDIMENT-SOURCED RECRUITMENT ON PHYTOPLANKTON POPULATIONS IN A MURRAY RIVER FLOODPLAIN (HATTAH FLOODPLAINS)

Mrs Sewwandi Wijesuriya[1], A/Prof. James Angus Webb[1], Prof. Michael Stewardson[1]
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Sediment-sourced recruitment of phytoplankton can have significant effects on their population dynamics. The spatial distribution and diversity of these seed bank phytoplankton genera reflect their past population composition and possible future threats of algal blooms. We have assessed the seed bank functionality of five lakes in the arid Hattah Lakes floodplain system, Victoria, Australia, to understand the post-flood impacts on its phytoplankton populations. The Hattah Lakes floodplain system is watered using engineered (pumped) floods; hence, phytoplankton population control plays an important role in its management. All lakes showed an active seed bank, but a temporal variation of emergence was observed among lakes for the same species. The results also indicate a spatial variation of the sediment-sourced recruitment of phytoplankton. The lakes showed distinct species assemblages despite the system's cascade filling pattern. Statistical tests showed a spatial variation of species richness within and among lakes, contradicting the common assumption of lake matter homogenization due to mixing. These findings emphasize the importance of assessing phytoplankton seedbanks for their effective control in restored wetland water bodies.