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

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

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

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

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

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

Emerging issues for wetland conservation and wise use

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

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

Peatland ecosystems – status, restoration and role in climate regulation

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

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

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

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

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

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

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

Impacts of climate change on freshwater wetlands of the Mekong River Delta

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

The Mekong Delta is one of the largest river delta systems of the world, home to approximately 20 million people. It is also considered one of the regions that are most severely impacted by climate change. Even though large areas of the Mekong Delta have been converted to agricultural lands, some wetlands are protected under various forms of protection. In 2017-2018, we conducted a vulnerability assessment for 3 important protected wetlands in the Mekong Delta, using the social-ecological system vulnerability assessment framework developed by IUCN. All together, we assessed climate change impacts on 8 wetland habitat types, 15 species and 9 local communities. Droughts, floods and salinity intrusion caused by sea level rise, extreme heat waves, and irregular monsoon seasonality are the major climate threats that are common to most wetlands and communities. Among the 8 wetland habitats assessed, 3 were considered highly vulnerable, including peat-swamp forests, seasonally inundated grasslands, and permanent freshwater swamps. Species that have small populations and narrow habitat range, such as Sarus Crane, Pangolin and Hairy-nosed Otter, are highly vulnerable. Community vulnerabilities to climate change mainly come from direct impacts on people's health and livelihood activities such as farming and fishing and from diminishing fresh water and other products provided by wetlands. Improving freshwater resources management and diversifying livelihood options are among the adaptation strategies that are most important for communities. Cumulative impacts of climate change and Mekong upstream hydropower development on wetlands of the Mekong Delta are expected to be severe but still poorly understood.

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

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

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

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

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

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

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

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

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

The root causes of wetland loss in New Zealand

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

In 2020, the National Wetland Trust, supported by the Environmental Law Initiative, undertook a multi-pronged investigation into the root cause of recent wetland loss in New Zealand. We aimed to unravel the policy-related enabling factors - inadequate policy provisions, inadequate policy application, inadequate monitoring, inadequate enforcement, or a combination of these.
Our presentation will reveal the extent of human-induced wetland destruction since 1996, the regions that experienced the greatest loss, and the land use to which most were converted.
Under the Resource Management Act (1991), regional councils and unitary authorities, are responsible for wetland protection. We found their policies and plans varied in strength, but overall there was a weak link between regional plan rules and recent wetland loss. This strongly suggests that other factors, such as compliance, monitoring and enforcement contribute more to wetland loss than weak policy or rules.
The “Essential Freshwater” package of reforms has recently brought in strong new rules, national consistency, and greater direction for local government to protect wetlands. Given that of 79 wetlands cleared since 1996 that we investigated, none were subject to a resource consent, we conclude that wetland destruction in New Zealand is generally unconsented (i.e. illegal). That suggests that these new national rules will not prevent future loss of wetlands unless the consenting and enforcement processes are similarly strengthened.

Access and impact: To what extent are off-road vehicles affecting saltmarsh wetlands in New Zealand?

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

Wetlands are highly productive environments that provide a wide range of ecosystem services, yet many of them have been lost globally and continue to be degraded. Significant impacts can occur when wetlands are extensively used by off-road vehicles, however, little is known about the extent or significance of their impacts on saltmarsh wetlands, and how to mitigate them through design, planning and management. Using Te Waihora's saltmarsh wetland, near Christchurch, as a case study, this research uses GIS spatial analysis to measure the extent and intensity of off-road vehicle damage. The wetland is co-managed by Te Runanga o Ngāi Tahu and the Department of Conservation, according to a management plan which seeks to protect mahinga kai, restore and protect indigenous wetland biodiversity and improve the mauri of the lake. Results demonstrated that impacts of off-road vehicles on the saltmarsh wetland were substantial. Damage measured in samples stretching from the park's inland edge to the water's edge showed that the entire park width had been damaged. Impacts were extensive, being present in 66% of samples. Proximity to access increased the density of impacts, with an average 19% of off-road vehicle track cover in samples adjacent to roads; compared with 8% cover of damage in samples not adjacent to access points. The results of this study indicate that the objectives of Te Waihora's Joint Management Plan are not being met under the current design of the park and that actions must be taken to mitigate off-road vehicle use impacts.

Monitoring the performance of a constructed wetland using an unmanned aerial vehicle (UAV)

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

A wetland planted with native species covering nearly a hectare was constructed at Kaiwaiwai Dairies Ltd in 2014. This wetland design comprises a serpentine flow path down 6m wide bays that slow down water flow, maximise residence time and water treatment. This wetland sufficiently removes contaminants from drainage water, particularly nitrate and removes about 640kg of nitrogen annually. This wetland helps to improve the water quality of the downstream Wairarapa Moana.
Unmanned Aerial Vehicle (UAV) monitoring seemed to be a viable and cost-effective method to enhance the ground level monitoring of the wetland. The monitoring firstly assisted in mapping the wetland as one of the key outcomes is obtaining a better understanding of biomass accumulation in the wetland and the carbon sequestration services that the wetland supplies. The monitoring included the mapping of dead organic wetland plant material on the surface of the wetland. This information provided an improved understanding of the expected organic matter that may accumulate at the base of the wetland to increase the capacity of denitrification. Secondly, the monitoring supplies valuable information on the performance of the numerous native species that were planted in the wetland including the status of invasive species within the wetland. Mapping of species that clog up the bays including the extents of open water covered by duckweed was also possible using the ultra-high-resolution UAV imagery. This information is important to support maintaining a high cover of emergent wetland vegetation and to enable appropriate management actions.

Wairarapa Moana Wetlands - where to from here?

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

Research and monitoring has been underway at Wairarapa Moana wetlands for the past 14 years. This 10, 500ha wetland complex meets seven of the nine Ramsar criteria, as it provides habitat for a high diversity of indigenous species and is now a refuge for at least 56 threatened or at risk species. It was once the 'eel basket' of the Lower North Island and a treaty claim process is in train. The research and monitoring programme focusses on wetland and wading birds, exotic fish studies and wetland vegetation assessments. Findings include the effect of water levels on wading bird numbers, the ongoing threat of pest animals on bittern numbers as well as ways to enhance the indigenous fish populations and the outcomes of grazing removal on wetland plants. The wetland system is affected by an existing flood protection scheme, but proposals to 'turn back the ecological clock' need to take into account the altered equilibrium that has now developed since the scheme was put in place in. The findings of the research and monitoring will be presented, along with a discussion of the future challenges for the wetland complex.

What is Influencing the State and Condition of Wetlands in Wellington?

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

Greater Wellington Regional Council's wetland health monitoring programme has been designed to survey 150 wetlands across the Wellington region over a five year timeframe. The region has been divided into five whaitua (super-catchment areas) for the purposes of freshwater planning. Thirty wetlands are surveyed annually, with a whaitua-based approach being taken in the sampling programme. 120 wetlands (across all five whaitua) have been assessed to date using the national Wetland Condition Index (WCI) methodology. Overall the WCI scores ranged between 10 and 24 (out of 25). It was found that the responses of wetlands to different pressures depended upon past changes in land-use, e.g. grazing pressure or urbanisation, but the historical development of the wetland was also a factor. The results of the first five years of the programme will be presented.

Exploring the relationship between the Rights of Wetlands, biodiversity loss and threats to human well-being.

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

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) describes the critical relationship between biodiversity, ecosystems, and the capacity of nature to provide benefits to people. The IPBES Americas Assessment documents the continent's biodiversity, supporting 40% of the world's most biodiverse countries and with three times more "biocapacity" per capita than the global average. However, the increasing demand for food, water, and other material goods has increased consumption and intensified land use, continuing a pattern of widespread wetland degradation and destruction with regional wetland losses ranging from 20-60% of total wetland area since 1970. The result is the loss of the benefits that wetlands provide including food and water supplies, climate regulation, and adaptation extreme events. Overall, there has been a substantial decline in nature's contribution to people (NCP, a broader term than ecosystem services); of the 18 NCP evaluated across different wetland types, 66% are in decline, with 30% declining strongly, effectively reducing wetland contributions to human well-being. The declaration of the Rights of Wetlands reflects these linkages and acknowledges the importance of wetlands as a universal heritage. A legal recognition of the inherent rights of wetlands should be considered as an approach to ensure the future of wetlands globally.

Identifying priority habitats for protecting braided river birds

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

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

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

Late Holocene history of long- and short-term environmental changes in a backbarrier wetland, Moawhitu, Rangitoto ki te Tonga/D'Urville Island

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

Long- and short-term environmental changes in Moawhitu wetland, on the west coast of Rangitoto ki te Tonga, were revealed using a multi-proxy approach, including sedimentological, geochemical (ICP-AES, ICP-MS and Itrax core scanning) and diatom analyses, with the chronology established using radiocarbon and ^{210}Pb dating. Our study shows that a brackish lagoon started developing 7300 years ago after formation of a sand barrier, following the end of the post-glacial marine transgression. This was followed by periods of alternating wetland encroachment and open water. While peatland development might be attributed to a change to a cooler climate, local conditions, due to difference in drainage and input of mineral matter, led to spatial variations across the two main areas of the wetland. Alternating terrestrialisation and drowning of the wetland were also reflected in different diatom assemblages. About 1300 cal. yr BP, a peatland was established across the area. It was, however, partially drained by European settlers in the early 1900s (post WWI) for farming, with ~2 m-wide drains extending across the wetland still visible today. Thin, very fine-grained grey layers conspicuous in the sedimentary sequences, had distinct diatom assemblages and chemical composition. One layer with few diatoms suggests runoff from the surrounding hills, possibly reflecting a wet period, while the high proportion of benthic diatoms in other layers indicates stream runoff. Evidence of an overwash about 2500-3000 years ago was also found, either as a coarse layer containing gravel, sand and shells, or a geochemical signature marking the extent of inundation.

On the Use of Surface Elevation Tables to Determine Potential Gains in Soil Carbon Sequestration on Mangrove Sites Undergoing Hydrologic Rehabilitation

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

Mangroves are tidally dependent wetlands that are often negatively impacted by alterations in hydrology resulting from coastal development. Alterations in frequency, depth, duration, and seasonality of tidal inundation can lead to mortality of mangroves. These stress-adapted ecosystems may persist in a degraded state for many years before succumbing to mortality, thus providing opportunities to promote recovery through management action. Much of the mangrove resource on Marco Island (Florida, USA) is unhealthy or dead as a result of road construction that stymied tidal hydrologic exchange for several decades. Using surface elevation tables (SETs), soil C content, and soil N content along a gradient of degradation, we document that the restoration of regular tidal inundation to Marco Island mangroves has the potential to increase C sequestration in surface soils alone from 0 to 360 g C m-2 y-1 (3.60 Mg C ha-1 y-1) and increase N sequestration from 0 to 24 g N m-2 y-1 (0.24 Mg N ha-1 y-1). Additional sequestration benefits would be realized with aboveground forest recovery. While these increases in C and N sequestration potential do not currently have a timeline for realized benefit, we expect recovery will begin to occur within a decade of tidal hydrologic restoration of these sites. In this session, we will discuss the potential value of using SET methods to provide insight to restoration planners and wetland managers, as well as outline some of the prominent limitations.

Subtropical coastal peatlands of eastern Australia: Past, Present and Future

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

Wire Rush (Empodisma minus) is a key peat forming species across eastern Australia and New Zealand. In eastern Australia it occurs from tropical to temperate latitudes and from coastal to alpine environments. In addition, Wire Rush has adaptations to fire, particularly the ability to re-sprout after being burnt. Within South East Queensland (i.e. subtropical eastern Australia) it is a key component of extensive coastal mire systems located on the giant sand mass environments of Fraser Island (largest sand island in the world), North Stradbroke Island (2nd largest), Moreton Island (3rd largest) and Cooloola (mainland sand mass). Further, the only known subtropical patterned fens in the world are located within these mire systems. This presentation will examine results from three Wire Rush wetlands, Moon Point (Fraser Island), Nilkan Coastal Plain (Cooloola) and Jumping Grass Marsh (North Stradbroke Island), which provide a north-south transect of these mire systems. In particular, the current characteristics of these wetlands, ages for peatland formation and response to past and future environmental changes will be discussed. This information provides important knowledge for the conservation and management of these unique Southern Hemisphere peatlands, which are relatively unknown and poorly understood in the global context of mire research.

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

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

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

Assessing land use change to improve water quality in Lake Ōkareka, New Zealand

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

Changes in land use and climate have profound impacts on catchment hydrology and water quality but few studies have assessed the type (native or exotic species of forest) and extent of land use change required to meet water quality targets under a changing climate. The aim of this study was to quantify the extent of land use change (LUC) required to meet nutrient load targets for a lake, based on its desired trophic state. We hypothesised that afforestation and construction of wetlands could offset potential increases in nutrient loads associated with climate change. This hypothesis was tested using 9 years (2002 to 2010) measurements of streamflow, total nitrogen, total phosphorus, nitrate and ammonium pre-LUC and six years post LUC (2011 to 2016) to assess if LUC could offset climate change impacts. We quantified the feasibility and effectiveness of afforestation and implementation of wetlands to mitigate climate change impacts using measurements and a model that was applied through a period of non-stationarity when afforestation was an important driver of LUC and to a period of projected climate change. As hypothesised, flow, total nitrogen, and total phosphorus loads decreased associated with LUC involving afforestation and LUC also offset climate change impacts. The findings provide guidance about the effectiveness of LUC required to meet nutrient load targets and can serve as a prototype for other lake catchments subjected to LUC for water quality improvement.

Keywords: Non-stationarity, land-use change; climate change; water quality; Lake Ōkareka; New Zealand

Avoiding perverse outcomes: A solution for concept bias within wetland carbon sinks

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

Measuring rates of carbon sequestration is based on an assumed equivalency between net ecosystem production (NEP) and sedimentary carbon accumulation (CA). Over time, this accumulates a standing stock, which if disturbed is largely remineralised. However, we show that this equivalency breaks down from both allochthonous labile and recalcitrant inputs. What is required is a subtraction of allochthonous recalcitrants from carbon stocks, and the subtraction of allochthonous labile and recalcitrant carbon at the moment of deposition from CA, corrected for 100 yrs of decomposition. A solution is proposed: 1) measurements of black carbon (BC) as the allochthonous recalcitrant; and 2) projecting CA losses and hindcasting allochthonous carbon losses with a robust global decomposition model. This was tested within mangrove sediment containing a small fraction of seagrass litter and subtidal seagrass sediments dominated by mangrove detritus. The median seagrass carbon accumulation (CA) not for decomposition (241.4 g C m-2 y-1) was an order of magnitude larger than the seagrass cal annual NEP (7.2 g C m^{-2} y^{-1}), and typical for these shallow meadows. In contrast, the median mangrove CA not corrected for decomposition (62.5 g C m^{-2} y^{-1}) was more than double the cal annual NEP (27.6 g C m^{-2} y^{-1}). From the limited data set, stocks assessments may be overestimated between 3% and 38% when accounting BCacross coastal canopy ecosystems. Such overestimates can lead to perverse outcomes where carbon credits become overvalued and allow the customer to emit above the capacity of the ecosystem.

Hydrology driven state and transition simulation models for flow ecology (HySTSiM)

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

Managing freshwater ecosystems and their hydrologic requirements has become increasingly difficult as the social, economic and environmental value of water rises in a changing climate. Interventions to improve the health of freshwater ecosystems often employ environmental watering as a management action, though river morphology, target species, temporal context and the timing of flows mean outcomes are far from generalisable.

To better understand how different scenarios of flow time-series influence floodplain ecosystems we developed a state and transition simulation model (STSM) to link the condition of floodplain vegetation to the timing and frequency of floodplain inundation events. The approach relies on expert informed state transitions, describing response to individual flood events conditional on both the flood characteristics and the condition of local vegetation at the time of flooding. This has led to the development of a generalised statistical package (HySTSiM) for generating multiple time series of state transitions for aquatic ecology based on different flow scenarios. There are two major benefits in this approach. First, STSM allows for the application of the state-and-transition framework to a range of ecosystem outcomes. Secondly, the first order Markov process at the core of STSM's can help reveal lags and feedbacks in ecological responses to differences in the sequencing of flow events. This presentation summarises the workflow of the package and demonstrates its application in forecasting spatial dynamics of floodplain vegetation condition at sites along the River Murray, NSW, Australia, in response to potential future inundation scenarios.

Response of wetland vegetation regenerating since sugarcane cropping abandonment to managed hydrology and salinity regimes.

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

Coastal freshwater wetlands (CFWs) are highly vulnerable to climate change and the hydrological and salinity alteration that is predicted with sea level rise (SLR). Here, we investigated the responses of major wetland vegetation communities to simulated SLR, through an in-situ manipulation of flooding and salinity regimes at a regenerating CFW. Repeat surveying of vegetation composition, structure and, condition was conducted in permanent plots established in Casuarina swamp, Melaleuca swamp, Herbaceous marsh, and Riparian zone vegetation communities, to observe change over time. Distinct vegetation communities have passively established after the cessation of agriculture. Surveying under altered conditions has shown that understorey species richness decreased in all regenerating communities (Salt pan, Casuarina, and Melaleuca). Understorey vegetation cover also decreased in Melaleuca and Casuarina sites, but increased in Salt Pan sites, with increased cover of salt tolerant species. Changes in woody vegetation community and structure were not observed in this the short time period of this study, suggesting that woody vegetation may be more resilient to SLR and persist while the understorey is significantly altered. Altered conditions have reduced the regenerative capacity of tree species and minimised the cover of understorey vegetation in these vegetation communities, where a transition to salt-tolerant vegetation is likely. This transition is likely for many CFWs globally where provision of space for landward expansion is one option for SLR mitigation.