FIRE AND WETLANDS FORUM September 8 and 9, 2021

PROGRAM and ABSTRACTS

Forum purpose

In an already dry continent experiencing rapid climate-change, fire is increasing in frequency, intensity and both geographic and temporal extents. In many regions wetlands and surrounding ecosystems are becoming much more prone to burning, while in other regions fire is missing from wetland landscapes. The challenges are significant for wetland and fire managers trying to manage, prevent or control fire to mitigate short- and long-term effects on wetlands.

This forum will bring together scientists and managers dealing with these issues from across Australia, with topics including overviews and case-studies of fire management in and around a range of wetland types, wetland fire paleo-histories in Australia, cultural burning and wetland responses to fire and post-fire recovery.

Forum outcomes

- Shared knowledge on the effects of fire and management in wetlands, cultural burning, and the implications of current research for improved mitigation.
- Knowledge gaps identified for further research.

Acknowledgments

This Forum has been made possible by a development grant from the Society of Wetland Scientists (SWS) to the Oceania Chapter. Technical support (Adobe Connect) was provided by the New South Wales Department of Primary Industry and Environment, and the Sydney Wetland Institute of the Sydney Olympic Park Authority.

SWS promotes understanding, conservation, protection, restoration, science-based management, and sustainability of wetlands. SWS Oceania welcomes membership from wetland scientists and managers from around the Oceania Region. SWS also provides a program for the certification of wetland science training and experience. The Professional Certification Program is designed to meet the needs of professional ecologists, hydrologists, soil scientists, educators, agency professionals, consultants, and others who practice wetland science.

Program

Day 1

10:30	**Welcome and acknowledgment to country**	
10:33	**Welcome from SWS President**	
10:35	***Introduction to session 1 speakers***	
10:40	**Hamish Clarke (Plenary)** *University of Wollongong Bushfire Risk Management Research Hub*	Climate change and bushfires: what you need to know
11:05	**Mark Quoyle** *University of Wollongong*	Monitoring post-fire recovery and regeneration in mangrove and saltmarsh wetlands
11:20	**Kathryn Storey and Jenny Styger** *Department of Primary Industries, Parks, Water and Environment*	Fire in the organic deposits of Tasmanian near coastal wetlands
11:35	***Facilitated panel discussion***	
11:50	**Break**	
11:58	***Introduction to session 2 speakers***	
12:00	**Janine Liddelow** *Department of Biodiversity, Conservation and attractions, Western Australia*	The challenges of introducing prescribed fire into areas containing organic soils with the influence of an increasingly drying climate using two case studies from south west Western Australia
12:25	**Nina Mclean** *Environment, Planning and Sustainable Development Directorate (EPSDD) | ACT Government*	Restoration of Sphagnum Bogs after fire
12:40	**Pierre Horwitz** *Centre for People, Place & Planet, Edith Cowan University*	Water chemistry, macroinvertebrates and other post-fire effects for wetlands at Yanchep, southwestern Australia
12:55	**Norm Lenehan** *Batemans Marine Park*	A management perspective: implications of bushfires for marine estate planning and management
1:10	***Facilitated panel discussion***	
1:30	***Concluding remarks***	

Day 2

1:30	**Welcome and acknowledgment to country**	
1:35	***Introduction to session 3 speakers***	
1:40	**Peta Standley (Plenary)** *Firesticks Alliance Indigenous Corporation*	The Importance of Indigenous Peoples' knowledge of fire in wetland management
2:05	**Bradley Graves** *Macquarie University*	Fire in floodplain wetlands
2:20	**Tim Ralph** *Macquarie University*	A landscape approach to understanding wetlands and fires
2:35	***Facilitated panel discussion***	
2:50	**Break**	
2:58	***Introduction to session 4 speakers***	
3:00	**Pauline Ross** *The Universty of Sydney*	Fire and the recovery of gastropods in south-east Australian salt marsh
3:15	**Phillip Stewart** *University Queensland*	Wetland vegetation thickening on the Giant Sand Islands of Subtropical eastern Australia
3:30	**Patrick Moss** *University Queensland*	From coast to uplands – A palaeoecological perspective of Tasmanian peatlands
3:45	**Dave Blake** *Centre for People, Place & Planet, Edith Cowan University*	Water quality impacts for fire impacted, organic rich wetlands on the Swan Coastal Plain, southwestern Australia
4:00	***Facilitated panel discussion***	

Abstracts (in the order they appear in the program)

Day 1

Hamish Clarke

Climate change and bushfires: what you need to know

Repeated fire disasters have reinforced risk's pivotal role in fire management. Current research supports fire managers to understand and track risk's drivers – from micro to macro, split-second to century scale – and to close the loop by understanding how fire management itself affects risk. However, a major knowledge gap remains: the future trajectory of fire risk, with early efforts limited by unrealistic assumptions, coarse temporal and spatial resolution, and poor representation of variability and uncertainty. Furthermore, history shows that the only way out of the "Valley of Death" between research and impact is meaningful engagement with decision makers and the public. In this talk, I discuss the key drivers of bushfire risk and how they might respond to climate change, with the Black Summer fires of 2019-20 as a case study.

Mark Quoyle, Jeff Kelleway, Kerrily Rogers, Norm Lenehan, Shamaram Eichmann

Monitoring post-fire recovery and regeneration in mangrove and saltmarsh wetlands

The Currowan and Clyde fires of the 2019/2020 fire season burnt extensive areas of native forest resulting in considerable damage to property and the environment. An unusual feature of this event was the spread of fire through mangrove forests, saltmarsh and Casuarina/ Swamp Oak communities on the Clyde River and nearby estuaries. There is little information available to determine how these vegetation communities will respond to such a fire event in the short term and what mechanisms may promote post-fire recovery in the short, medium, and longer term. There is a unique opportunity to quantify the extent of fire damage and to examine recovery response characteristics.

A combination of field-based vegetation survey, drone imagery, and Geographical Information Systems were employed to produce a multi-perspective analysis. Preliminary analysis shows that rush-dominated saltmarsh communities demonstrate a rapid recovery to near pre-fire biomass in the first 12-18 months following fire. This is contrasted by the response of mangrove forests. Mangrove responses were spatially varied, ranging from tree mortality to partial or full defoliation following fire. Post-fire re-growth – where observed – was minimal within the first 12 months and dominated by epicormic growth after 18 months.

These results suggest that saltmarsh ecosystems have a stronger recovery than mangrove forests following fire disturbance. Further monitoring is required to understand vegetation recovery over longer timeframes. Coastal management practices will need to incorporate restoration projects that protect regrowing habitats, whilst restoring severely degraded habitats using a range of methods suitable to the region's intertidal characteristics. It is too early to anticipate the timescale until full recovery; however, these results prove promising for mangrove species fire response which could be adapted to Australian and global fire-prone locations.

Kathryn Storey and Jenny Styger

Fire in the organic deposits of Tasmanian near coastal wetlands

To the knowledge of the authors, since 2001, there have been 19 fires in the organic deposits (peat) of Tasmanian wetlands close to sea level, with 12 of them in the last six years. This count excludes soil fires in our other classes of organic soil, chiefly blanket peats and alpine soils.

Soil fires in wetlands have immediate and long term ecological consequences, caused by both the combustion of soil and the fire suppression activities. At the most extreme, soil fire causes effectively permanent ecosystem change, as well as converting significant volumes of stored carbon to greenhouse gases.

Wetland soil fires in Tasmania are caused by both bushfires and planned burning. Reasons for the recent high frequency of wetland soil fires are not well understood, but are likely to be multifaceted. They may include climate change, other changes to catchment hydrology, changed fuel loads and cumulative impacts on organic soils altering vulnerability to fire.

Recently DPIPWE and the University of Tasmania have invested significant effort into improving fire management guidelines for organic soils in Tasmania. This includes mapping the likelihood of encountering organic soils, improved understanding of how soil combustibility is controlled by soil moisture, translating university based research into fire management guidelines embedded in fire planning procedures, and converting the BoM models of soil moisture into assessments of soil fire risk. Opportunities are also being sought to research methods that will improve the efficiency of soil fire suppression.

Janine Liddelow

The challenges of introducing prescribed fire into areas containing organic soils with the influence of an increasingly drying climate using two case studies from south west Western Australia.

Organic soils represented as peat swamps or peat lakes in the southwest Western Australia are poorly mapped and understood. It is known that ignition of peat substrate can be detrimental to hydrology and soil properties and result in loss of organic material important as habitat and the formation of acid sulphate soils. Peat swamps and peat lakes in southwest Western Australia have traditionally relied on wet winters to recharge to a level of saturation to provide protection against ignition from fire. Due to a drying climate with less winter rainfall this is becoming increasingly inconsistent in the landscape. As a result of this the practice of prescribed burning in the southwest Western Australia has become increasing complex when trying to meet the objectives of fuel reduction to protect life and property and prevent large uncontrolled wildfires whilst minimizing impact on organic soils. In this presentation I present some of the problems and strategies being used to balance these issues.

Nina McLean

Restoration of Sphagnum Bogs after fire

Alpine *Sphagnum* Bogs and Associated Fens is a listed endangered community in Australia and is highly vulnerable to human impacts, notably climate change and associated increases in bushfires. In January and February 2020, fire impacted almost all bog and fen complexes across the Australian Capital Territory, with many bogs losing near 100% of vegetation cover. Arguably, the most common management technique to promote resilience and restore bogs after fire are leaky weirs (commonly coir logs, straw-bales or rock). In fire-impacted peatlands leaky weirs have three specific objectives; (1) prevent or reduce erosion and incision of the peat, (2) spread water throughout the peat, and (3) promote rapid recovery of vegetation. However, our understanding of how effectively they meet these objectives or whether some might be more successful than others (e.g. due to slope, fire severity, number of weirs) is lacking. Following the installation of coir logs

across multiple bogs by ACT Parks and Conservation Service staff, we investigate the coir logs' effect on the degree of erosion, peat moisture and vegetation re-growth after fire. We present some initial findings on the success of the coir logs in meeting their objectives and detail the ongoing monitoring to understand long-term effects. Using an adaptive management framework, this ongoing monitoring will not only provide annual feedback to land managers on the success of individual coir logs, but also answer important questions about their long-term effectiveness to improve our evidence-based decision making around post-fire recovery in bogs in the future.

Pierre Horwitz, Dave Blake and Karl Zwickl

Water chemistry, macroinvertebrates and other post-fire effects for wetlands at Yanchep, southwestern Australia

This presentation reports on the findings of an opportunistic study conducted during 2020 following an intense bush fire in the summer of 2019/2020 on the Swan Coastal Plain north of Perth in southwestern Australia. We investigated the post-fire effects of burnt sediments on water quality and macroinvertebrate assemblages for two groundwater window wetlands (Lake Yonderup and Loch McNess).

Surface waters and macroinvertebrate assemblages were compared post-fire against a substantial pre-fire dataset. Deep aquifer and shallower porewater bores were sampled post-fire.

This study demonstrates that the most severe post-fire water chemistry response would be found with the first hydration of sediments in winter as water tables rise for the first time since the fire, and that effects will subside in spring as sediments are inundated and flushed for months by higher water tables. This pattern was most evident in porewater; deeper groundwater and surface water also showed a seasonal pattern. However, the generated acidity did not exceed the buffering capacity of the wetlands, unlike that seen in other studies.

The response following hydration of the sediments needs to be considered in context with the wetting activities (saturation) carried out post-fire. Further investigation into management of wetland fires via saturation is required to ascertain the leaching potential and oxidation proliferation that may result. Ultimately, maintaining the groundwater hydrological integrity of these systems remains the most effective strategy for preventing wetland sediment fires and the long-term environmental harm that results.

Norm Lenehan

A management perspective: implications of bushfires for marine estate planning and management

The 2019/2020 'Black Summer' fires of eastern Australia were unprecedented in terms of their scale and intensity. These fires burnt numerous ecosystems which are rarely affected by fire, including coastal wetlands (mangrove, saltmarsh, swamp oak forests, paperbark wetlands). This included significant portions of the coastal wetlands managed within the Batemans Bay Marine Park.

At present we have little understanding of fire dynamics in such ecosystems, or the likelihood of future fire impacts. These uncertainties have important implications for the planning and management of marine parks and other conservation strategies in the coastal zone.

Day 2

Peta-Maria Standley

The Importance of Indigenous Peoples' knowledge of fire in wetland management

Wetlands are incredibly important places they support function of the landscape and provide essential ecosystem services. Wetlands hold significant and many values to Indigenous people and Indigenous peoples' knowledge of wetlands and waterways has been accumulated over millennia. Indigenous people have witnessed and documented significant changes to wetlands through time and have skilfully managed and protected wetlands with fire. The Firesticks Alliance is supporting Indigenous communities in the mentoring, sharing and study of Indigenous cultural fire knowledge to increase its application across the landscape and support healthy land and waters into the future.

Bradley Graves

Fire in floodplain wetlands

Fire plays an important role in floodplain wetlands, which respond dynamically to flooding, fire and geomorphological processes. A multifaceted approach is required to understand and interpret their fire history. Fire mapping and analysis of sediment and macro-charcoal from contemporary fluvial deposits were used to assess and interpret past fire regimes in the Macquarie Marshes. After accounting for fluvial macro-charcoal flux from upstream sources, local macro-charcoal in ~1 m deep sediment profiles accumulated over the last ~1.7 ka were highly variable and inconsistent between cores in two core wetlands (concentrations 0 to 438 no. cm-3, mean accumulation rates 0 to 3.86 no. cm-2 a-1). A positive correlation existed between the number of recent fires, satellite-observed ignition points, and macro-charcoal concentrations at the surface of the wetlands. Sedimentology, geochemistry, and carbon stable isotopes varied little with depth and were similar in both wetlands. Application of macro-charcoal and other environmental proxy techniques is inherently difficult in large, dynamic, and patchy wetland systems due to variations in charcoal sources, sediment and charcoal deposition rates, and the prevalence of taphonomic processes. Future palaeo-fire research could benefit wetland management if sufficient spatial and temporal analysis and assessment of fire, flood and other environmental conditions can be achieved.

Tim Ralph

A landscape approach to understanding wetlands and fires

Wetlands experience and cope with fire in different ways. Biophysical factors that influence the severity and extent of burning in wetlands include their position in the landscape, antecedent conditions (e.g. wet/dry), water source/s, geomorphic processes (e.g. erosion/sedimentation), vegetation types, and fuel loads. The former four factors usually contribute to the latter two factors, which, altogether, prime wetlands for future fire events. Examples from upland swamps in the Blue Mountains of NSW demonstrate the uneven distribution of fire impacts on wetlands after the severe and widespread bushfires of 2019/20. Some upland swamps burned completely and severely, others burned partly and mildly, while others did not burn at all. Floodplain wetlands such as the Macquarie Marshes in inland regions rarely burn completely and have patchy burn patterns at hotspots of fuel loading related to channel and inundation patterns. Isolated wetlands such as Dunphy Lake in the Warrumbungles burn occasionally but may be more resilient to fire impacts due their ephemeral inundation regimes, and inbuilt capacity to cope with extreme drought conditions. Management of wetlands for fire impacts could consider the landscape controls that characterise these systems, as well as their fire history, natural range of variability, propensity for change, and inherent resilience (or lack thereof) to extreme events. Ultimately, a landscape approach to understanding wetlands and their fire regimes can benefit both the assessment and management of fire impacts.

Philip Stewart

Wetland vegetation thickening on the Giant Sand Islands of Subtropical eastern Australia

Wire rush (Empodisma minus) is a key wetland and peat forming species in eastern Australia. Within subtropical eastern Australia it forms extensive coastal mires, with some areas developing distinctive wetland systems called patterned fens, which occur on K'Gari (Fraser Island), the Cooloola Sand Mass and Mulgumpin (Moreton Island). A key aspect of wire rush is that it is fire adapted with the ability to regenerate after the wetland has burnt. This presentation will discuss dramatic alterations in wetland structure at two wire rush mires, Moon Point (patterned fen), K'Gari and Jumping Grass (non-patterned fen), Minjerribah (North Stradbroke Island), which has occurred since European settlement. Combined palynological, charcoal and remote sensing analysis has indicated that the open wire rush mires have been invaded by arboreal taxa, particularly paperbark communities. This change appears to be driven by changes in fire regimes linked to European fire suppression. Projections of future alterations in wetland structure have been made at both sites and unless there is a change in fire management strategies a significant area of wire rush may be replaced by paperbark forest in the next 50 years.

Patrick Moss

From coast to uplands – A palaeoecological perspective of Tasmanian peatlands

As Australia wettest, most temperate and alpine state, Tasmania has a plethora of wetland environments and in particular large areas of peatlands, with buttongrass moorlands being the most iconic. This presentation will examine three key peatland sites that provide insight into environmental change over the Holocene period (last 10,000 years), as well as having direct implications for fire management. The first site is Lutregala Marsh, a salt marsh system, owned and managed by the Tasmanian Land Conservancy and located on Bruny Island, eastern Tasmania, provides a high-resolution record of sea level change and environmental alterations associated with European settlement of the island. The second site, Yellow Marsh is situated in the upland Surrey Hills regions, northern Tasmania and provides a 10,000-year record of peatland development and change, as well as insight into the surround region, particularly in terms of testing the Fire Stick Farming Hypothesis, which was partly developed from this area by the archaeologist Rhys Jones. The final site is located at Port Davey, southwest Tasmania and is ongoing research with the Tasmanian Wilderness World Heritage Area managers and is focussing on understanding the long-term development of these unique coastal wetland systems that are situated in this region. There is a focus on fire history at this site, particularly in terms of the role of Indigenous people influencing these sites and the surrounding landscape.

David Blake, Pierre Horwitz and Mary Boyce

Water quality impacts for fire impacted, organic rich wetlands on the Swan Coastal Plain, southwestern Australia

This presentation focuses on the water quality impacts of fires and fire management practises in organic rich wetlands on the Swan Coastal Plain, southwestern Australia and presents the finding of a study investigating pore- and groundwater responses and the implications of management practises in organic rich wetlands north of Joondalup.

Over the last decade the incidence of smouldering combustion events in organic-rich wetland sediments on the Swan Coastal Plain of southwestern Australia has increased in frequency and/or intensity and duration. The intimate link between wetland sediments and groundwater means that the combustion of wetland sediments has the capacity to influence water quality. This study investigated wetland water quality responses in wetlands with varying fire histories (recent to +5 years since fire). The results show that fire brought about a substantial increase in oxidation of sulfidic wetland sediments that resulted in the

generation of acidic porewaters and the concomitant mobilisation of metal species. The generated acidity was found to be episodic in nature, varying with seasonal fluctuations of groundwater and fire management practises. In the long-term, the magnitude and repeated incidence of such events and there management, could lead to the erosion of the acid buffering capacity of these wetlands.