

## Estuaries of Australia in 2050 and Beyond

Edited by: Professor Eric Wolanski, James Cook University, Townsville, QLD, Australia; In: 'Estuaries of the World', Series Editor: Jean-Paul Ducrotoy, Institute of Estuarine and Coastal Studies, University of Hull, Hull, UK.

I was asked to do a review of this book at very short notice and resisted the thought of taking on such a large piece of work (292 pages) and providing a coherent view within just a couple of days. However, having visited several of the estuarine systems discussed in the book as a tourist over the years, either as a walker of their shores or a day-trip boat user of their waters, and having worked on one of them as a visiting researcher, I could not resist the opportunity to look more closely at this new book by Professor Wolanski. So, I have taken myself east of Plymouth to the Bedford Hotel in Sidmouth, South Devon, overlooking a sunny, beautiful, Lyme Bay and its Jurassic Coast, where the only distraction is the environment itself, and have carefully read this new work from Australia. What I can tell you immediately is that I am absolutely glad that I did!

This nicely illustrated book is a wonderful mix of case studies, geographical descriptions, history, scientifically-based predictions, socio-economic anecdotes, and fundamental physical, biological, chemical and environmental science - and much more besides. It is written at a level where most readers, specialist scientists or not, will have no difficulty following the text and appreciating the arguments. As a summary of the historical, the current, and the anticipated status of Australian estuaries, on a level that can be appreciated by almost everybody, it is excellent. As expected, the 'physical' chapters are the most technical, but even there the mathematical descriptions are kept to an absolute minimum, or consigned to a short appendix, where they can be readily skipped over without loss of essential information by those less interested in mathematical details.

I will give you a few details about the work and its contents. This book: 'Estuaries of Australia in 2050 and Beyond', in the series: 'Estuaries of the World' addresses the question: Is Australia's growing human population and economy environmentally sustainable for its estuaries and coasts by 2050? It begins with an impressive Prologue by The Right Honourable Malcolm Fraser, AC CH, former Prime Minister of Australia, 1975–1983, and it is valuable to repeat a small part of his Prologue here:

*'This book offers science-based solutions to achieve ecologically sustainable development. It is a wake-up call that every Australian estuary faces present and future socio-economic and environmental problems with various scales. This book shows that we have much to learn by understanding the lessons from the past and from each other as they apply to the wide variety of Australian estuaries in order to ensure that future developments do not occur at the cost of the environment. To help achieve this outcome, this book demonstrates how to use science to balance the socio-economic imperatives with the ecological needs of the estuaries so that they can deliver the full range of ecosystem services – such as a high quality of life – that the population expects.'*

The first Chapter: 'Estuaries of Australia in 2050 and Beyond – A Synthesis' by Eric Wolanski and Jean-Paul Ducrotoy, sets the scene for Australian estuaries and their geographical settings and provides a brief a description of the book's contents,

but it is also more. In places it is moving, in particular its plea for greater efforts to ensure the ecological health of Australian estuaries for future generations, and in other places it motivates indignation, as in its section on ‘conflicts of interest’. The chapter summarises detailed studies of a number of important Australian estuaries and bays in order to answer the original question posed by the book. The case studies are divided into three classes based on human impact: (a), estuaries that experienced the full pressure of historical developments; (b), estuaries in the process of being degraded, and; (c), estuaries that still are relatively pristine. For (a), the chapters are concerned with the Sydney Estuary, the Coorong/Murray-Darling Estuary, Port Philip Bay and the Tamar Estuary, Tasmania; for (b), they are the Gold Coast Broadwater, the Hawkesbury Estuary, the Burdekin Flood Plains, Moreton Bay, the Ord River Estuary, Brisbane peri-urban estuaries, South Australia’s gulfs, Hervey Bay and Darwin Harbour; for (c), they are the Mary River Estuary and Flood Plains in the Northern Territory, and Deluge Inlet in Queensland.

I will give the chapter titles and their authorships, together with a very brief description of what I think are two or three of the key points that the authors have highlighted from their various contributions, in order to give you a flavour of their contents. Although my mode of presentation in what follows may be rather mundane and somewhat repetitive, i.e. – title – authors – two or three points: (a), (b), (c) - I can assure you that the individual contributions most certainly are not.

In Part 1 (estuaries that experienced the full pressure of historical developments), the first Chapter is: ‘Sydney Estuary, Australia: Geology, Anthropogenic Development and Hydrodynamic Processes/Attributes’ by Serena B. Lee and Gavin F. Birch; (a), in 2006 there was closure of the Sydney commercial fin fish and prawn industries due to high concentrations of dioxins detected in fish and prawn tissue; (b), storm water runoff represents the major contemporary source of estuary contamination; (c), these contaminants end-up in the estuary’s bed. The second Chapter is: ‘the Murray/Coorong Estuary: Meeting of the Waters?’ by Jochen Kämpf and Diane Bell; (a), the natural environment of the river has been severely degraded over the last 150 years through extensive water extraction used for irrigation and the construction of barrages; (b), modifications to the system have been so detrimental and far reaching that a return to natural conditions is an almost impossible task. The third Chapter is: ‘Port Phillip Bay’ by Joe Sampson, Alan Easton, and Manmohan Singh; (a), the population here could double by 2050, putting pollution and water-supply pressures on the environment; (b), global warming could cause regular flooding of bay-side areas. The final chapter in this section is: ‘Past, Present and Futures of the Tamar Estuary, Tasmania’ by Joanna C. Ellison and Matthew R. Sheehan; (a), the upper estuary channel was dredged from the late 1870s until the 1960s and during this period contamination increased due to organic and inorganic wastes from industrial, mining and domestic sources, as well as heavy metals from mining industries in the catchments, combined with high sediment yields; (b), there are significant threats to native species’ habitats from introduced-species in the estuary; (c), community preference is for an upper estuary that resembles its early twentieth century dredged state, rather than how it was first described 200 years ago.

In Part 2 (estuaries in the process of being degraded), the first chapter in this section is: ‘Gold Coast Broadwater: Southern Moreton Bay, Southeast Queensland (Australia)’, by Ryan J.K. Dunn, Nathan J. Waltham, Nathan P. Benfer, Brian A. King, Charles J. Lemckert, and Sasha Zigic; (a), the Broadwater has important biodiversity values that have led to areas of it being listed as an international Ramsar site; (b), it provides a vital function in the provision of feeding, spawning and nursery

sites for recreationally and commercially important finfish species; (c), protection requires a reduction of pollutant loads from urban and agricultural storm-water runoff, golf courses and industrial infrastructure/areas. The second chapter is: 'Hydrodynamics and Sediment Transport in a Macro-tidal Estuary: Darwin Harbour, Australia' by F.P. Andutta, X.H. Wang, Li Li, and David Williams; (a), transport of sediment was estimated for the dry season, when river discharge was negligible, and numerical simulations also were made; (b), mangrove areas may trap fine sediments for long periods, which will have important consequences if these sediments carry pollutants. The third chapter is: 'The Ord River Estuary: A Regulated Wet-Dry Tropical River System' by Barbara J. Robson, Peter C. Gehrke, Michele A. Burford, Ian T. Webster, Andy T. Revill, and Duncan W. Palmer; (a), the lower Ord River is a wet-dry tropical river that is one of the few heavily regulated rivers in Australia's tropical north, providing water for hydroelectric production and irrigation; (b), plans involve an increase in the area of irrigated land surrounding the lower Ord River and its estuary. The fourth chapter is: 'South Australia's Large Inverse Estuaries: On the Road to Ruin' by Jochen Kämpf; (a), the biggest threat to ecologic health of South Australian gulfs is the planned massive industrialization of the Upper Spencer Gulf region; (b), a number of seawater desalination plants are proposed for the region, the biggest immediate environmental hazard of desalination brine discharges being the development of deoxygenated dead zones. The fifth chapter is: 'Turbulent Mixing and Sediment Processes in Peri-Urban Estuaries in South-East Queensland (Australia)' by Hubert Chanson, Badin Gibbes, and Richard J. Brown; (a), small peri-urban estuaries may provide a useful indicator of potential changes that may occur in larger systems with growing urbanisation; (b), there is potential for some smaller peri-urban estuaries to be used as 'natural laboratories' to gain information on estuarine processes. The sixth chapter is: 'Hervey Bay and Its Estuaries' by Joachim Ribbe; (a), this is a large, low inflow and predominantly hypersaline system in which a continuing trend towards drier and warmer conditions may lead to an intensification of hypersaline and possible inverse circulation states of the Bay; (b), physical processes associated with climatic trends and variability are likely to impact more dramatically on the natural environment of the region than direct human activities. The seventh chapter is: 'Moreton Bay and Its Estuaries: A Sub-tropical System Under Pressure from Rapid Population Growth' by Badin Gibbes, Alistair Grinham, David Neil, Andrew Olds, Paul Maxwell, Rod Connolly, Tony Weber, Nicola Udy, and James Udy; (a), the decline in ecosystem health within the Bay and its estuaries is significant and management responses have been implemented to reverse this; (b), whether the current rate of change is too rapid for the system to satisfactorily adapt cannot be determined currently. The eighth chapter is: 'Water Resource Development and High Value Coastal Wetlands on the Lower Burdekin Floodplain, Australia' by Aaron M. Davis, Stephen E. Lewis, Dominique S. O'Brien, Zoë T. Bainbridge, Christie Bentley, Jochen F. Mueller, and Jon E. Brodie; (a), this combines northern Australia's largest and most intensively developed agricultural floodplain with one of the largest concentrations of high value freshwater, estuarine and marine wetlands in Australia; (b), the establishment of water resource schemes to support this extensive irrigated agriculture threaten the integrity of the downstream receiving wetlands. The final chapter in this section is: 'The Hawkesbury Estuary from 1950 to 2050' by Peter Collis; (a), eutrophication is a feature of the Hawkesbury-Nepean River estuary that drains Sydney's western suburbs; (b), the river system has been degraded with occasional outbreaks of floating flowering plants (macrophytes) in the upper Nepean and blue/green algae at the saltwater-freshwater interface, and 'red tides' of toxic

diatoms near the mouth of the estuary; (c), ongoing urbanization and the wet-weather inflow of degraded storm water results in sediments, nutrients and many other contaminants reaching the estuary.

In Part 3 (estuaries that are still relatively pristine), the first chapter is: 'Deluge Inlet, a Pristine Small Tropical Estuary in North-Eastern Australia' by Marcus Sheaves, Ka'tya G. Abrantes, and Ross Johnston; (a), the inlet is protected by National Parks, World Heritage and Wild Rivers legislation; (b), its habitats and rich biodiversity make it an important nursery for many species; (c), current threats are from increasing fishing and boating pressures, and effective governance will be needed to ensure continuation of its near pristine condition. The second and final chapter in this section is: 'Recent, Rapid Evolution of the Lower Mary River Estuary and Flood Plains' by David Williams; (a), the coast has receded during the last 50 years and the estuary's channels have expanded and become deeper and wider and tributary channels have grown, invading previous freshwater environments; (b), by 2050 the Lower Mary River Estuary may have grown to become similar to neighbouring estuaries of the Northern Territory.

Although what I have tried to do above is give you an idea about the general contents of the various chapters, the authors, editor and series editor go to great lengths to ensure that the focus of these studies remains on the original question. In addition, the editors provide summaries of the state of the environment and the management strategy for a number of other estuaries and coastal waters. They provide a valuable synthesis of multidisciplinary scientific knowledge to suggest what Australian estuaries may look like in 2050 based on socio-economic decisions that are made now, and the changes that are needed to ensure sustainability. They do suggest that tentative answers to the original question: 'Is Australia's growing human population and economy environmentally sustainable for its estuaries and coasts by 2050?' based on the socio-economic decisions made now, may be (1), possibly 'yes' in large cities as long as the population is pro-active in demanding a high quality of life, which implies healthy waterways, and (2), 'probably not' in rural and remote areas and especially so in the tropics. But they hope that this pessimistic prediction turns out to be incorrect and point out that Australia has a number of eminent estuarine scientists to help propose and guide future strategies.

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