

# Inventory and Assessment of Australian Estuaries

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**Australian Government**  

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**Fisheries Research and  
Development Corporation**

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**OBJECTIVES:**

- Determine, using readily available data where possible, the state of ecological health of Australia's estuaries
- Bring together in an accessible and comparable format across Australia, readily available data on estuarine health, diversity, impacts and management practices
- Develop and apply models that describe the processes driving particular estuary types and providing a specification for the nature of data to be collected on each estuary type
- Identify management regimes required for estuary types, assess current management and recommend improved management
- Develop a series of monitoring and assessment activities protocols that will result in high quality information on the health of Australian estuaries, informs and evaluates management, and identifies research and development priorities
- Assist in the establishment of an Australia wide network of researchers, managers and policy makers that facilitates a greater understanding of estuarine natural resources

**NON TECHNICAL SUMMARY:**

Australia has over 970 estuaries nationally. The project, jointly supported by the National Land and Water Resources Audit and Fisheries Research and Development Corporation coordinated an assessment of these estuaries based on their current condition and the processes that drive the way they function. Generic models were developed as part of the project to assess the effectiveness of various management options for the different types of estuaries. An on-line searchable database (OzEstuaries) is available, along with the final Audit report 'Australian Catchment, River and Estuary Assessment 2002'.

A 278 page, photographically rich non-technical book titled *Where river meets sea: Exploring Australia's estuaries* was produced, based on the information in the estuary assessment. 1500 copies were printed. The book is being marketed by CSIRO and is available through retail outlets.

Feedback to date suggests it has been well received and is suitable for (and reaching) the intended audience.

## **OUTCOMES ACHIEVED TO DATE:**

There were two major outputs of this project. The outcomes produced to date from those products include:

1. National Land and Water Resources Audit Report
  - A classification of 979 Australian estuaries by the extent to which River, Wave and Tidal energy dominate the processes that drive estuary function and an outline of the implications for estuary management.
  - An assessment of the condition and use of Australian estuaries within a pressure-state-response framework.
  - Engagement of state and territory agencies and key community groups in assessing the health of their estuaries and the establishment of a framework to incorporate additional information on-line.
  - An increase in the awareness of estuaries, their processes and function, condition and management needs.
  - Contributions to an information base to support estuary management through the development of the Oz Estuaries database, the Australian Natural Resources Atlas and the Simple Estuarine Response Model (SERM).
2. Where River Meets Sea
  - Over 800 copies of the book have sold
  - Valuable networks have been forged
  - The profile of estuaries as an important ecosystem has been raised both through the presence of the book in the general market-place and through the contribution it has made to outcomes such as the short-listing of the National Estuary Package for a 2004 Eureka Prize
  - The book has penetrated into the environmental management sector as indicated by a review in the high profile environmental management periodical Waste Management and Environment.

**KEYWORDS:** *Estuaries, audit, ecosystem, management, river, environment*

## Background

The need to consolidate existing information on Australian estuaries has been recognised. Of the more than 700 Australian estuaries, less than 50 estuaries have been extensively studied and most of these studies have been undertaken on impacted estuaries and very little on pristine and ecologically healthy systems. What is needed for Australian estuaries is an easy to understand inventory and categorisation based on the key driving processes that determine change from natural to modified systems. This will provide a framework to identify management requirements, prioritise management effort and define monitoring and assessment activities and structure data collection and presentation.

## Need

Most of the impacts on estuaries result from the land use pattern of their contributing catchments. Understanding the trend and condition of Australia's estuaries will do much to provide a report card of the aggregate impact of our land use activities across catchments on the natural environment as well as providing a framework for more strategic estuary management.

Estuaries are the subject of systemic failure – for example, the estuary based oyster industry in NSW and southern Queensland has reduced in value in the last 3 years from \$50M to \$30M – most of which is related to impacts of land use.

Estuaries are key landscapes for recreational use and commercial use, with many fish and prawn species using estuaries for nursery and sometimes maturation phases of their lifecycles. Estuaries are greatly impacted upon by our growing population – with predictions that the next 5M people in Australia will virtually all live around estuaries.

Given the widespread nature of the problem, there is a need to take a national overview of the state of estuaries and identify mechanisms for restoring their health.

## Objectives

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## Methods

A project team was convened consisting of:

Ms Lynne Turner (Coastal CRC) – the principle investigator for the Australian Estuary Assessment

Associate Professor Bill Dennison (Marine Botany Unit, The University of Queensland) – mentor, advisor

Dr Dieter Tracey (Coastal CRC) – researcher, author and illustrator of the book “Where river meets sea”.

This team was later joined by:

Dr Jan Tilden (Coastal CRC) – further writing, editing, illustration, design, layout and production of the book

Dr David Scheltinga (Coastal CRC) – illustrations and completing sections of the book

There were eight core components/projects of the estuary initiative:

1. An initial classification
2. Integration and assessment
3. Estuary health assessment – sediment
4. Estuary health assessment – flora
5. Estuary health assessment – fauna
6. Estuary health assessment – physico-chemistry
7. Communication and adoption
8. Database development

Proposed procedure for developing management recommendations

- Apply numerical models to assess the effectiveness of management actions on a selected set of estuaries
- Based on conceptual and numerical model evaluations, in conjunction with management agencies, recommend management actions for different Estuary Types taking current management activities into account
- Prioritise management and monitoring efforts in estuaries

Management recommendations will be pitched at a policy level. This will be done by types of estuary and not individual estuaries. The development of these recommendations will be undertaken with cooperation of key government agencies.

### *Chapter 1: What is an estuary?*

- introduces the concept of an estuary and briefly outlines the history of the relationships between estuaries and people in Australia
- defines and describes different types of coastal waterways to be included under the heading of “estuary”
- introduces a process-based classification of estuaries, whereby the physical shape of the estuary, as well as the resulting estuarine environments, depend on the relative strengths of three forces – wave, tide and river
- briefly considers the management implications of this process-based classification

### *Chapter 2: Australian estuaries*

This chapter is a tour of the Australian coast, travelling clockwise from northern New South Wales, wherein:

- features and similarities of estuaries in each region are described both in text and diagrammatically
- regional threats to estuarine environments and regional management arrangements are examined
- conceptual diagrams summarise the key features of estuaries in each region.
- the size of catchment populations and the condition of estuaries in each region are summarised graphically

### *Chapter 3: Estuary Habitats*

The following habitats are described:

- seagrass
- mangroves
- salt marsh
- Melaleuca swamps
- open waters
- muddy and sandy basins
- coastal floodplains
- intertidal mudflats
- coral
- sandy shoals and beaches
- rocky shores and reefs

For each of these habitat types, the extent, typical species and species distributions around the continent are examined.

### *Chapter 4: Estuaries and People*

This chapter looks at ecosystem values, threats to estuaries, how we are addressing these threats and the importance of integrated management. In a “box” section called “Caring for estuaries” nine estuary users from around Australia are introduced. These people are recreational, commercial and indigenous users of estuaries and conservationists. All are aware of the importance of conserving estuaries and all are actively involved in doing so.

### *Chapter 5: Assessing estuary health*

This chapter describes methods for assessing and monitoring estuaries and the audit process. It also explains why the audit is important.

### *Chapters 6 –12: Estuaries of [State]*

Estuaries are examined State by State. The states are divided into regions with each region described in turn. For some regions there are case studies illustrated with conceptual diagrams.

### *Chapter 13: Looking back – moving forward*

Includes nine international case studies giving key lessons about how *not* to manage estuaries. Suggests ways to move forward with estuary management in Australia in order to build on our strengths and avoid disasters such as those highlighted in the first section of the chapter.

### *Chapter 14: Estuary resources*

Lists resources for those wanting to know more about estuaries or get involved in estuary conservation and management.

Based on this outline, the information from the Estuary Assessment was recast in a reader-friendly style. Those who had managed the estuary

assessment at a state level contributed to the chapters about their respective states.

Conceptual diagrams were produced for chapters two and three, to illustrate typical estuaries in each region and habitat types, respectively. Case studies from various regions were also illustrated with conceptual diagrams.

Geoscience Australia provided conceptual models of different types of estuaries. Other illustrations were sourced from the estuary assessment or produced in-house.

At this point a designer joined the team. The brief was to produce a book using the developed material (i.e. text and illustrations). The book was to be suitable for the general public. "National Geographic" look and feel was specified which was interpreted as heavy in illustrative content with lots of big photos set "full bleed" (i.e. right to the edges of the page) and with some information in separate boxes clearly delineated by changes of colour and style.

Designs were produced and circulated for approval.

The next major production phase involved sourcing over 300 photographs included in the book. More than 60 photographic sources were acknowledged, however this underestimates the number of contributors as many of those acknowledged were government agencies. Most of the photographs were provided free of charge.

The book layout was completed in-house. The chosen design included many self-contained sections with repeating patterns in the contents. This tightly constrained copy placement, as sections had to fit within allotted spaces and could not be allowed to run over pages. This, along with the necessity to edit to a style suitable for the general reading public, made editing a major project phase. This initial heavy editing was also done in house, as was the first round of proof reading.

Later stages such as final editing, final proof reading, indexing and printing were outsourced. 1500 copies of the book were printed. These are now being distributed by the Coastal CRC and marketed for commercial sale by CSIRO Publishing (on the advice of FRDC). Income from sales is being split among CSIRO, the Coastal CRC and FRDC.

## Results/Discussion

The assessment of estuaries identified that land use impacts are compromising the ecological, economic and social values of Australian Estuaries.

The assessment compiled readily available data and used qualitative and quantitative methods within a 'pressure, state, response' assessment framework. The assessment provides detail on the condition of Australian estuaries including:

- amount of modification from the pristine state;
- drivers of change;
- susceptibility to further change; and



- key management needs

Estuarine geomorphic data were mapped and compiled to classify estuaries in terms of the dominant processes governing their form and function. Detailed site-specific data were collected from a selection of estuaries around Australia and used to develop the Simple Estuarine Response Model. This internet-based decision support tool models the behaviour of estuaries identifying likely consequences of particular management activities.

Of the 979 estuaries and coastal waterways assessed:

- 50% are in *near pristine* condition;
- 22% are in *largely unmodified* condition;
- 19% are in *modified* condition;
- 9% are in *extensively modified* condition.

The key management challenges facing estuarine managers include:

- establishing and maintaining protective management for near-pristine estuaries;
- working to achieve estuarine management targets within catchment management planning processes;
- implementing a clear delineation of institutional and lead agency responsibilities for estuarine management at a State and national level;
- developing an Australia-wide, estuarine-specific policy and management initiative that builds on the strong industry and community commitment for improved estuarine management; and
- continuing to provide information, training and support to assist local government planning and estuarine management staff.

The book “Where river meets sea: Exploring Australia’s estuaries” meets the design criteria of being well-illustrated with a strong photographic emphasis while still containing plenty of information about Australia’s estuaries. The information is useful at several levels, adding to the book’s educational value.

For the general public, interested in the coastal natural history and coastal recreation, the book contains a good basic overview of the science of estuaries and also emphasises the diversity of scenery and recreational opportunities offered around the Australian coast. This is particularly brought out in the State by State guide to estuaries.

For the educational market, there is plenty of readily accessible scientific information about how estuaries work as natural environments and how to manage them well.

For estuary managers and commercial users, there is an introduction to science underpinning good management, a summary of threats to estuaries and useful information about the estuary assessment process and why it is important.

The resource section gives all sectors access to other sources of useful estuary information such as the OzEstuaries database, the National

Estuaries Network and the State agencies responsible for estuary management.

“Where river meets sea: Exploring Australia’s estuaries” has been well received. All comments to date have been positive and the book has sold over 800 copies since the launch in July 2004.

The National Estuaries Package, consisting of the OzEstuaries database, the book and the National Estuaries Network, was short-listed for the Sherman Eureka prize for Environmental Research (2004) and won the Coastal CRC “Excellence in Science” Award for 2004.

While the indications are all positive as regards the quality of the product and its suitability in meeting the objectives set out earlier, one less positive aspect of the project has been the cost of production. A print run of 1500 was chosen in consultation with CSIRO publishing and based on the CRC’s past experience with sales of books on related topics. The book was deliberately priced at the low end of the recommended range to make it as available as possible to the intended market. At this price, and in this quantity, there is no possibility of breaking even on a book with so many photographs and illustrations and requiring so much editing to fit the chosen format and be suitable for the proposed market.

The book is a hybrid, in that it is full of information but verges on being a coffee-table book in terms of the quality of illustration. We believe that sacrificing either aspect would have made the book considerably less successful in meeting its objectives. Commercial viability has been sacrificed instead. Time could have been saved by sourcing photographs from commercial photo-libraries but that would have raised the cost, negating any benefit.

## Benefits

For reasons just discussed, the book is a public-good exercise whose *major* benefit will be measured by the degree to which it meets its educational objectives.

Other possible benefits are:

- the book will serve as a publicity tool for those organisations involved in producing it
- many useful networks were formed during the production process
- WRMS was a cooperative effort involving many participants. About 70 general acknowledgements are made, including those who worked on the estuary assessment upon which the book was based. This is in addition to well over 60 photographic contributors most of whom are estuary stakeholders of one type or another. The completion of a cooperative project with such a high-quality product strengthens links between stakeholders and encourages further cooperation
- the book serves as a case-study for further projects which lend themselves to this type of treatment. Other ways of disseminating a body of information on a poorly publicised but important topic (say benthic habitats) could be compared with the book format. This would require some formal evaluation of the effectiveness of the current project in reaching and inspiring the intended market.

## Further development

The Coastal CRC funded an additional 2 year extension project to develop and deliver a series of tool kits including an improved OzEstuaries database with links to the Simple Estuarine Response Model (SERM); spatial, biological, biogeochemical and geomorphological indicators) and an assessment of them, for state and territory agencies and other custodians to effectively manage and monitor Australian estuaries and coastal waterways and their condition.

The project also engaged state and territory contacts to form a network of national estuary managers to ensure interdisciplinary research outcomes were linked to stakeholder requirements to enhance the management, monitoring and awareness of Australian estuaries. The National Estuaries Network remains an active and interested discussion and coordination body.

The National Land and Water Resources Audit MkII was at the planning/scoping stage at the time of writing. It does not appear likely to have funding for another extensive estuaries assessment.

As discussed above, one way of adding value to the estuary book produced by this project would be to evaluate its effectiveness in meeting the stated objectives.

## Planned outcomes

Estuaries across Australia are a key common property resource. This project proposed to focus on establishing protection, management and remedial works priorities to ensure these public resources were sustainably managed in the widest public interest. Market and non market benefits were substantial and were to be estimated as the project proceeded. All planned outcomes were realised.

## References

National Land and Water Resources Audit (2002) Australian Catchment, River and Estuary Assessment 2002. Commonwealth of Australia: ACT.

Collins, R. (2004) Loving our estuaries to death. *Waste Management and Environment Magazine* 15(8): 58.

Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, S. Naeem, K. Limburg, J. Paruelo, R.V. O'Neill, R. Raskin, P. Sutton and dM. Van den Belt (1997) The value of the world's ecosystem services and natural capital. *Nature* 387: 253-260.