A CLASSIFICATION FRAMEWORK FOR MAPPING ECOSYSTEM SERVICES IN THE PEEL-HARVEY ESTUARY: FROM MODEL TO MANAGER

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Introduction

The science, definitions and classifications of ecosystem services (ES) evolved in recent decades. While the proposed conceptual frameworks contributed to our understanding of the Ecosystem Approach, their application remains limited by the availability of reliable data and practical methods, which are necessary for computing and mapping ES, and how these evolve over time. For example, the Valued Nature Network (VNN) Framework (Figure1) highlights the strong link between ecosystem attributes and human well-being, through classifying the biophysical and biogeochemical characteristics of an ecosystem. However, new approaches are needed to quantify how the basic ecological attributes translate into goods and benefits that are meaningful for estuary managers.

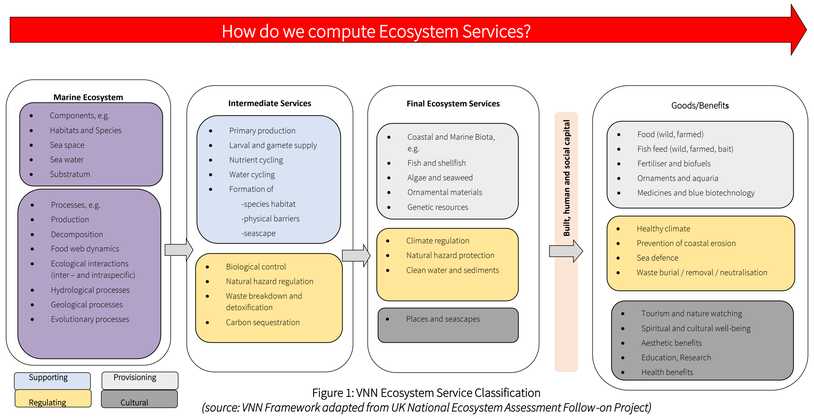


Figure 1: VNN Ecosystem Service Classification
(source: VNN Framework adapted from UK National Ecosystem Assessment Follow-on Project)

Project Aim and Objectives

We aim to :

- Quantify estuarine ecosystem services through computing attributes of ecosystem components and processes from an estuary ecosystem model; and
- Develop summary indices for decision makers, informed by stakeholder values.

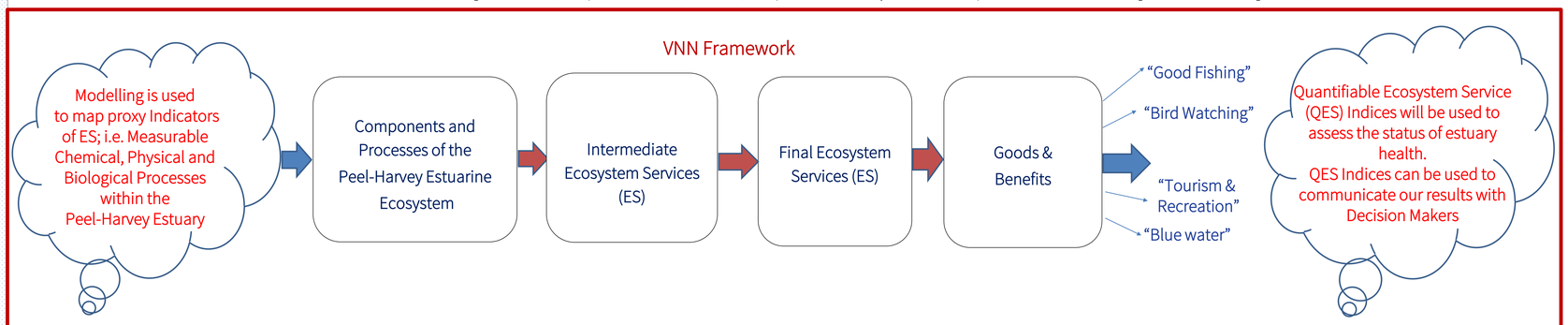
In order to achieve this, we integrate an aquatic ecosystem model with an ecosystem services assessment based on the VNN Framework. This enables us to compute proxy indicators which relate to an identified set of ecosystem services. The VNN Framework is used to identify and classify the ecosystem components and processes, and the intermediate and final ES that link to specific societal goods and benefits. A demonstration of the Peel-Harvey estuarine system is used to illustrate the research methodology.

The Peel-Harvey Estuary: A Coupled Human-Natural System

The Peel-Harvey is an ideal case-study for deepening our understanding of holistic (human-natural) system response to stress and the drivers of health. It is the largest estuary in Western Australia and a Ramsar-listed wetland whereby key wildlife communities and natural habitats exist. Between the 1960s and 1980s, hyper-eutrophication resulted in severe ecological impacts on the system, including extensive algal blooms and fish kills. To remediate the adverse impacts, a major engineering intervention in the form of a major entrance channel, known as the Dawesville Cut, took part in 1994. Despite this major rehabilitation work, ecological evidence show pronounced decline in aspects of estuarine health from pre-cut periods (mid-1980s) to post-cut periods (mid-2000s) (Wildsmith et al. 2009). Thus, the Peel-Harvey Estuary also provides a globally iconic case of severe decline through hyper-eutrophication. The local community highly value both the natural and socio-economic benefits. Currently there are no mechanisms for quantifying those benefits

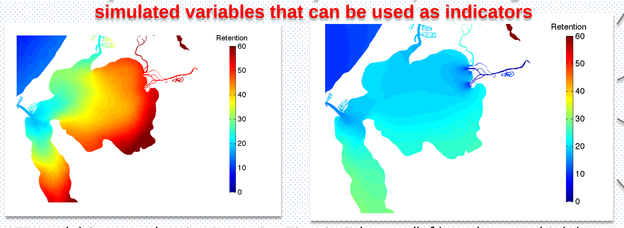
The Peel-Harvey Framework

1. Understand how ecological system functions link directly or indirectly to human activities;
2. Identify four Goods and Benefits which are valued by the Peel-Harvey community. These are: Fisheries, Tourism and Recreation, Bird Watching, and Water Quality;
3. Identify the physical and chemical components that relate to the goods and benefits, and the interactions among biotic and abiotic processes of the various ecosystem components;
4. Develop a list of algorithms which reflect the tolerance levels of the measurable attributes of ecosystem components and processes;
5. Process-based Modelling (TUFLOW-FV - AED2 Model) was tailored specifically for the Peel-Harvey Estuary through utilizing historical empirical data. Any missing data was replaced by "virtual estuarine data" which the model could create; and
6. The AED Model was used to test the algorithms identified in step 4, and will be used (in the future) to map the evolution of ecosystem services over space and time under various management and climate change scenarios



Mapping Proxy Indicators of Estuarine Ecosystem Services from Aquatic Ecosystem Models

The Aquatic Ecodynamic Model (AED) will be used to quantify proxy Indicators of Ecosystem Services. These are measurable attributes which can be used to assess the environmental conditions of the estuary. Retention time is only one example of a long list of simulated variables that can be used as indicators



AED Model Outputs showing Retention Time in February (left), and August (right). The model clearly shows how the estuary experiences longer retention times in summer months as opposed to winter months, due to less incoming flows from the rivers as well as less marine exchange with the ocean. This proxy indicator reflects Estuary-Ocean Connection and is linked to larval inputs and likelihood of population success. It will enable us to quantify the Final Ecosystem Service of Estuarine Biota. Estuarine Biota is an ES which results in the community's Good/Benefit of Fish Catch.

The utilised approach will improve science communication through translating model predictions to attributes that are consistent with people's views thus allowing managers to communicate future scenarios and management options

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