Major estuarine types in Tasmania: implications for management strategies

Estuaries are highly productive but complex systems with significant ecological and economic value. They receive freshwater and associated organic and inorganic matter including nutrients from in-flowing rivers, as well as saltwater and nutrients from the ocean and run-off, often including waste waters from towns and industries, from the direct estuarine catchment. The health of an estuary depends largely on the flushing time of freshwater through it. Flushing time is determined by a combination of estuary hydrodynamics, tidal range and the rate of freshwater input. Using data from past and current surveys of estuarine health around Tasmania, we are examining the effects of land-based activities such as increased nutrient input (eutrophication) and sediment loads on estuarine condition. Our indicators are a subset of the recently developed national indicator set and include pressure, system and value (ecological). We've divided Tasmanian estuaries into three categories: estuaries with high flushing rates due to high rainfall and tidal ranges (on the north coast); estuaries with long residence times (low flushing) on the drier east coast; and estuaries that are intermittently closed by sand bars. We have developed conceptual models of the effects of nutrient and sediment loads on these estuary types and assessed the sensitivity of a series of response variables, including water quality, phytoplankton, zooplankton and benthic invertebrate community structure, at a range of temporal scales (days to decades, through studies of sediment cores) and spatial scales (metres to kilometres). This study will provide the first detailed framework that can be used by estuarine and other environmental managers to interpret environmental data from Tasmanian estuaries. As a result of this study managers will be able to understand why particular estuaries are more sensitive to terrestrial inputs than others. For example, east coast Tasmanian estuaries that are intermittently closed (i.e. there is irregular connection to the marine environment) are far more susceptible to the negative consequences of eutrophication such as algal blooms, low dissolved oxygen concentration and fish kills than the tidally-dominated, well-flushed systems of the north coast. From data collected in the study we are setting baseline conditions and developing preliminary trigger values and threshold levels for indicators in both types of estuaries. Furthermore, the project will provide predictive information about the likely effects of proposed land-use changes on water quality and the ecology of Tasmanian estuaries.

Relevant publications

Beard J, Crawford C and Hirst A (2008) *Developing a monitoring program for six key estuaries in north-west Tasmania*. <http://eprints.utas.edu.au/8223/>.

Hirst AJ, Kilpatrick R, Guest MA, Probst T and Crawford CM (2007) Determining the ecological health of estuaries in NW Tasmania: A case study assessing the status of the Duck, Montagu, Detention and Black River estuaries. <http://eprints.utas.edu.au/5847/>.

Murphy RJ, Crawford CM and Barmuta LA (2003) Estuarine health in Tasmania, status and *indicators: water quality*. <http://eprints.utas.edu.au/6649/>.

Temby N and Crawford CM (2008) *A framework for coastal and estuarine resource condition assessment: Sharing resources and knowledge for better management*. <http://eprints.utas.edu.au/8222/>.

Dr John Gibson

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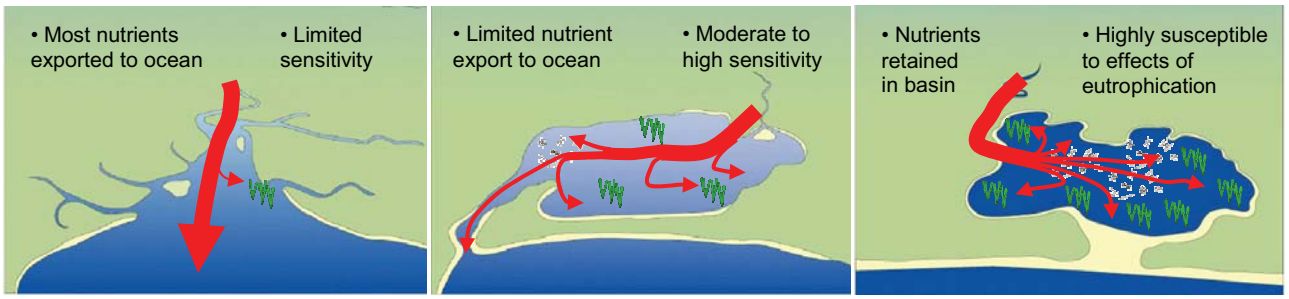
Day 2, 11.55pm

Area of work: Water quality

Specialty: Environmental chemistry, nutrient dynamics and carbon cycling.

Take-home messages:

- Understanding the sensitivities and tolerances of estuaries requires knowledge of the flushing rate, which is dependent on hydrodynamics, freshwater inflow and tidal exchange; the magnitude of external inputs from the drainage basin and the ocean; and role of internal processes such as sedimentation and photosynthesis.
- With this information we have classified Tasmanian estuaries into three groups based on sensitivity to landscape practices and are developing monitoring and management strategies for each.



Well-flushed estuary **Poorly-flushed estuary** **Open/Closed estuary**

Major estuarine types in Tasmania: implications for management strategies

John Gibson, Jeff Ross, Christine Crawford, Stephen McGowan, Jason Beard

TAFI, University of Tasmania
AMC, University of Tasmania

Why are estuaries important?

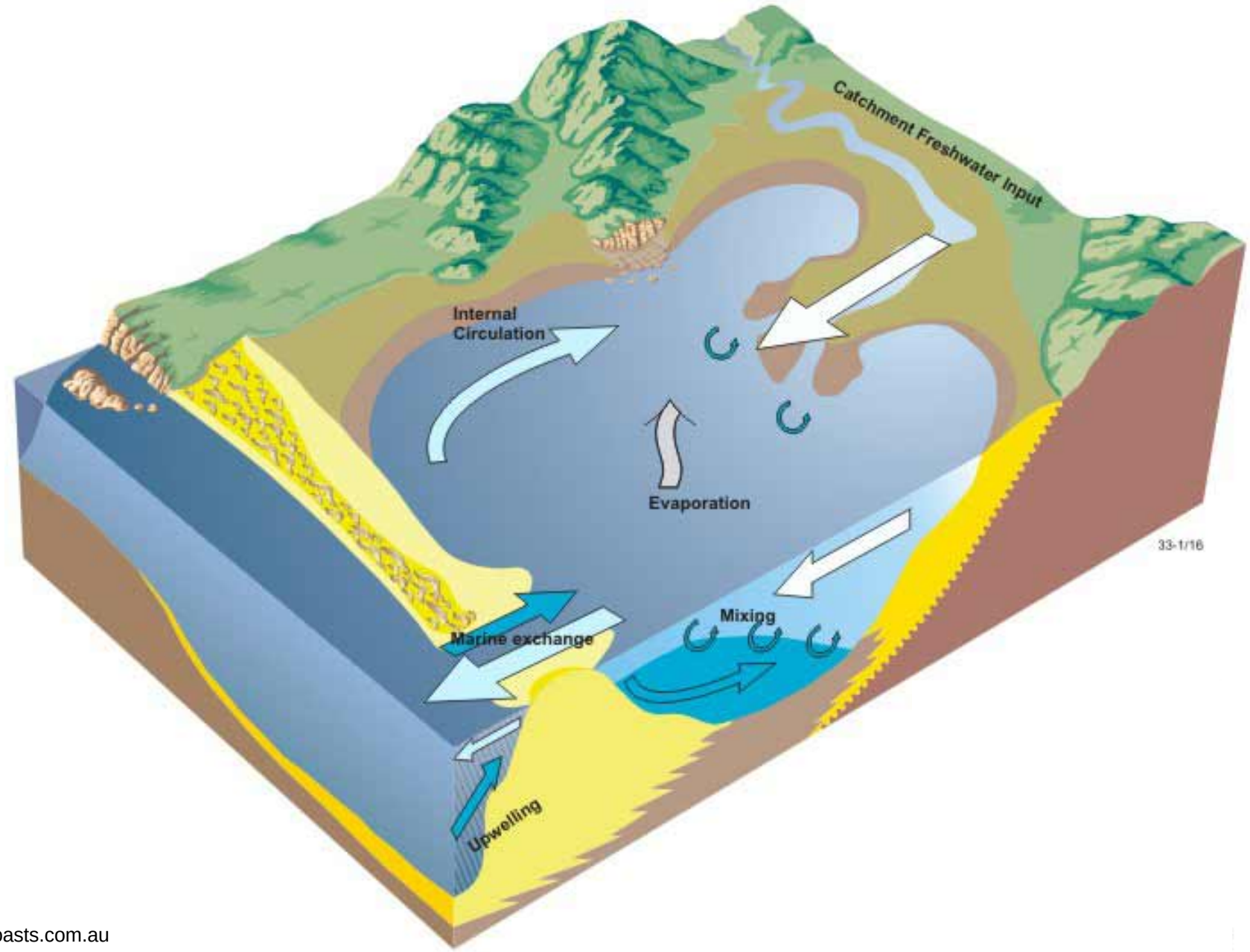
Estuaries are the critical transition zone between fresh and marine waters

- Highly productive ecosystems
- Site of major human habitation
- Estuary-based industries
- Contain ecological communities adapted to changing salinity

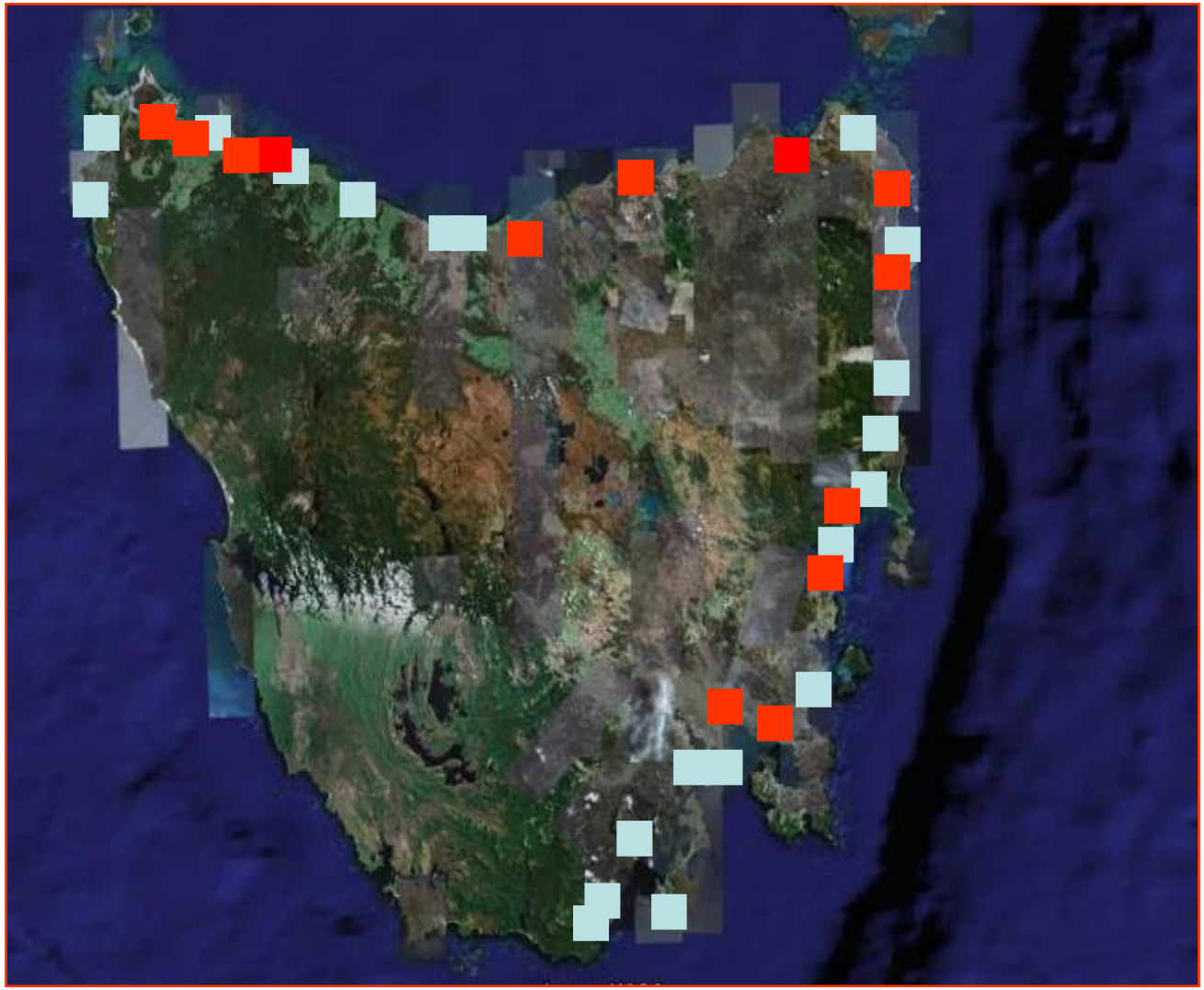
Stressors and pressures on estuaries

- Increased input of nutrients and sediments through poor landscape management practices in the catchment
- Direct input of industrial waste, urban stormwater and sewage effluent
- Alterations to the estuary itself that change hydrodynamics, biology and chemistry

Estuaries – complex systems



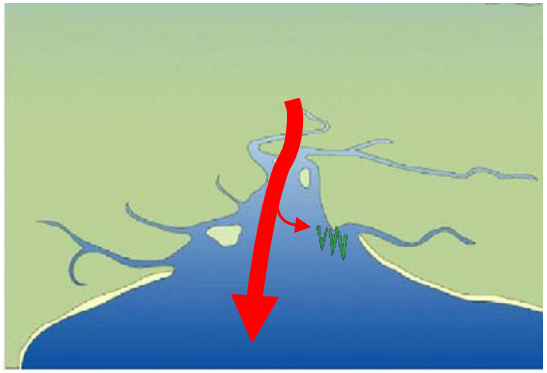
Understanding the resource condition of Tasmanian estuaries



Historical data

Landscape Logic

Separating estuaries into classes based on flushing time

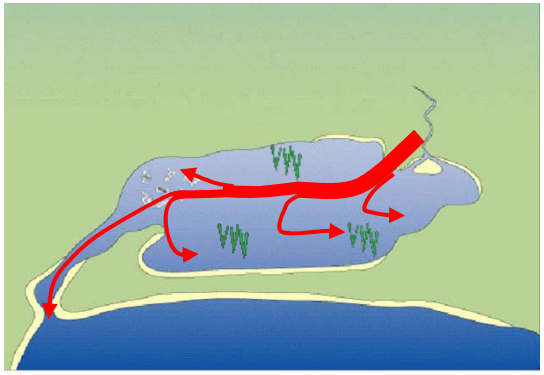


Well-flushed

High tidal range

High rainfall

Open mouth

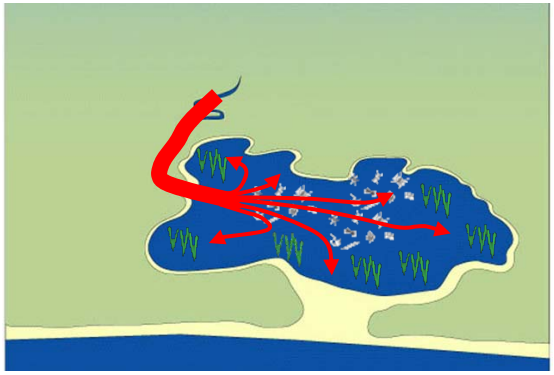


Poorly-flushed

Low tidal range

Low rainfall

Restricted mouth



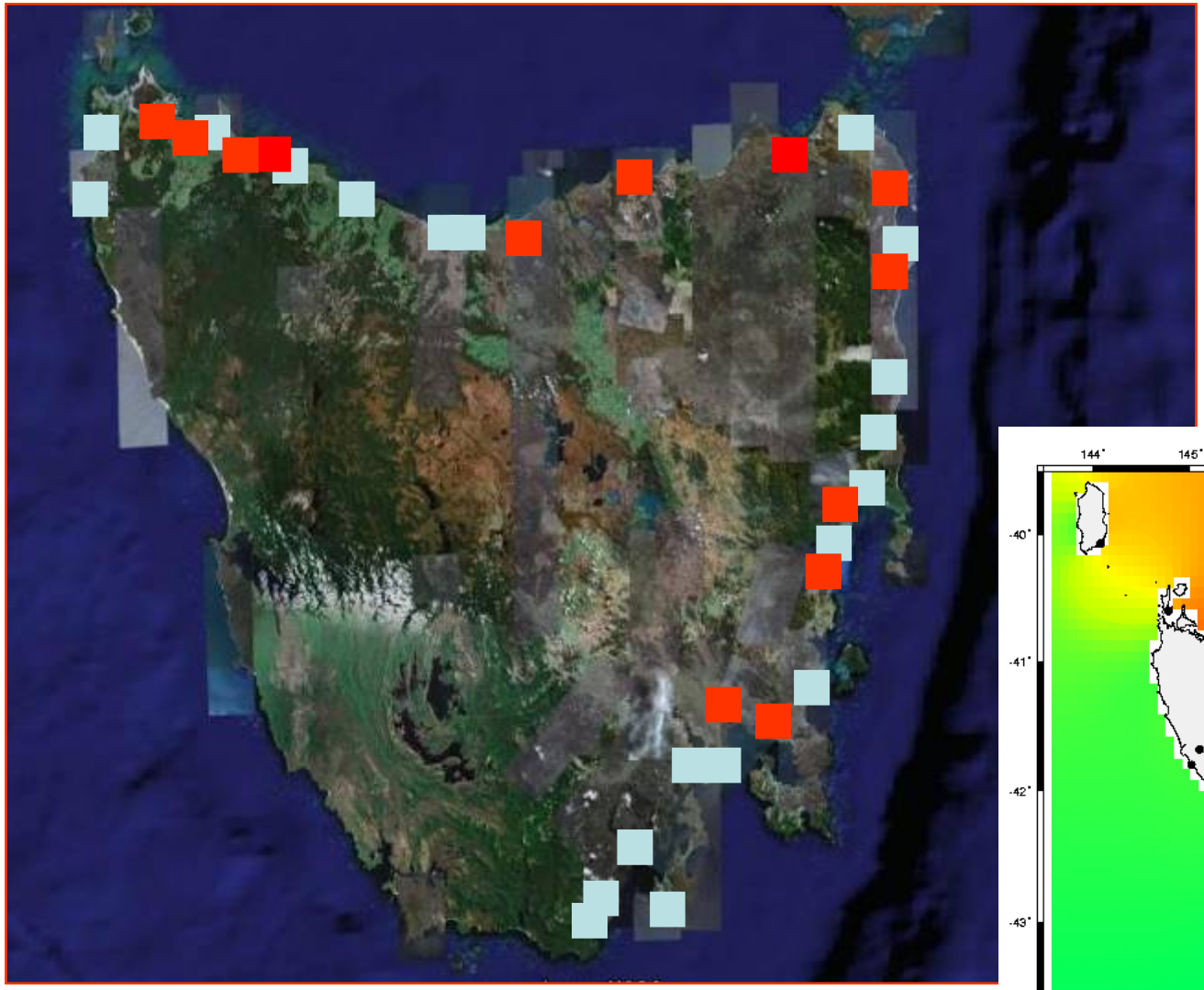
Open/Closed

No/low tides

Low rainfall

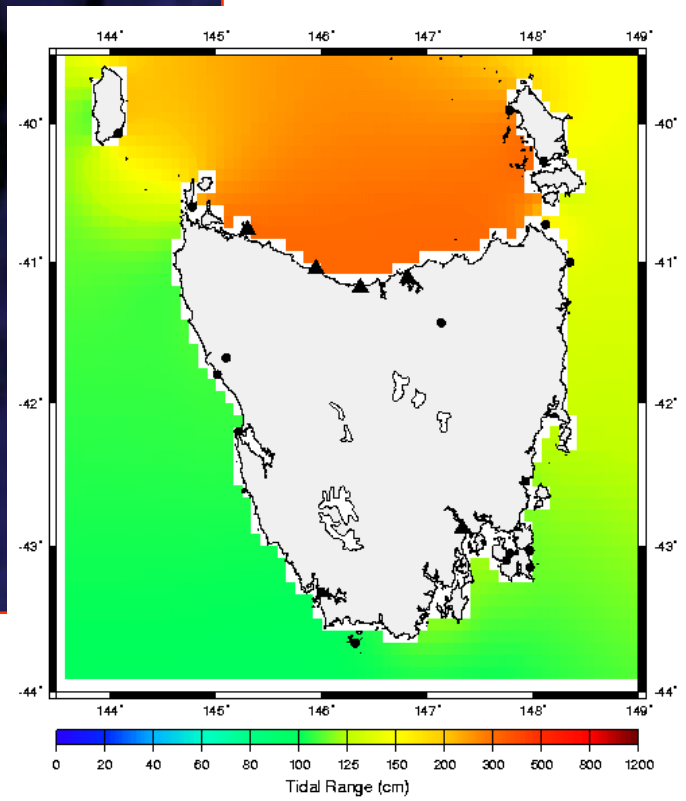
Closed mouth
/restricted mouth

Understanding the resource condition of Tasmanian estuaries

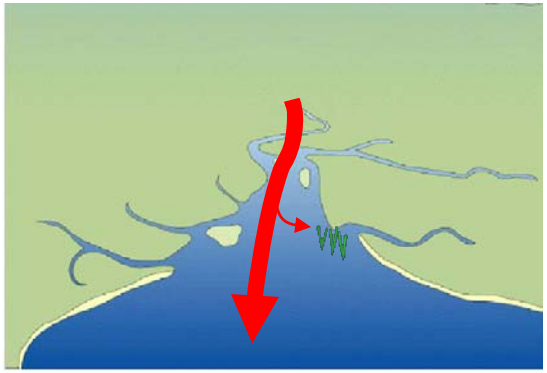


Historical data

Landscape Logic



Separating estuaries into classes based on flushing time

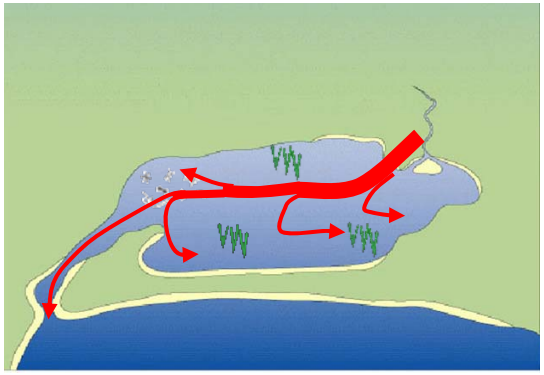


Well-flushed

High tidal range

High rainfall

Open mouth

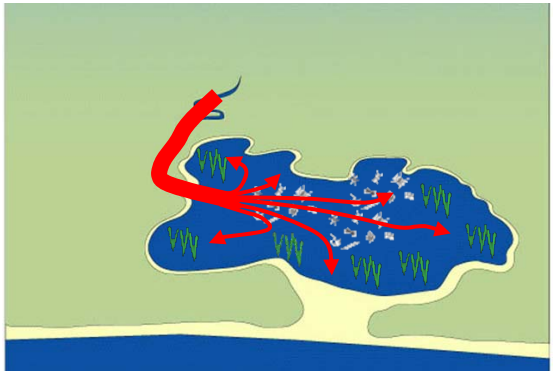


Poorly-flushed

Low tidal range

Low rainfall

Restricted mouth



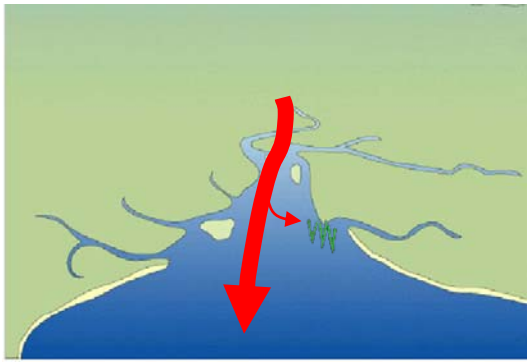
Open/Closed

No/low tides

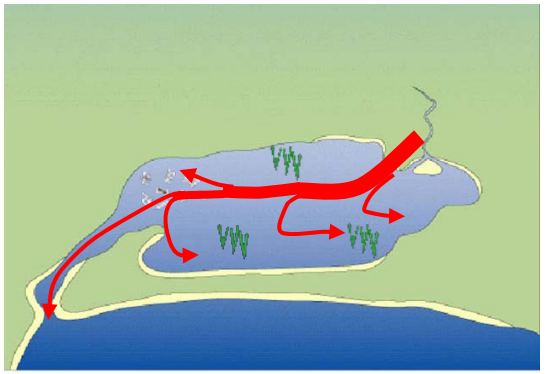
Low rainfall

Closed mouth
/restricted mouth

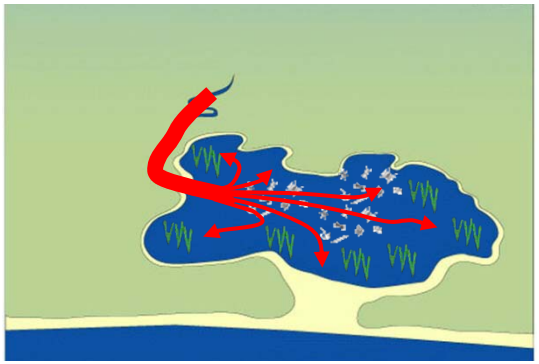
Estuary classes respond differently to inputs:



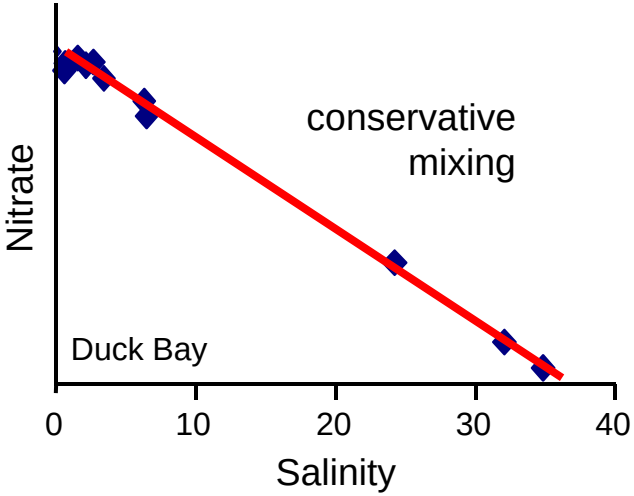
Well-flushed estuary

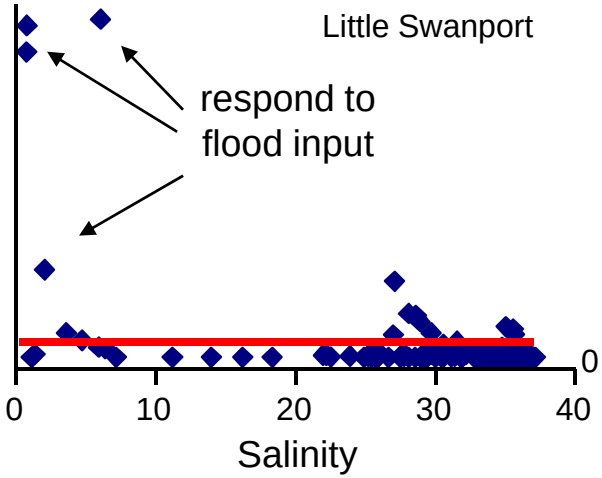


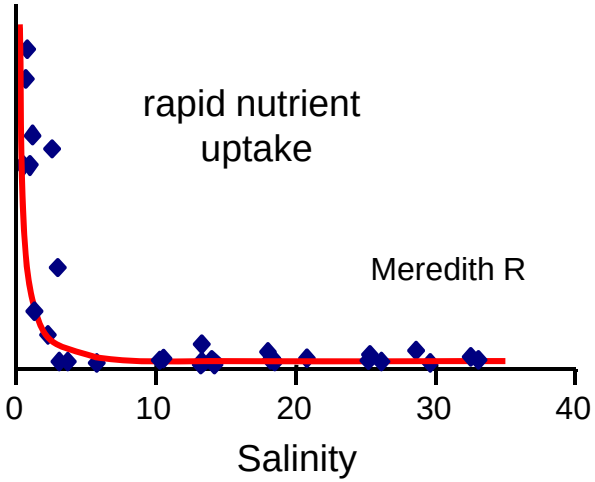
Poorly-flushed estuary



Open/Closed estuary

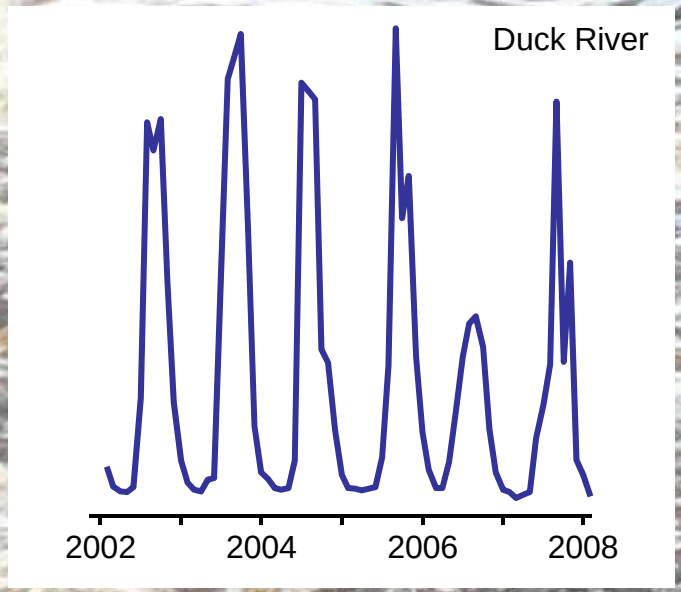


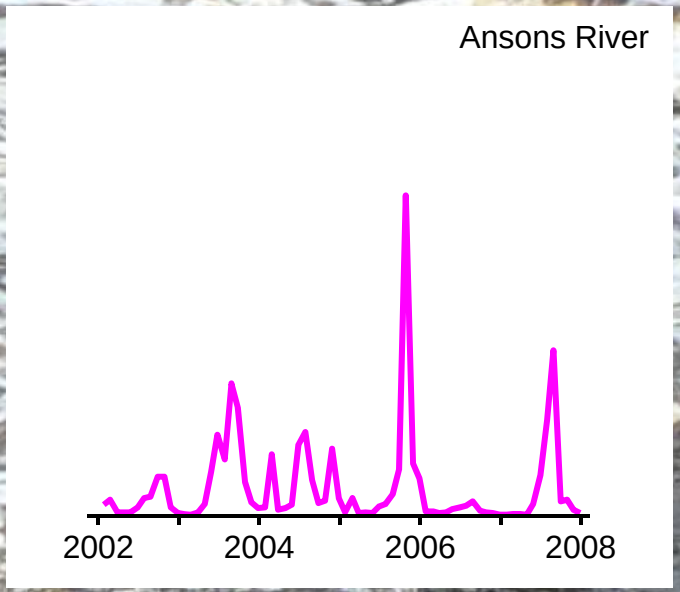




Eutrophication potential

Estuarine States: terrestrial inputs can be regular or irregular

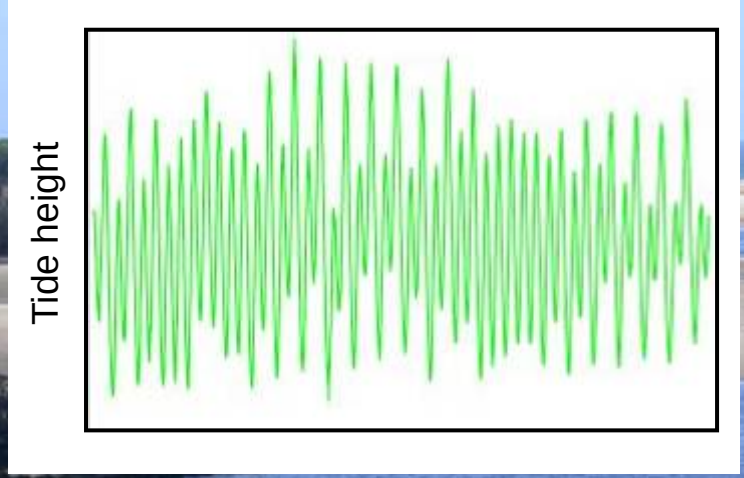




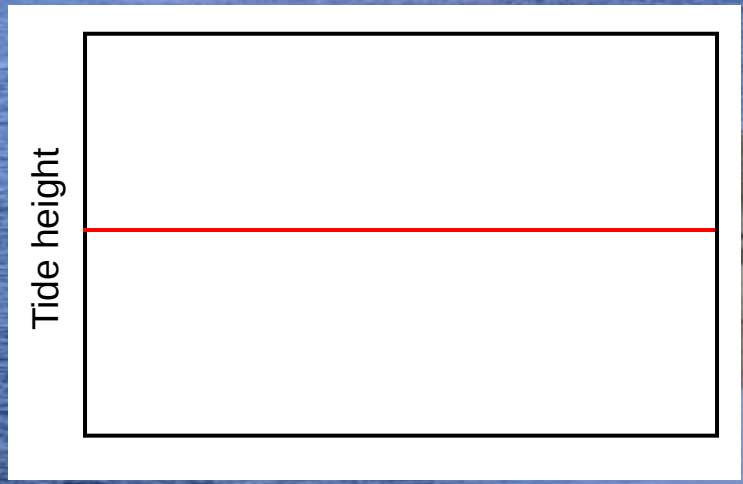
Regular, seasonal

Irregular, any season

States of Open/Closed Estuaries

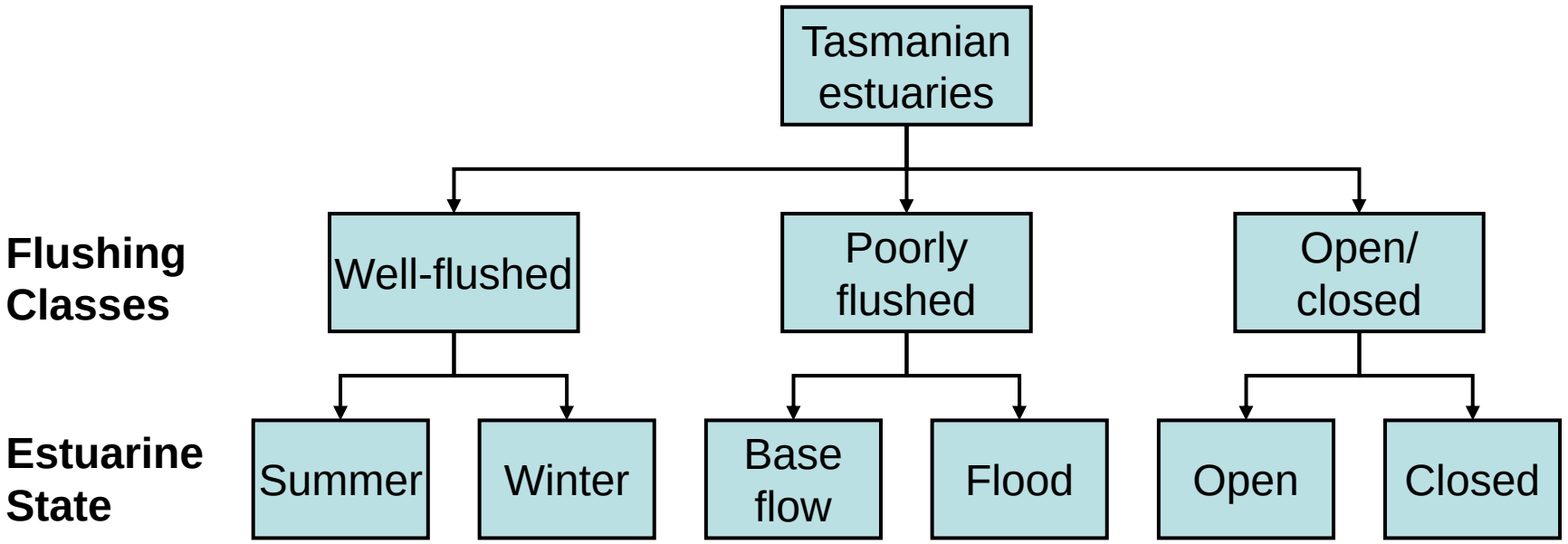


Open – tidal exchange



Closed – no tidal exchange

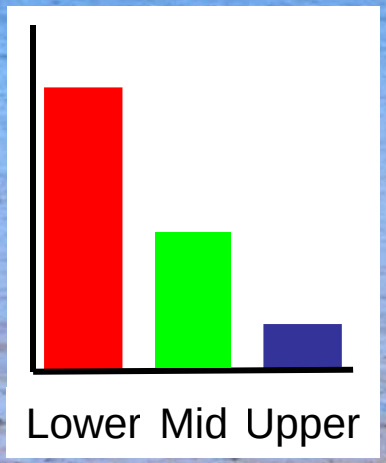
Dealing with estuarine complexity



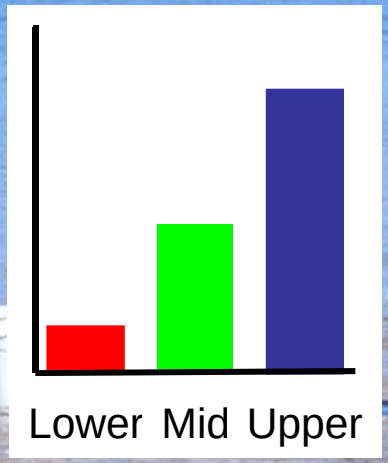
Location within estuary

Marked spatial variability occurs within estuaries

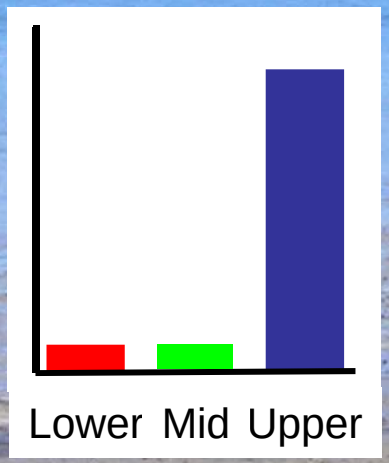
Percentage Sand



Percentage Organic Carbon

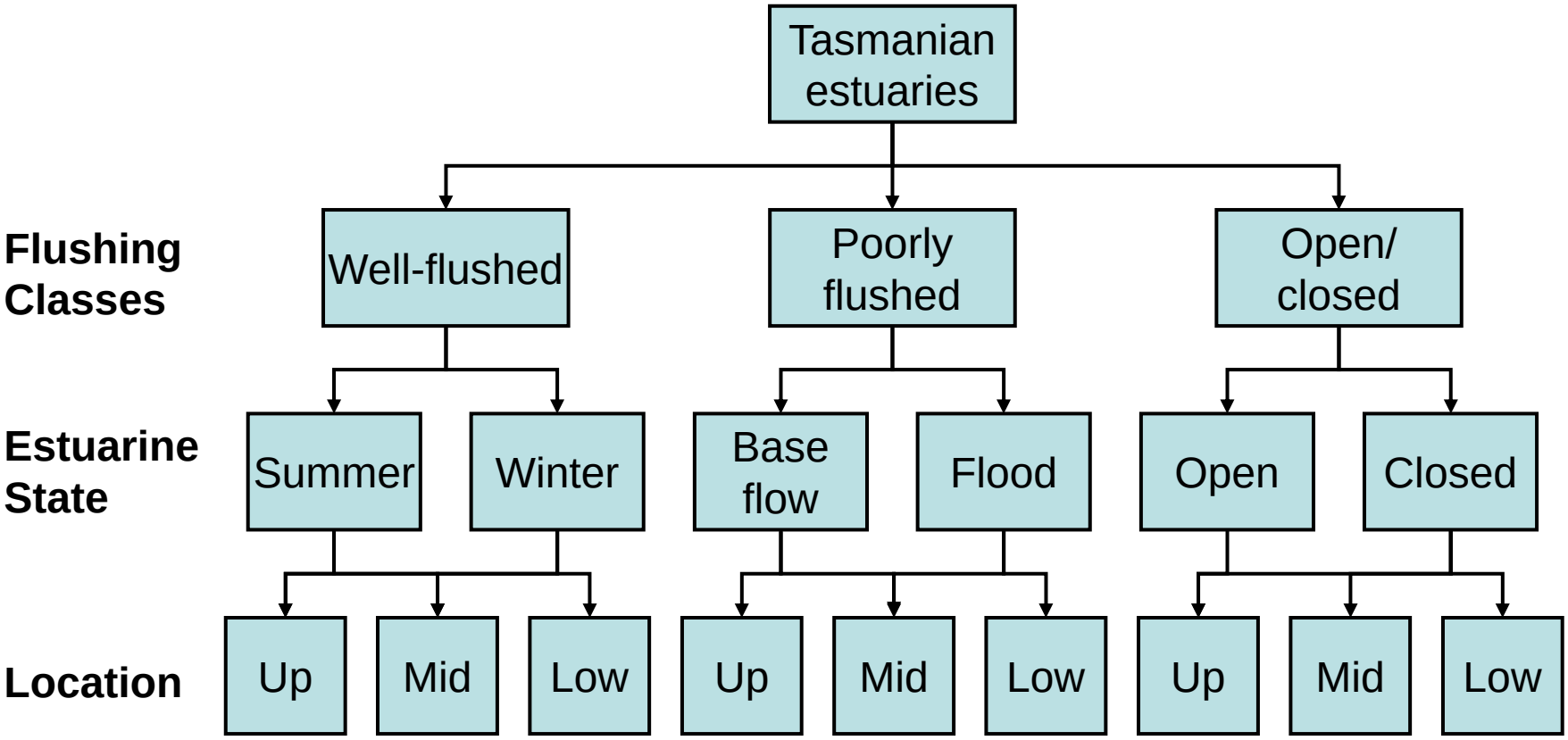


Scoloplos normalis Abundance



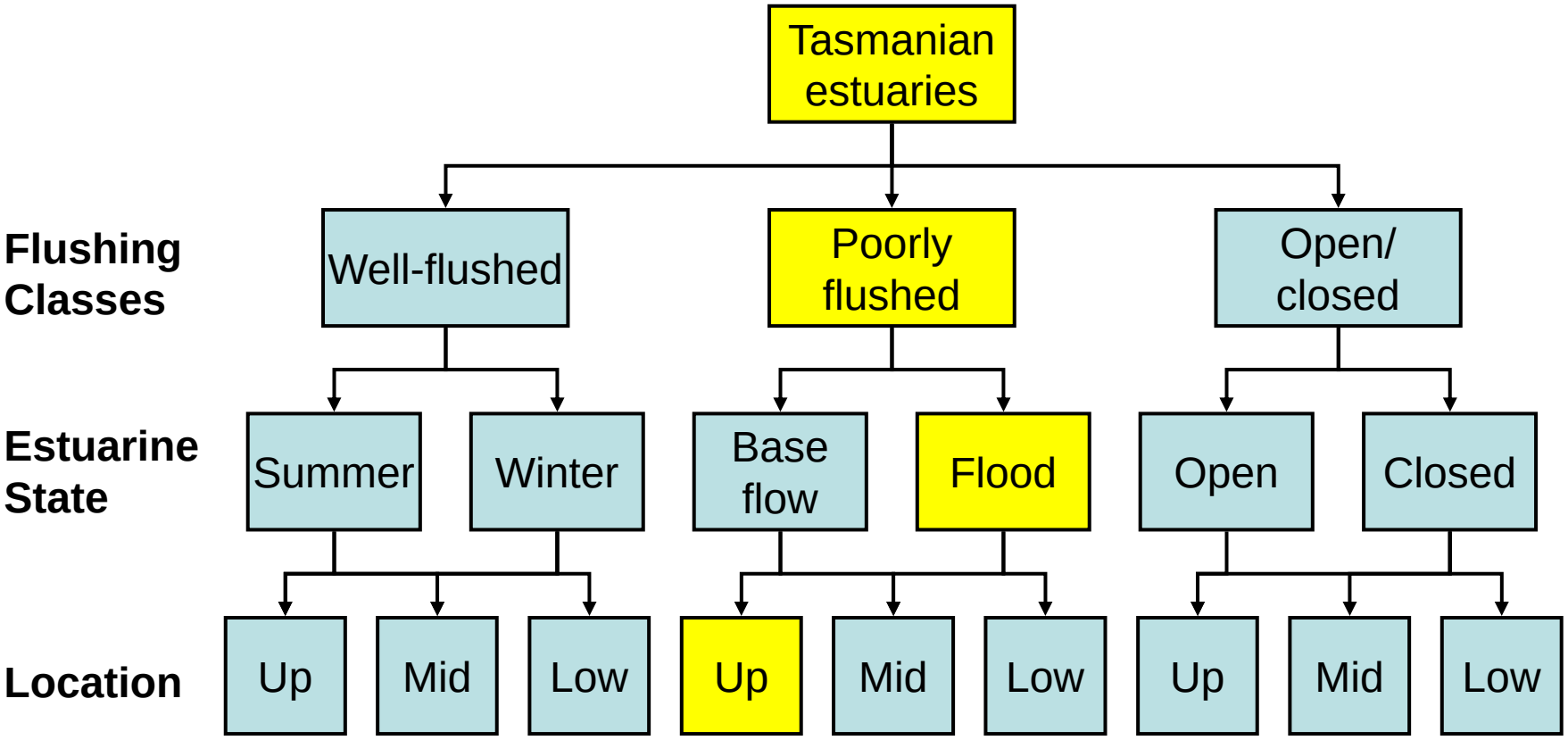
Hirst et al. 2007

Dealing with estuarine complexity



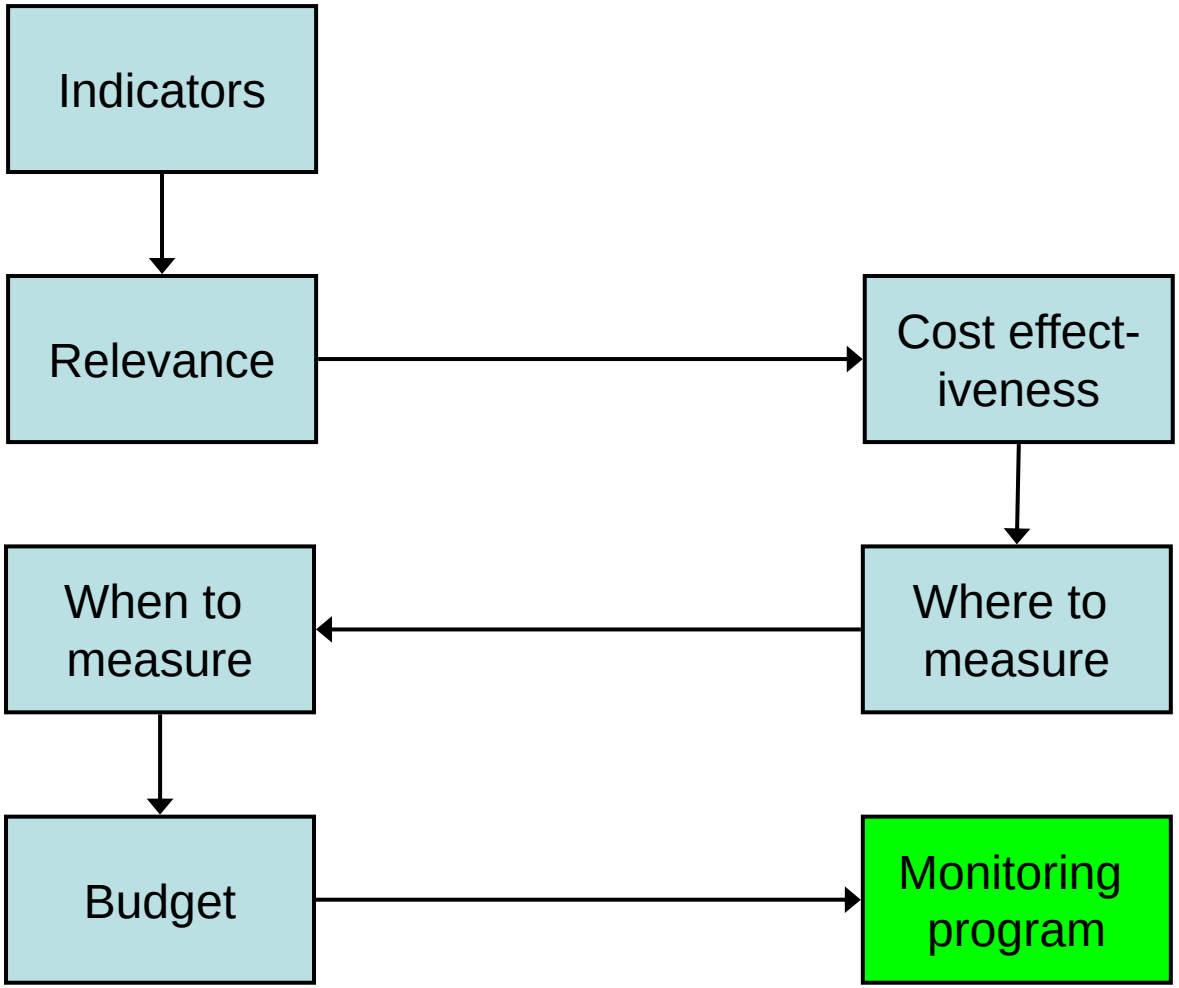
Providing a simple structure to complexity to assist management

Estuarine complexity



Providing a simple structure to complexity to assist management

Monitoring programs (1) – Design phase



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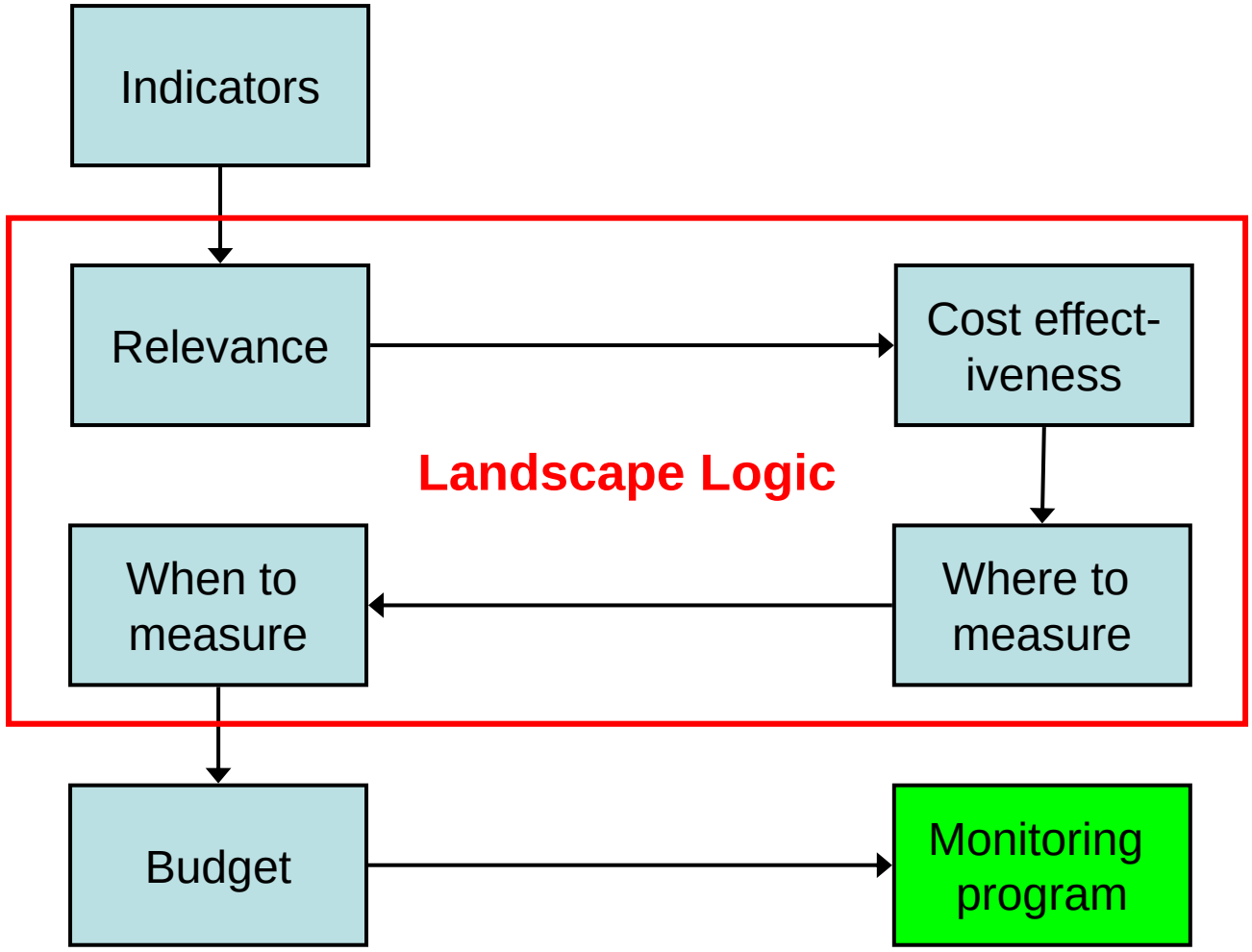
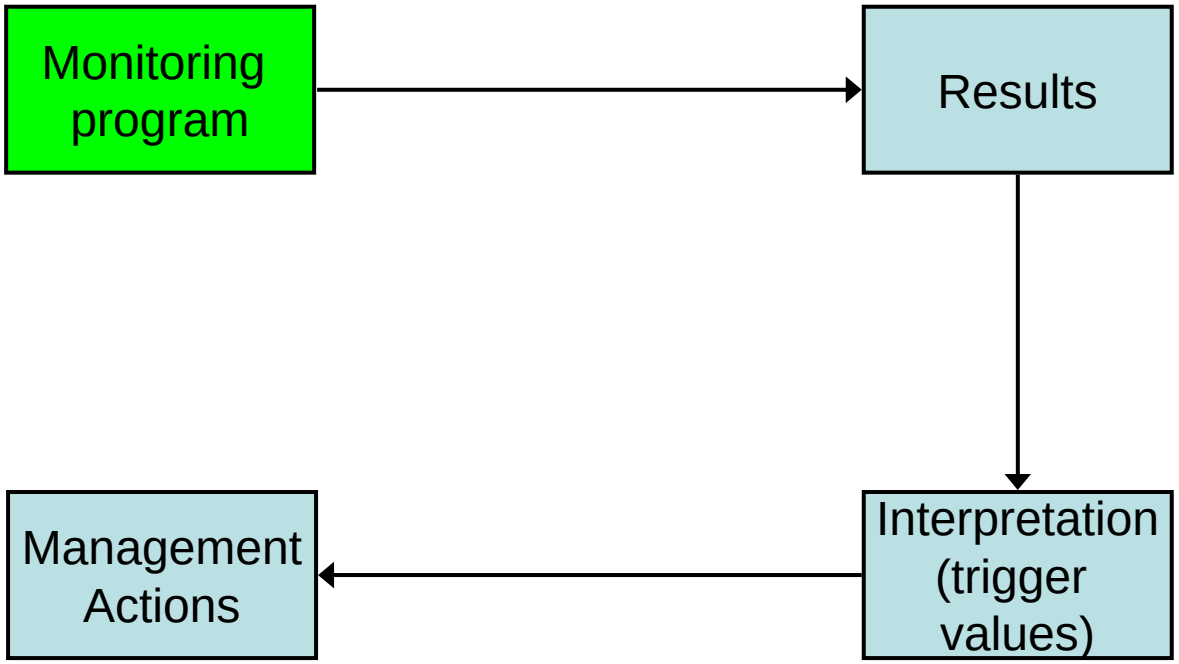


Monitoring programs (2) – Interpreting the results



Monitoring programs (2) – Interpreting the results