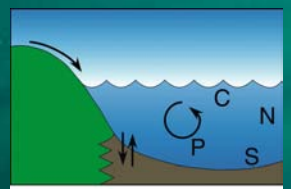
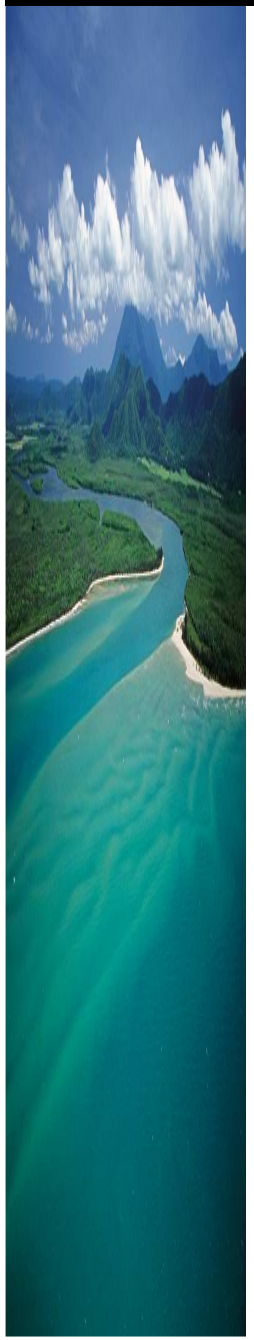
Overview of Centre for Coastal Biogeochemistry

Bradley Eyre
Centre for Coastal Biogeochemistry
Southern Cross University



Southern Cross University

About us

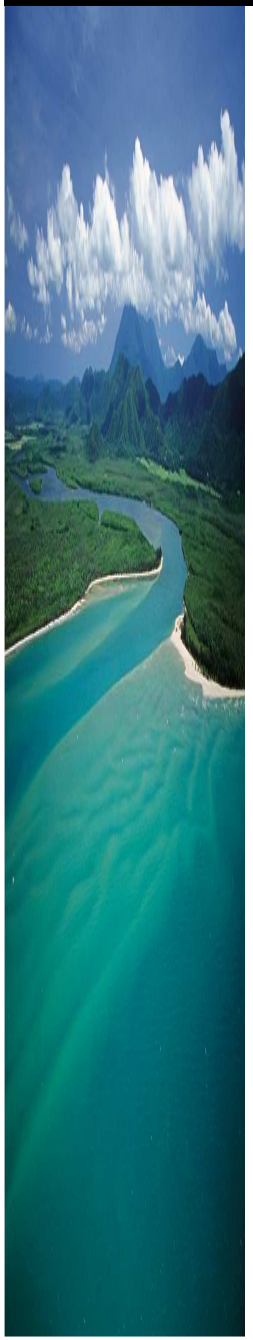


”

WHAT WE DO

CCBR undertakes high quality and innovative research that contributes to the understanding of global biogeochemical cycles and associated improved management of coastal systems impacted by global change (e.g. changes in the nitrogen cycle, climate changes, ocean acidification, land use changes).

People 2011



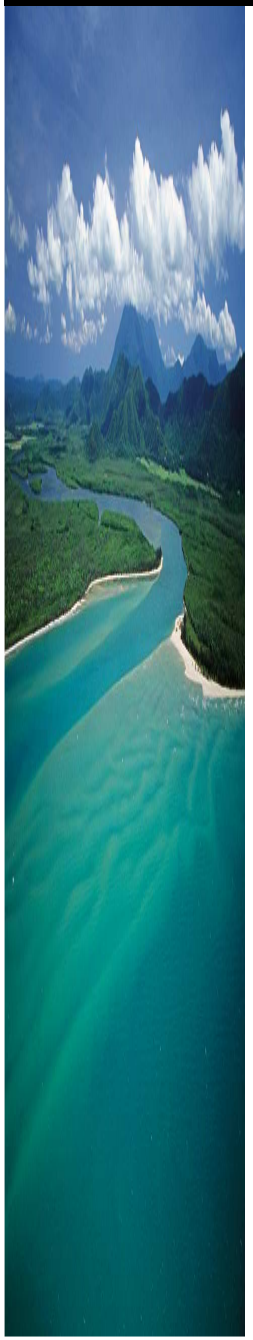
Research Staff

Prof. Bradley Eyre	Director
Dr. Isaac Santos	Senior Research Fellow
Dr. Symon Dworjanyn	Senior Research Fellow
Dr. Joanne Oakes	Research Fellow
Dr. Dirk Erler	Research Fellow
Dr. Damien Maher	Research Fellow

Technical Staff

Dr. Matheus Carvalho	IRMS Technician/ Research Fellow
Mr. Iain Alexander	Laboratory Manager
Mr. Max Johnstone	Laboratory Technician
Ms. Mellisa Gibbs	Laboratory Technician

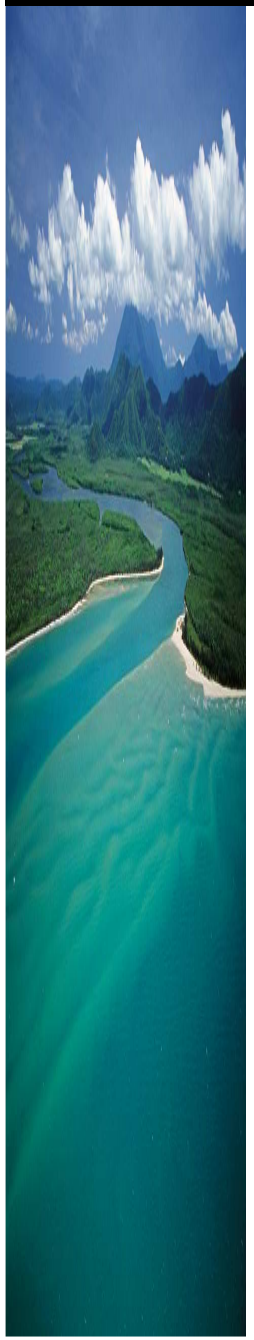
Research Collaborators - current projects/ 2010 papers



Utrecht University, Netherlands
Netherlands Institute of Ecology (*NIOO*-KNAW)
University of Southern Denmark, Denmark
Helmholtz-Centre for Environmental Research, Germany
Florida State University, USA
Coastal Carolina University, USA
University of Waikato, New Zealand
Univesidade Federal Fluminense, Brazil
Santa Catarina Federal University, Brazil
Ceara Federal Institute for Education, Science and Technology, Brazil
Pernambuco Federal University, Brazil
Porto University, Portugal
Patagonia National University, Argentina
Centro de Investigaciones Biologicas de Noroeste, Mexico

University of Queensland
University of Tasmania
University of Western Australia
Melbourne University
Monash University
James Cook University
Griffith University
AIMS
Tasmanian Aquaculture and Fisheries Institute
CSIRO Hobart

Collaboration Opportunities



- ARC Discovery
- ARC Linkage
- Contract Research
- Student Projects (PhD, Honours, 3rd Year)

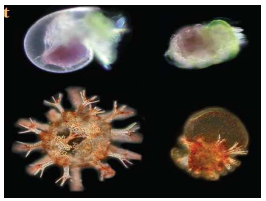
Research Programs

• Carbon, Nitrogen and Sulphur Cycling in Coastal Systems

• Stable Isotopes – Natural Abundance and Tracers

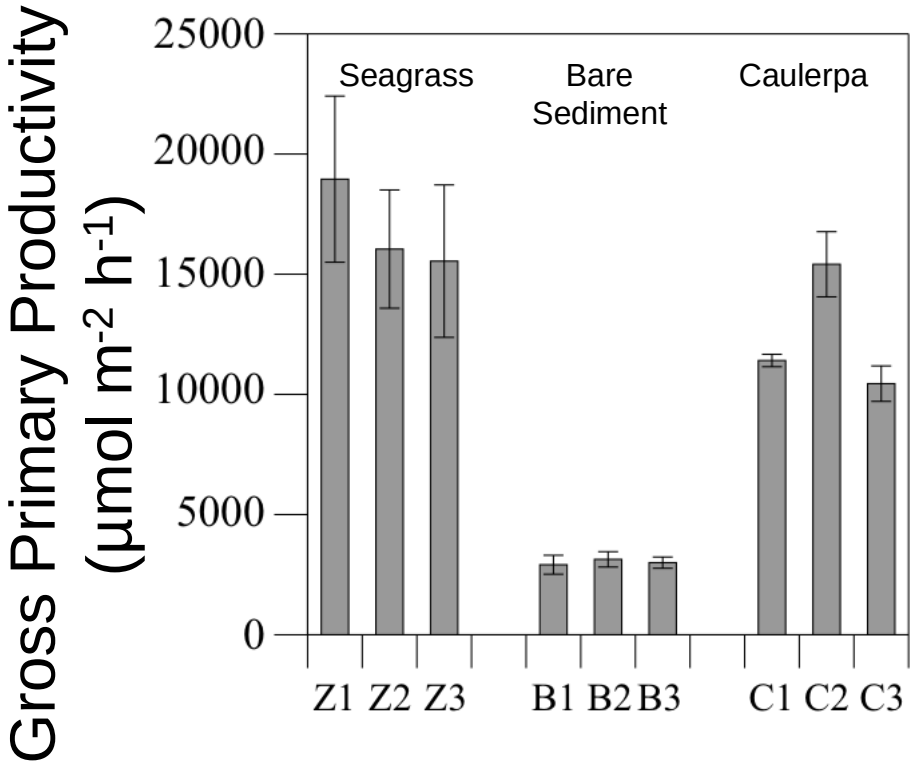
• Permeable Sands and Submarine Groundwater Discharge

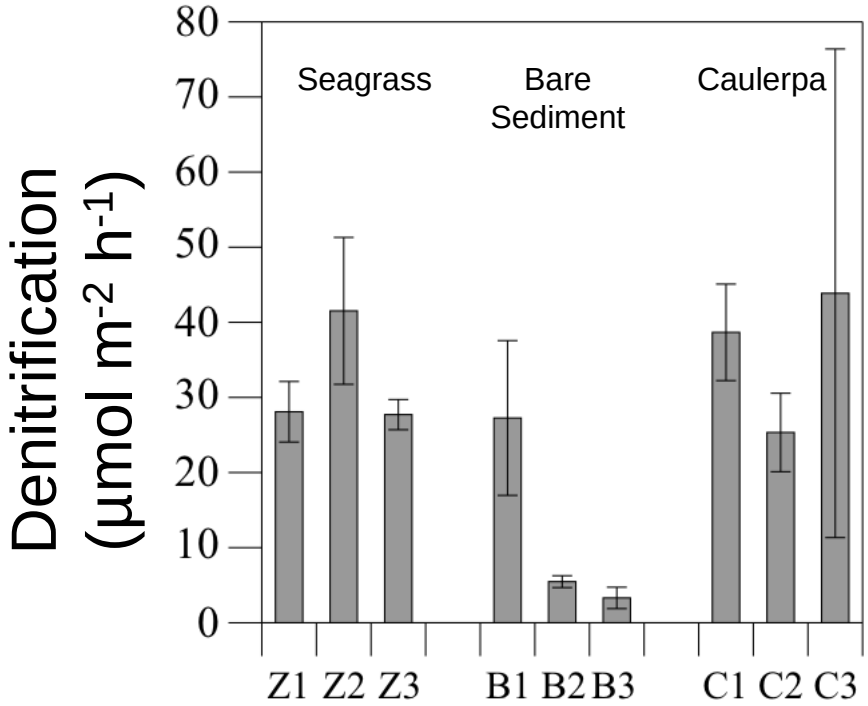
• Alternative Wastewater Treatment Systems



• Ocean Acidification

Example Project- Impact of Caulerpa taxifolia invasion on ecosystem processes

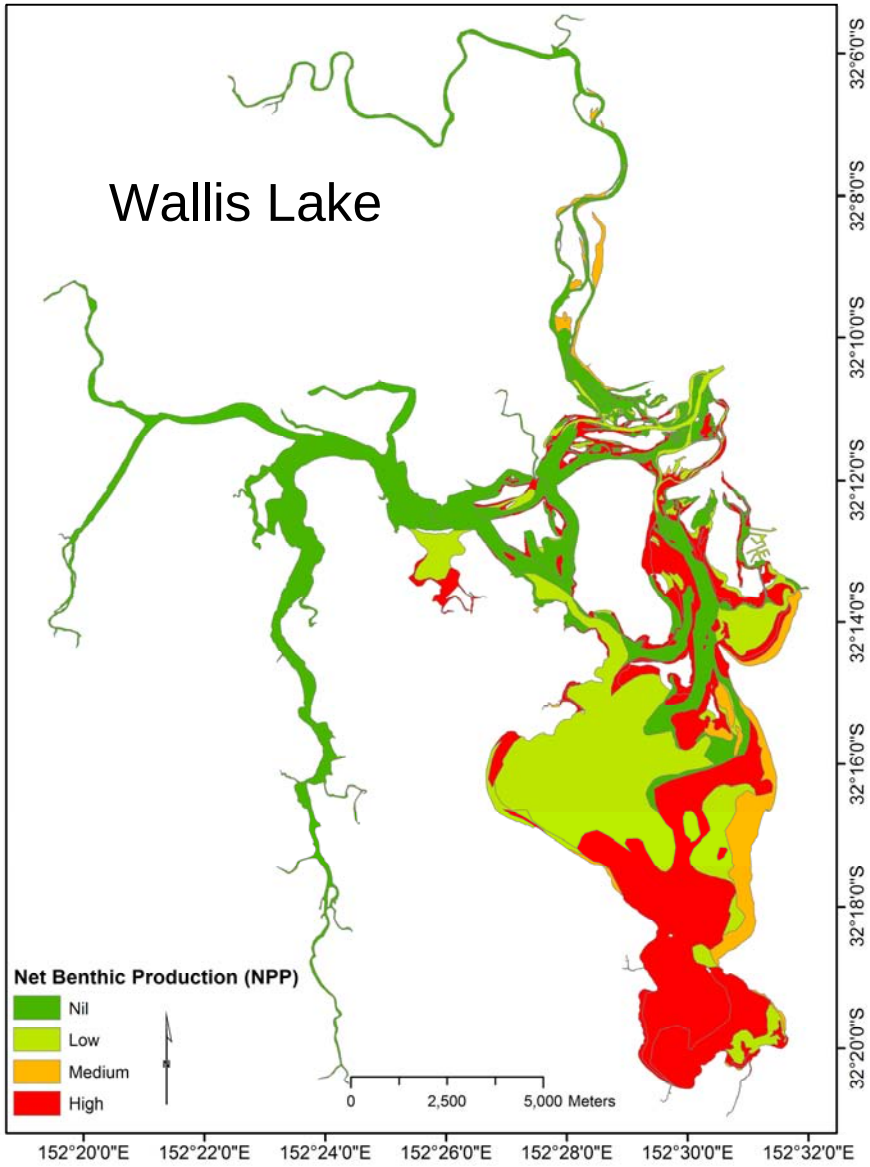




Funding: I&I NSW (Fisheries)

Eyre et al. submitted. L&O.

Example Project - Mapping Benthic Processes



Eyre, Maher. 2011. Continental Shelf Research (A)

Global Benthic DOC Efflux (0-200m)

- Previous: 90 Tg C/ yr
- Revised: 106 -416 Tg C/ yr

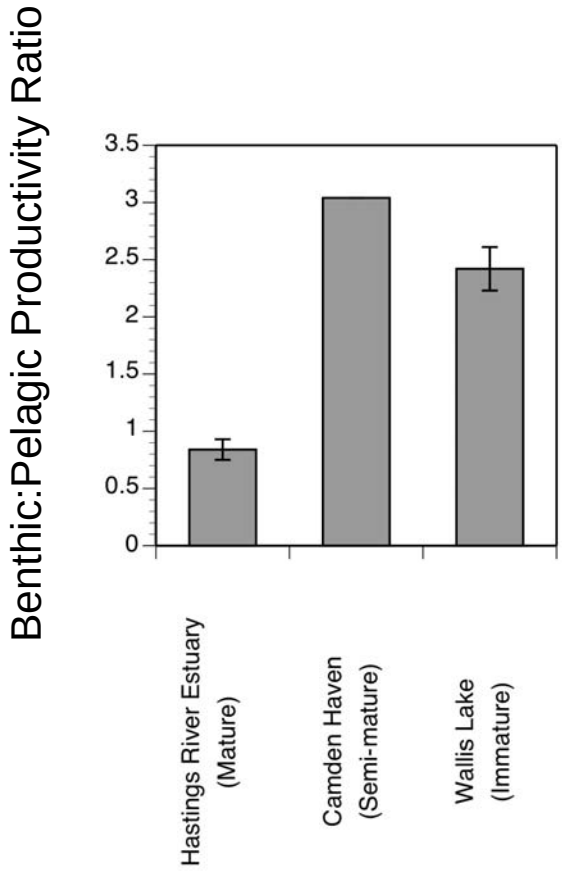
"globally significant"

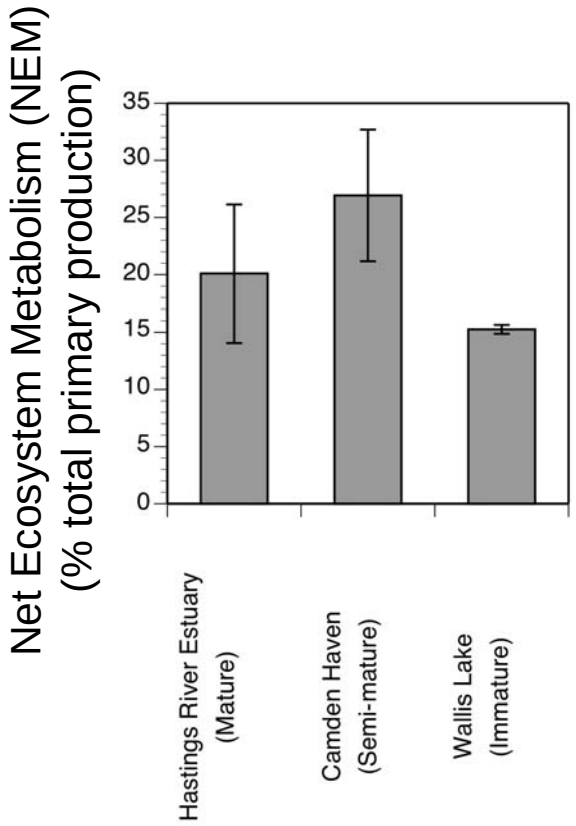
Maher, Eyre. 2010. Journal of Geophysical Research (*A)

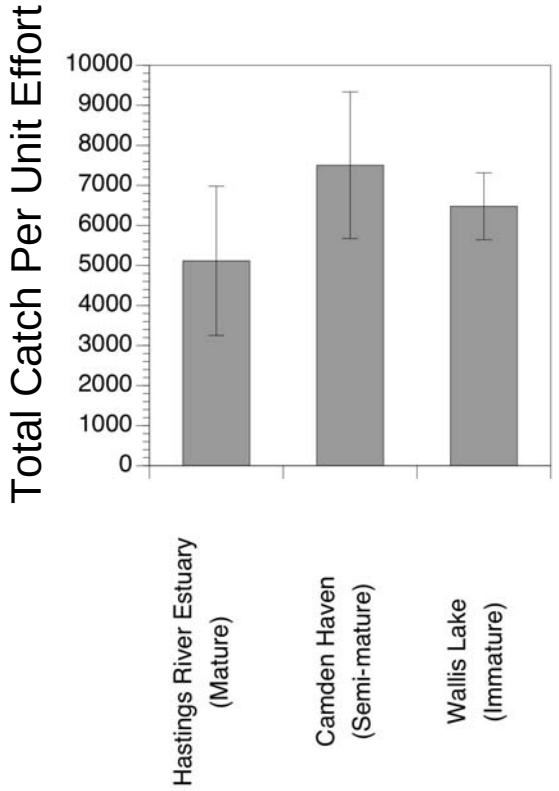
(Contract Research for Port Macquarie Hasting Council)

"regionally relevant"

Example Project – Carbon Budgets and Fisheries Production

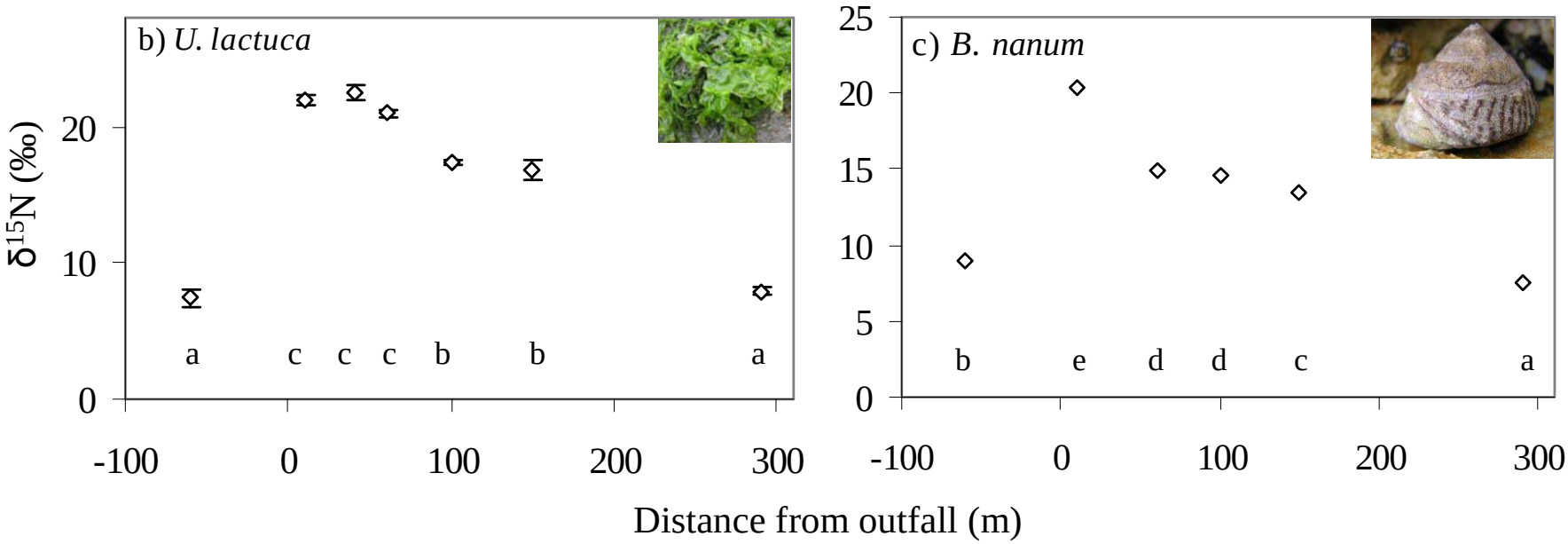






Example Project – Natural Abundance Stable Isotopes

Evaluation of the potential for ecological health impacts of discharges from Skennars Head wastewater treatment plant using stable isotopes
(Contract Research - Ballina Shire Council 2009-2010)



"regionally relevant"

Oakes and Eyre, 2009. Report Ballina Shire Council.

Example Projects - Stable Isotope Tracers

SMALL SCALE (^{15}N and ^{13}C)

- Benthic Microalgae
  - -sub-tidal
  - -inter-tidal
- Phytodetritus
- Pulp Mill Effluent (Pine Trees)
- Macroalgae Detritus
- Seagrass Detritus

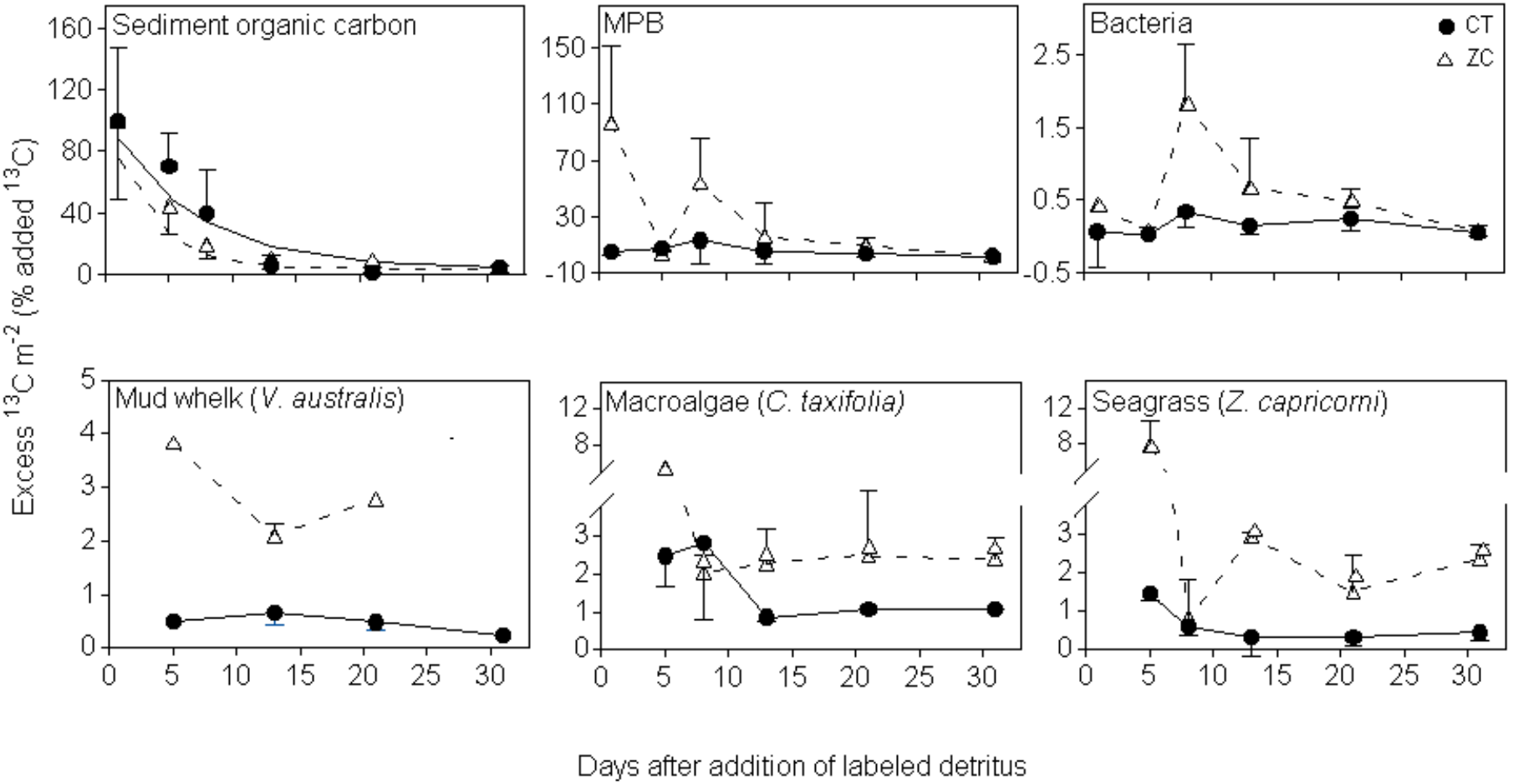
(ARC Discovery, ARC Linkage)

LARGE SCALE

- Whole system additions of ^{15}N and ^{13}C
  - - Wetlands
  - - Mangroves?
  - - Coral Reefs?

(ARC Linkage)

Example Project -Carbon self-utilisation may assist *Caulerpa taxifolia* invasion



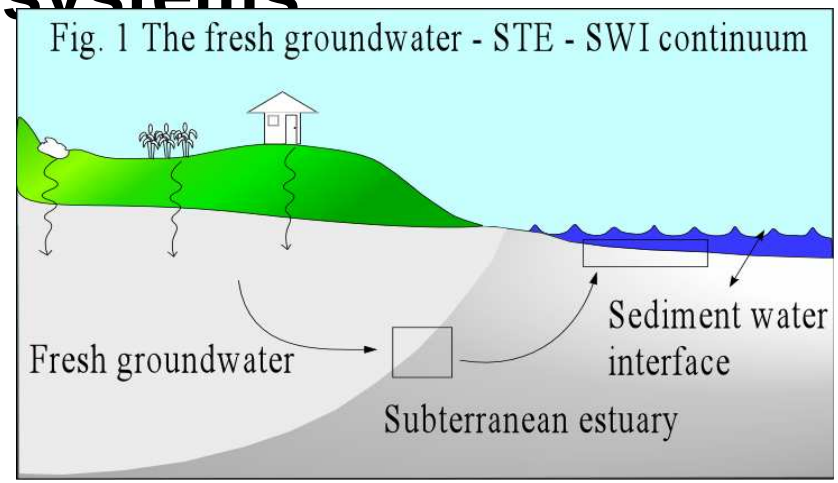
Oakes et al. submitted. L&O.

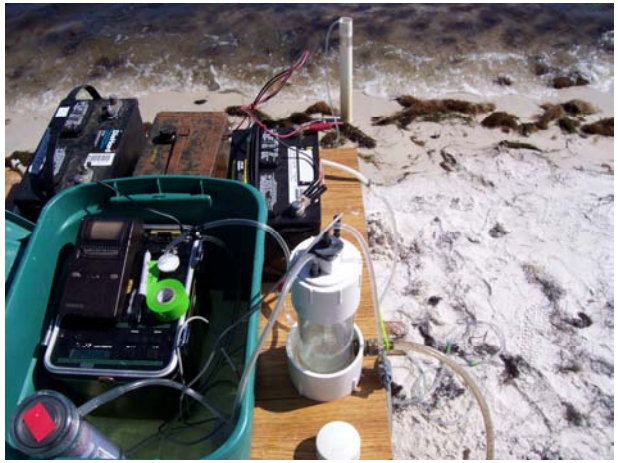
Example Projects - Submarine Groundwater Discharge

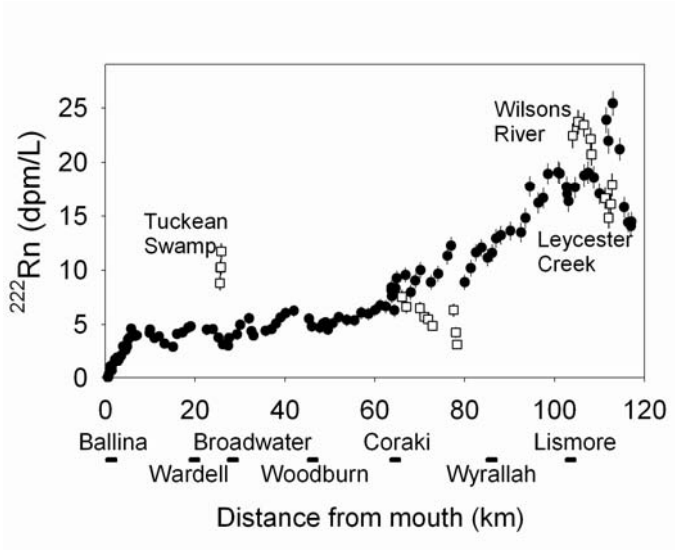
Forgotten source of nutrients and contaminants to coastal systems

- Radon
  - -RAD 7
- Stable Isotopes

(ARC Linkage; Herman Slade)

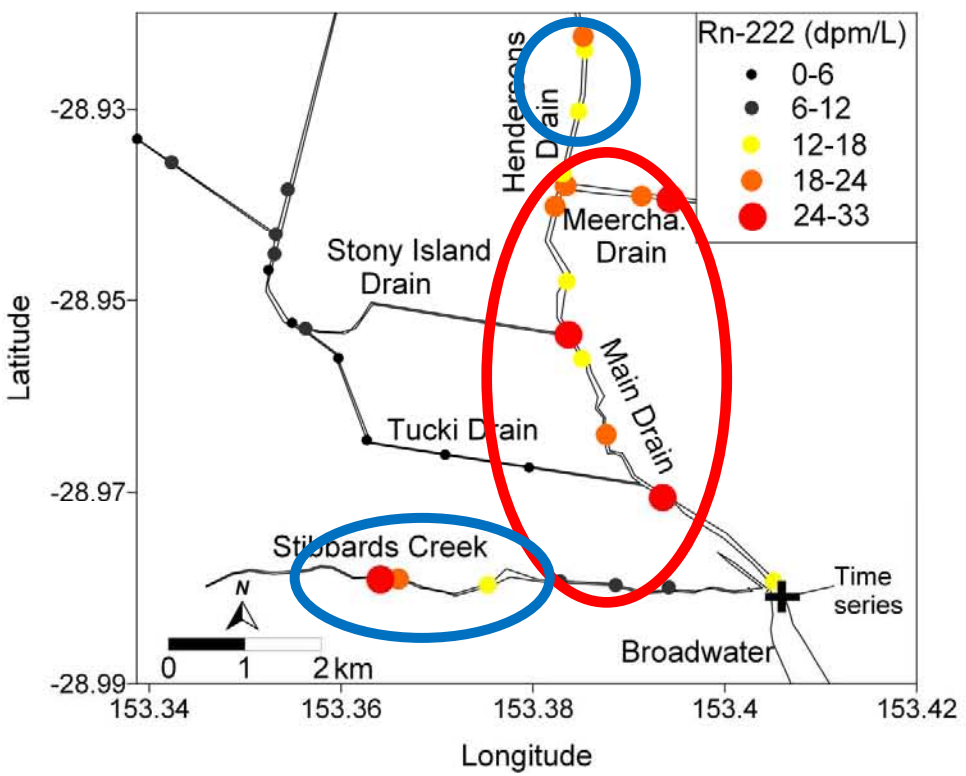


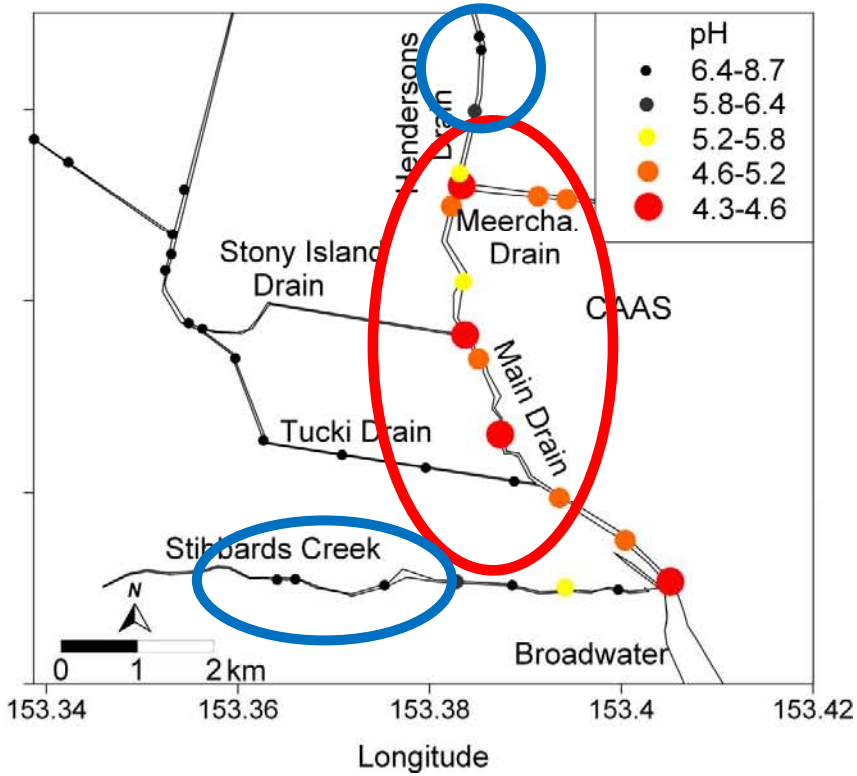




Santos and Eyre. Journal of Hydrology (*A)

Example Project – Tracing groundwater as a source of acidity using radon





1 - High radon, low pH

2 - High radon, high pH

Santos and Eyre. Journal of Hydrology (*A)
deWeys, Santos. Eyre. ES&T (*A)

Example Project – Alternative Wastewater Treatment Systems

Constructed Wetlands

-Whole system additions of ^{15}N

-Process measurements (e.g. anammox)

(ARC Linkage- Partners: Ballina and Byron Council, Ecotechnology)

Carbonate Sands/ Groundwater Systems

-Stable Isotopes

-Process measurements

-Reactors

-Radon

(ARC Linkage - AusAid)

Example Project – Ocean Acidification and Carbonate Sands Biogeochemistry

-Global acidification models assume that **only the water column** will buffer CO_2 inputs into the ocean

-**What about sediments?**

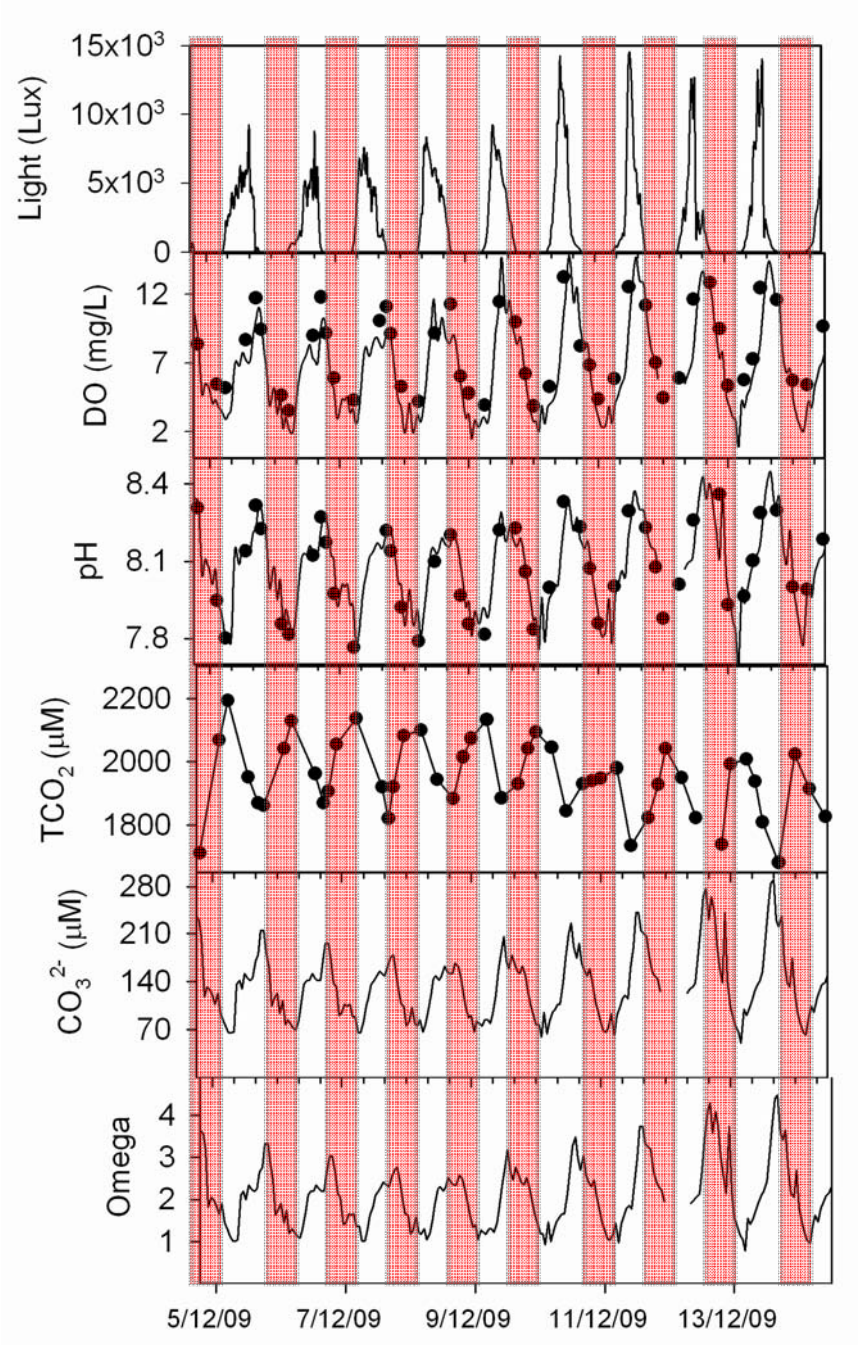
-**$CaCO_3$ sediments cover 40% of world's continental shelf !**

Remember, **$CaCO_3$ dissolution consumes CO_2**

$$CaCO_3 + CO_2 \leftrightarrow Ca^{2+} + 2HCO_3^- + H_2O$$

-Advection and associated carbonate dynamics in sediments has never been considered

Funding: 2011 ARC Discovery



Time series in the Heron Island reef lagoon

Day: High oxygen, low CO_2, high carbonate

Night: Low oxygen, high CO_2, low carbonate

The diel ranges are the broadest, and the night-time values are among the lowest ever reported for healthy coral reefs

Night-time pH is lower than predicted for 2100!

Santos et al. 2011. Geophysical Research Letters (*A)

Example Project – Ocean Acidification and Ecological Communities

• Multigenerational experiments on marine invertebrates investigating physiological tipping points

• Asking if there is capacity for acclimatisation and evolutionary adaptation, and identifying potential adaptation strategies

Funding: Environmental Trust, ARC Discovery

Abalone larvae (normal)

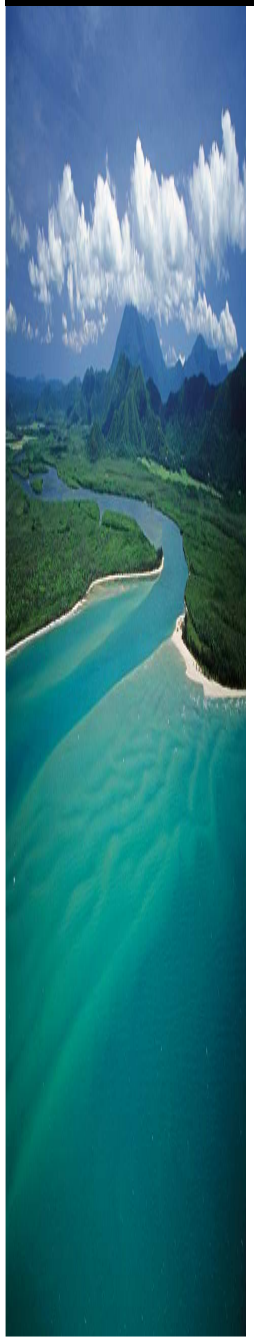
Grown in water acidified to 2100 level

Sea urchin larvae (normal)

Grown in water at 2100 temperatures

Proceedings of the Royal Society B 2010 (*A)

More Information



www.scu.edu.au/coastal-biogeochemistry

Analytical Laboratory- Stable Isotope Facility

EA-IRMS

- Animal/plant tissue, sediment
  - ^{13}C, ^{15}N, ^{34}S
- Isolated compounds
  - $^{15}NH_4^+$
  - $^{15}NO_3^-$
  - $DO^{15}N$

TOC-IRMS

- Dissolved inorganic carbon ($DI^{13}C$)
- Dissolved organic carbon ($DO^{13}C$)

GC-c-IRMS

- Gases
  - $^{29}N_2$, $^{30}N_2$
  - $^{45}N_2O$, $^{46}N_2O$
  - $^{13}CO_2$
- Specific compounds
  - fatty acids
  - amino acids

(ARC LIEF 2006, 2009)