

# CHANGING THE WAY WE LOOK AT ENVIRONMENTS – BIGGER BETTER AND FASTER DATA

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Photo Antonia Cooper

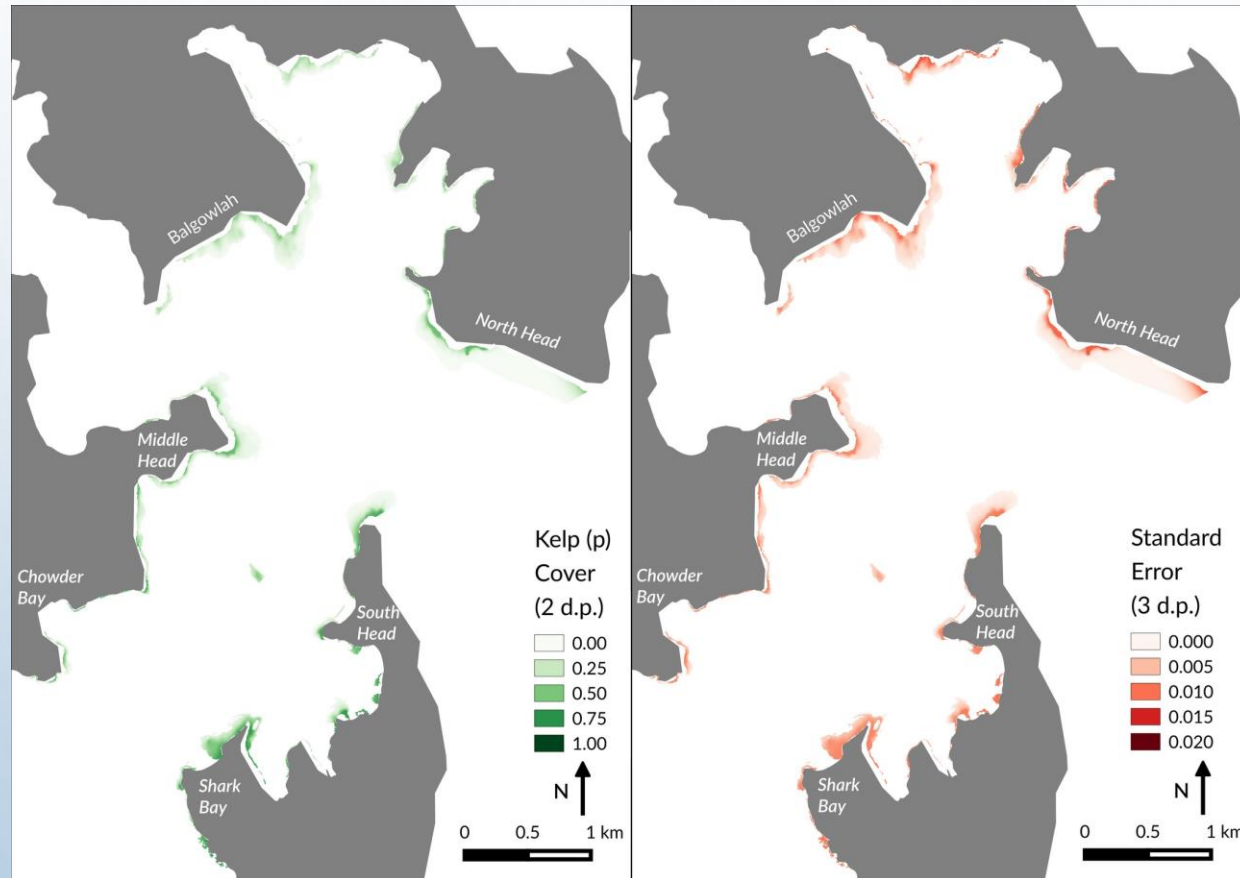




© Underwater Earth - Richard Veyers

Image Catlin Seaview Survey

# An evaluation of semi-automated methods for collecting ecosystem-level data in temperate marine systems

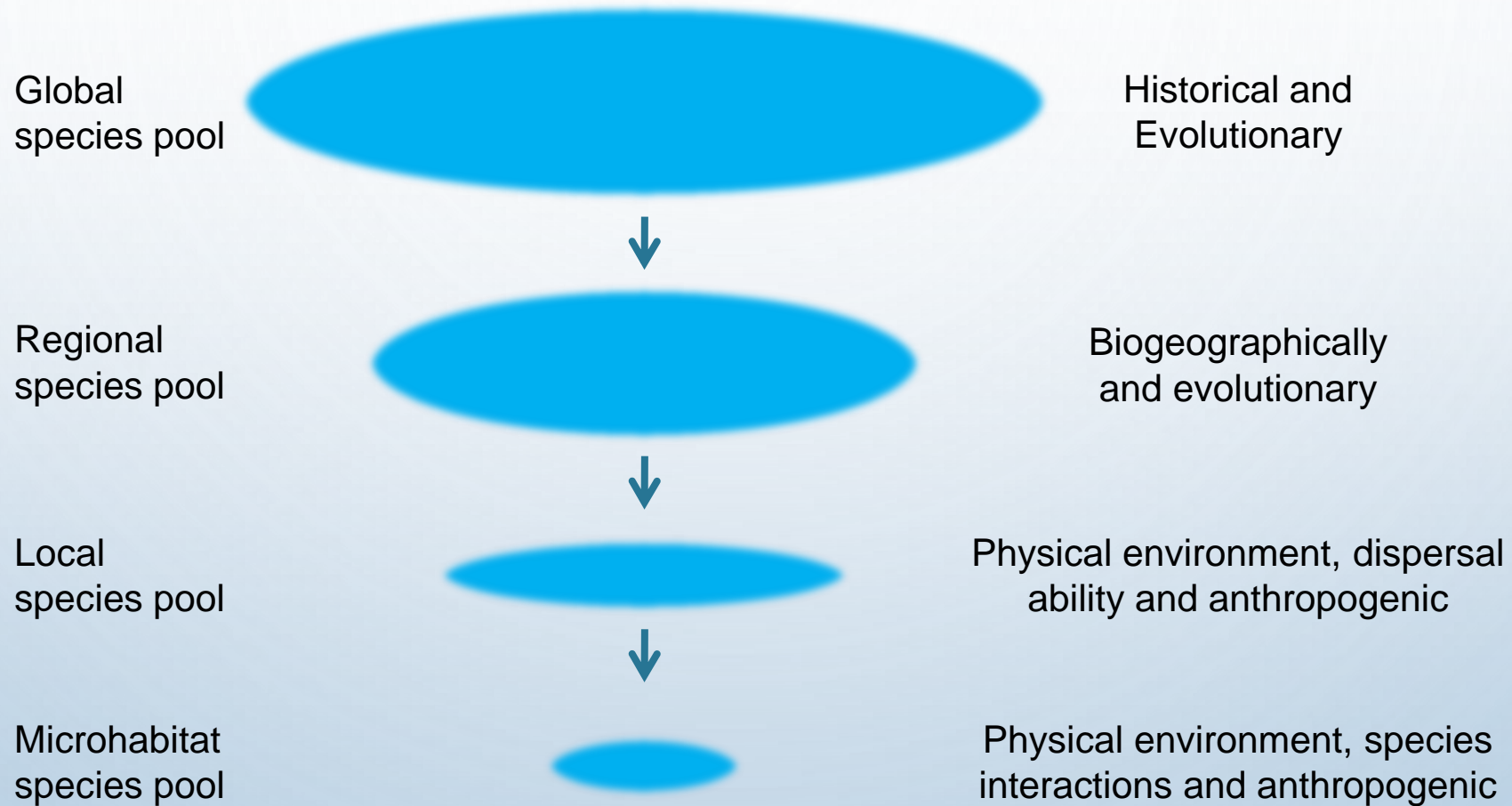


Griffin et al. 2017

Ecology and Evolution

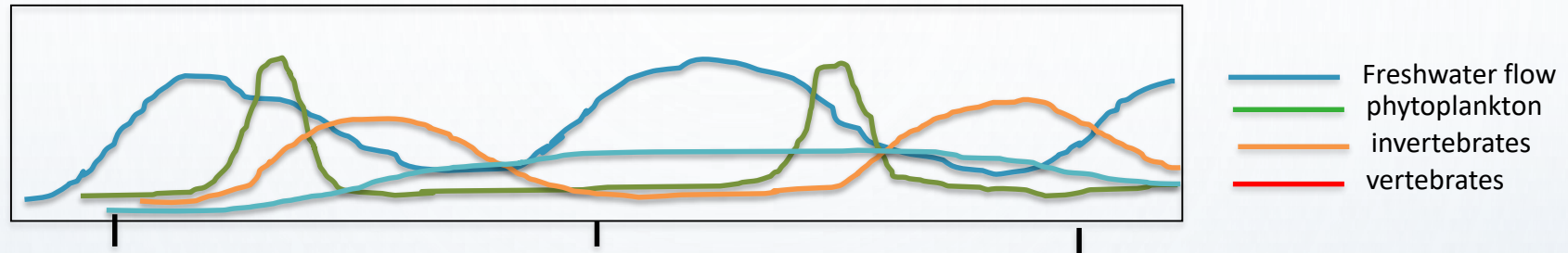
Open Access

*Historical, biogeographical and environmental factors determine membership of species in a community*

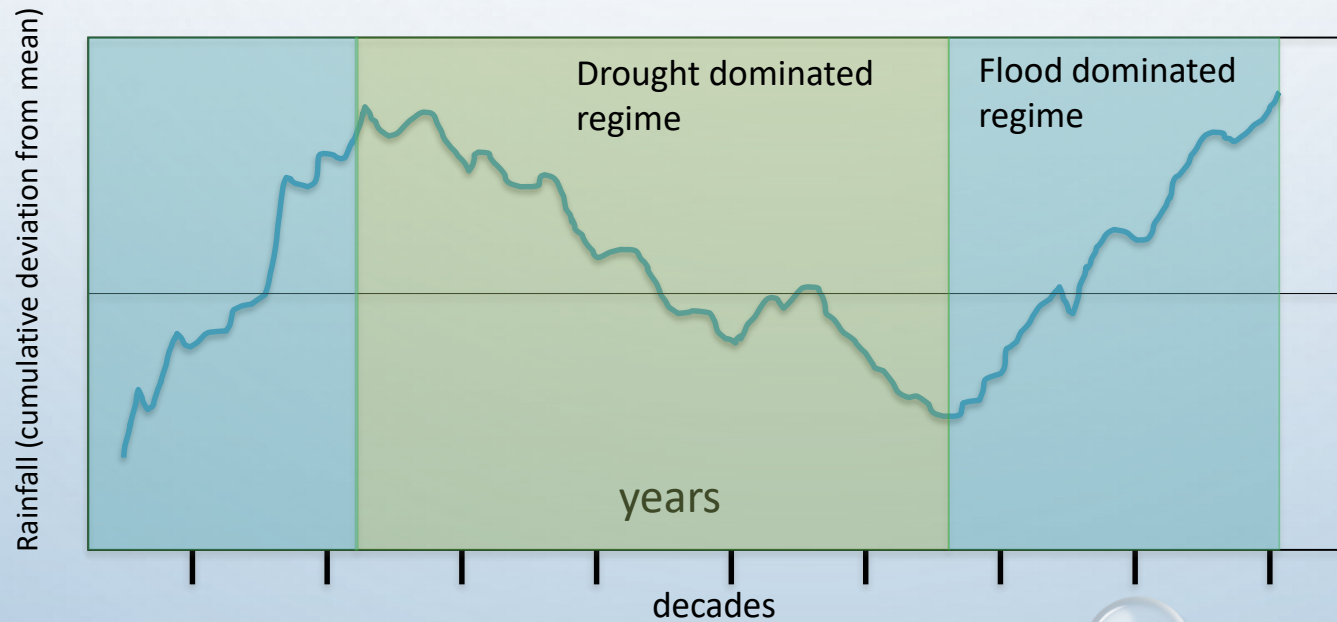




# Weaving time in a tapestry



Long period climatic cycles – impacts on abiotic drivers

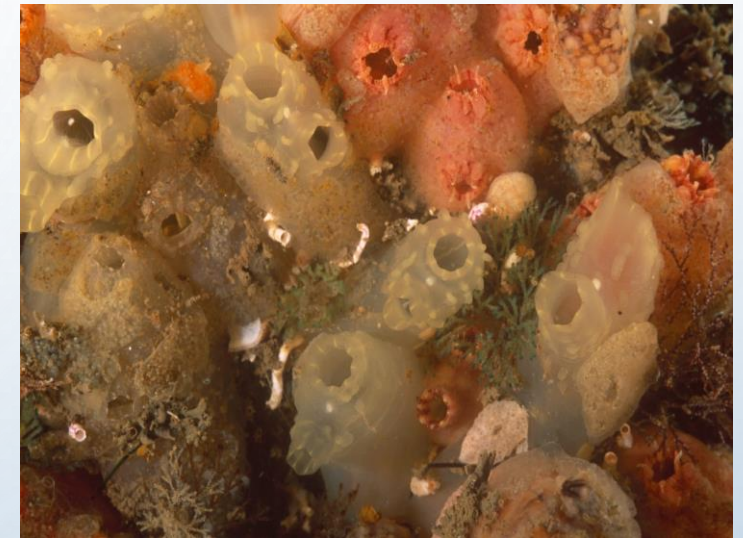
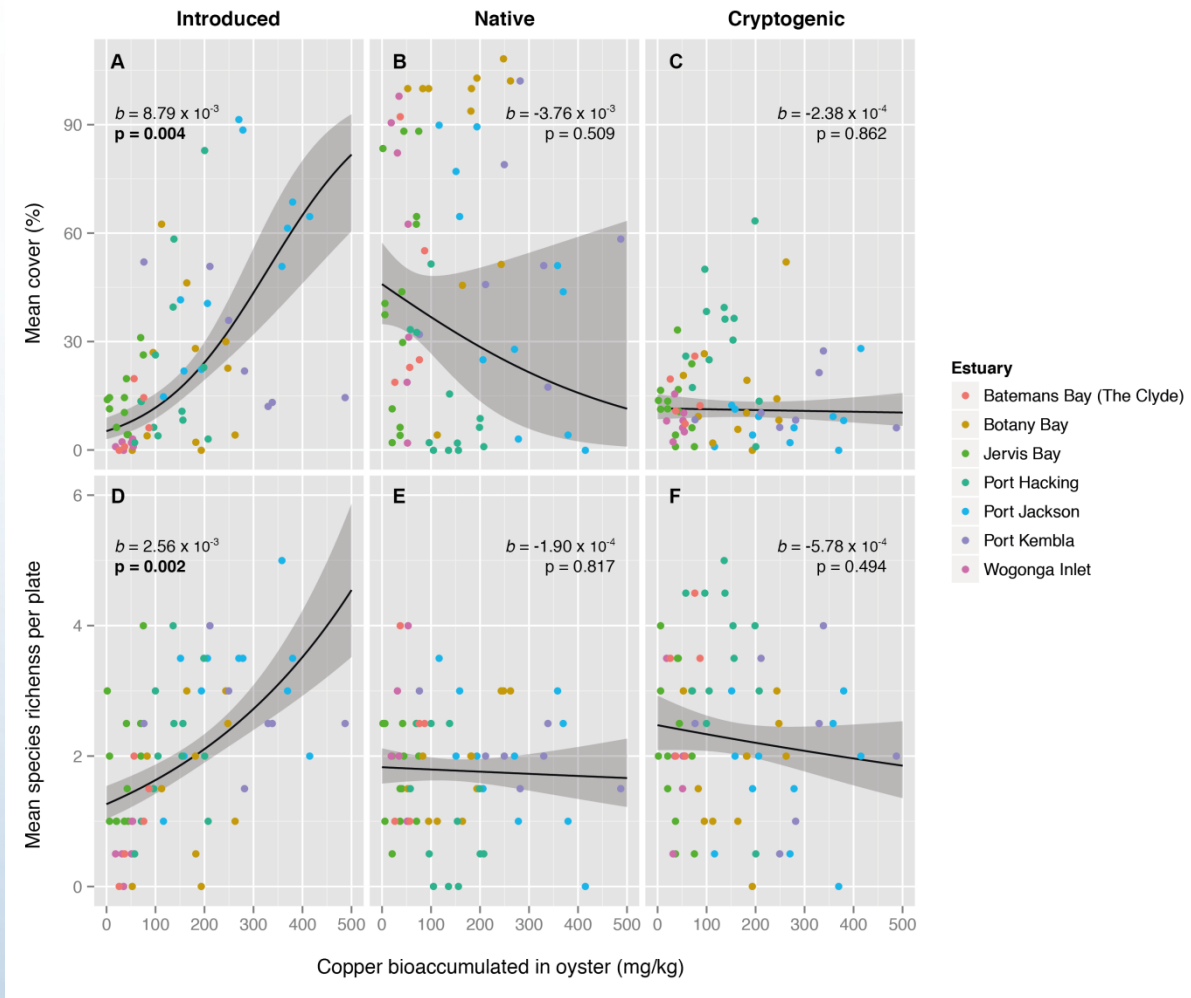


Dafforn, et al 2016



## Physical, biological and chemical stressors





Clark, Leung, Dafforn & Johnston (in prep)

Piola and Johnston, (2008) Diversity and Distributions

Dafforn, Glasby & Johnston (2009) Diversity and Distributions





Picture Vanessa Hunter





# Australia

State of the Environment

2016

## Coasts

Graeme F Clark  
Emma L Johnston

[soe.environment.gov.au](http://soe.environment.gov.au)

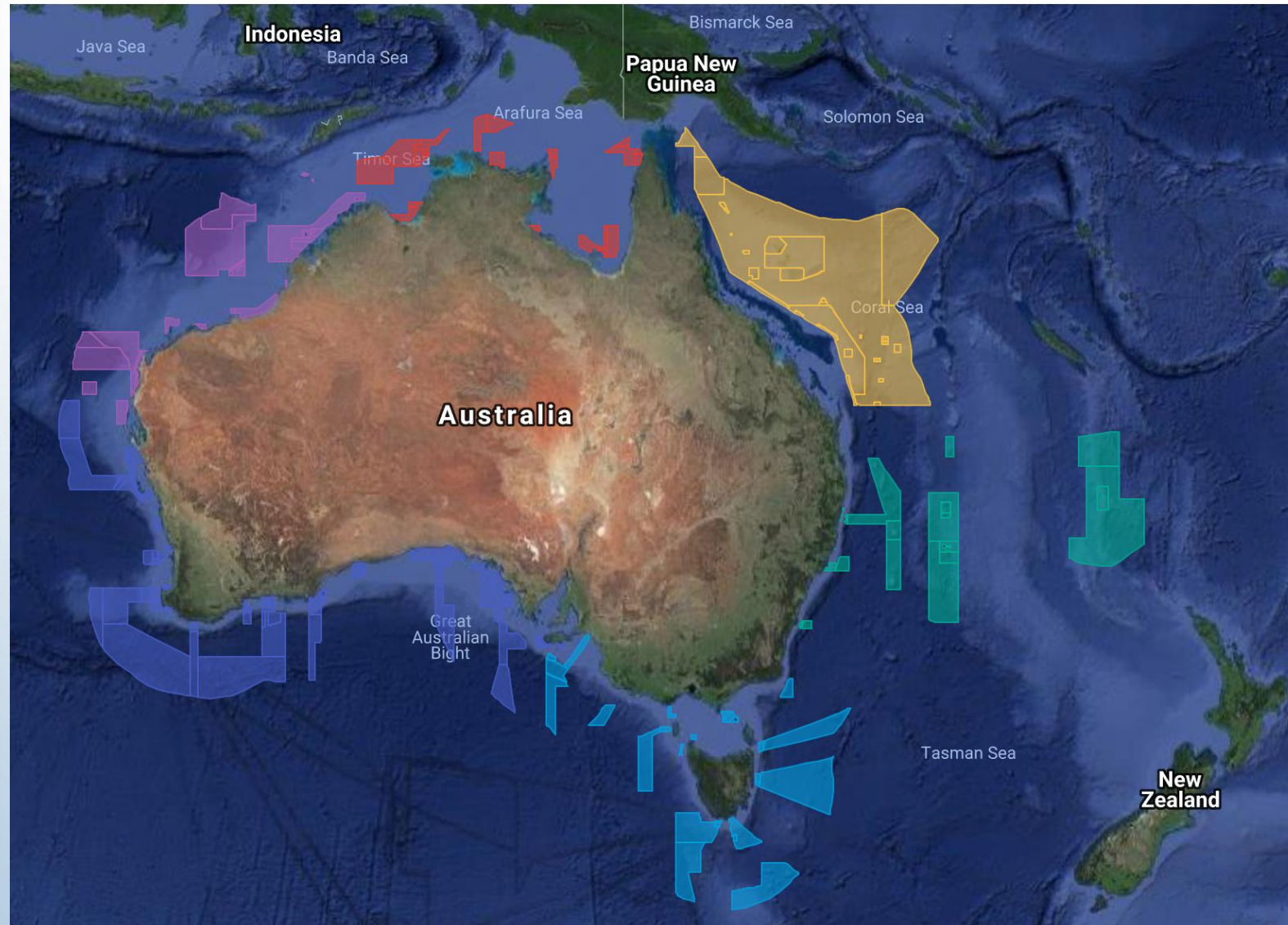


# Researchers and Sponsors

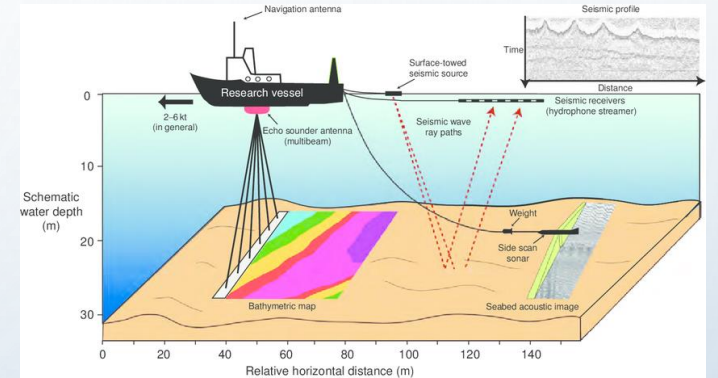
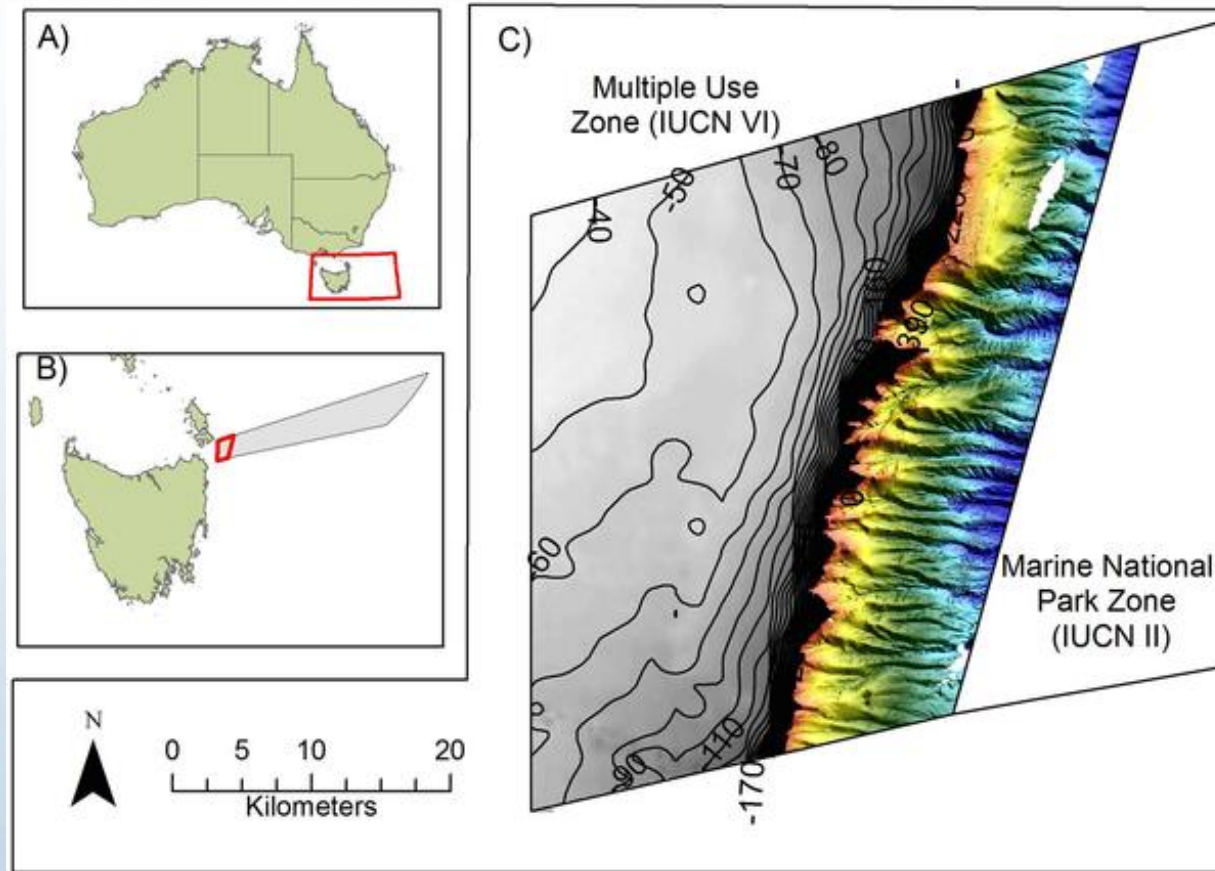




# Where are Australian Marine Parks?



# SONAR AND VIDEO COMBINED



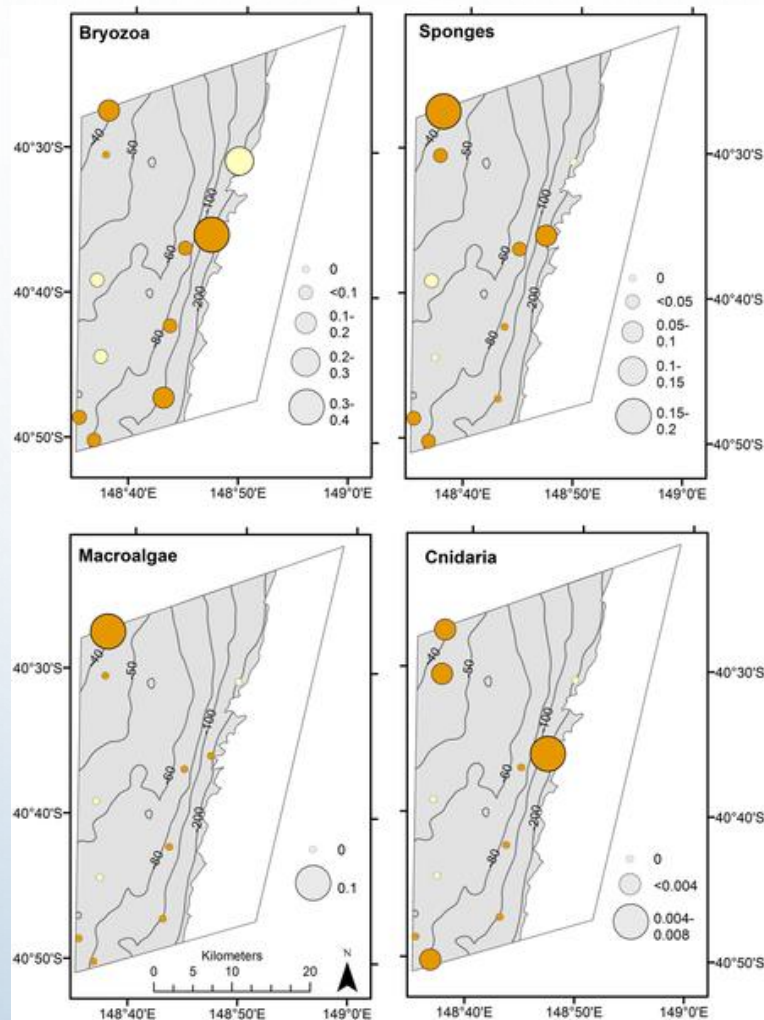
Garel et al 2009

Lawrence E, Hayes KR, Lucieer VL, Nichol SL, Dambacher JM, et al. (2015) PLOS ONE 10(10): e0141051.

**FIG 1. LOCATION OF THE FLINDERS COMMONWEALTH MARINE RESERVE (CMR).**



## DISTRIBUTION OF PERCENTAGE COVER OF SESSILE BIOLOGICAL COMMUNITIES



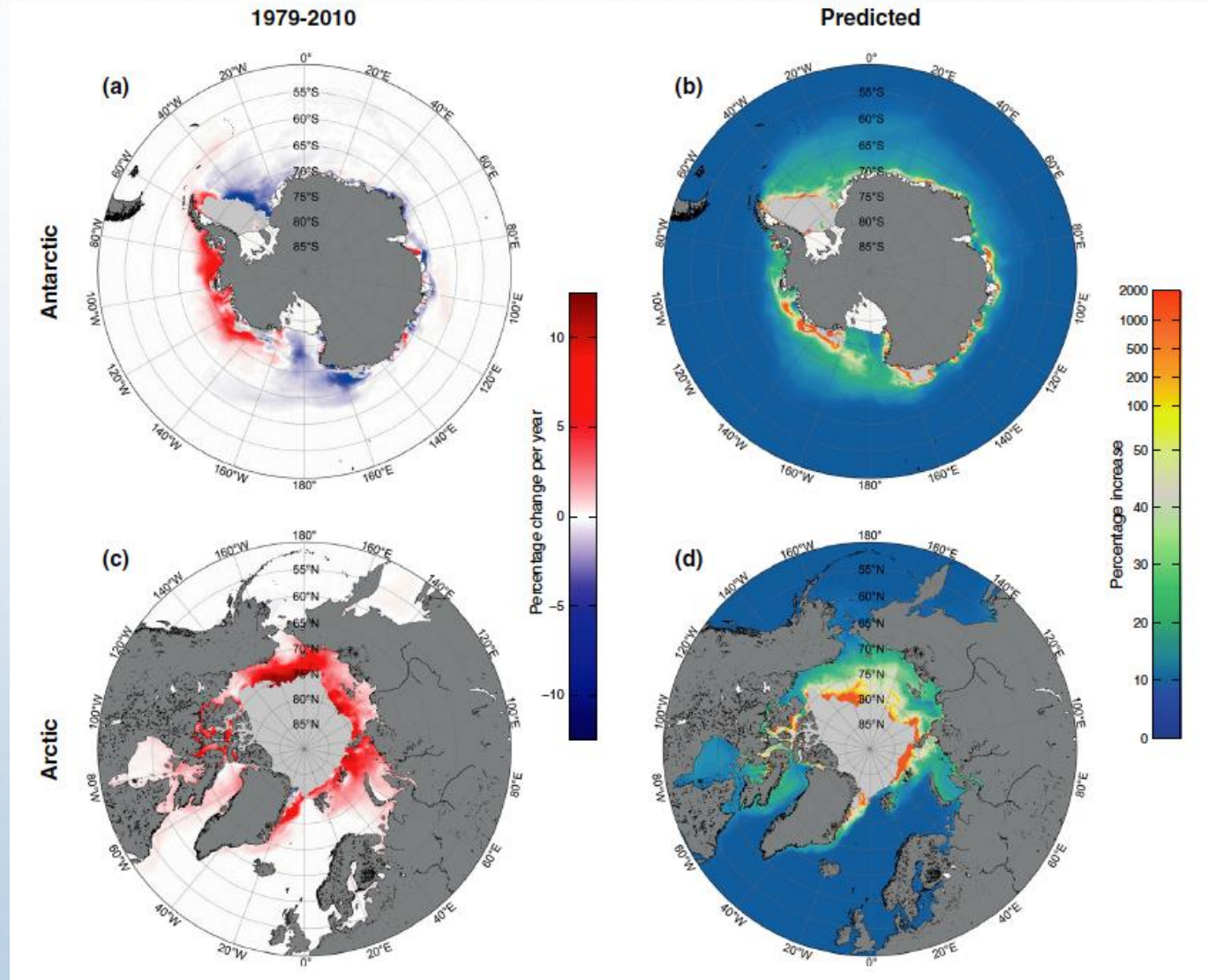
Lawrence E, Hayes KR, Lucieer VL, Nichol SL, Dambacher JM, et al. (2015) PLOS ONE 10(10): e0141051.



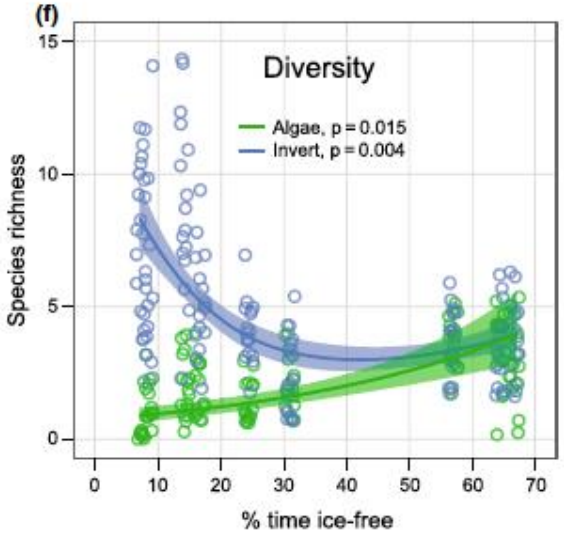
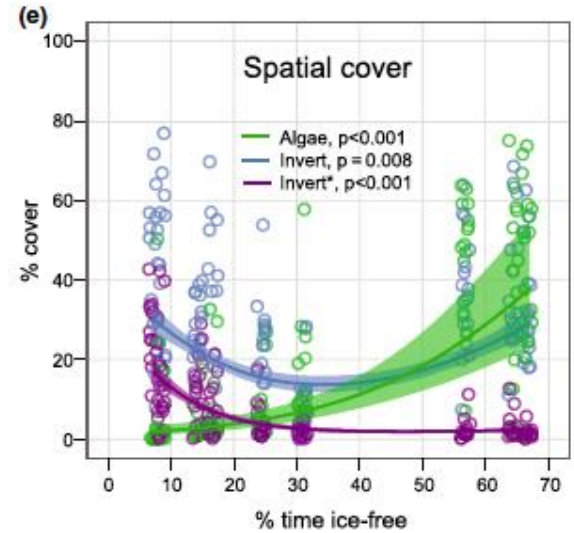
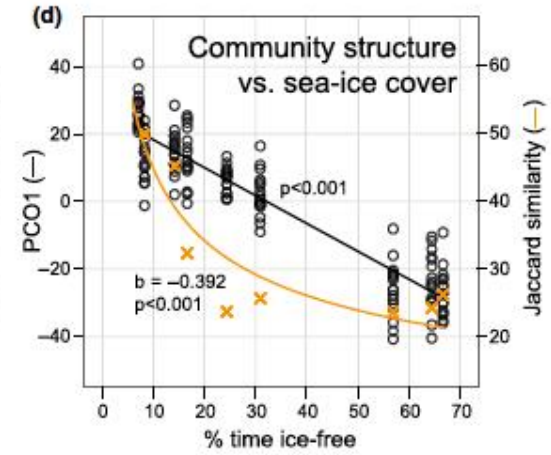
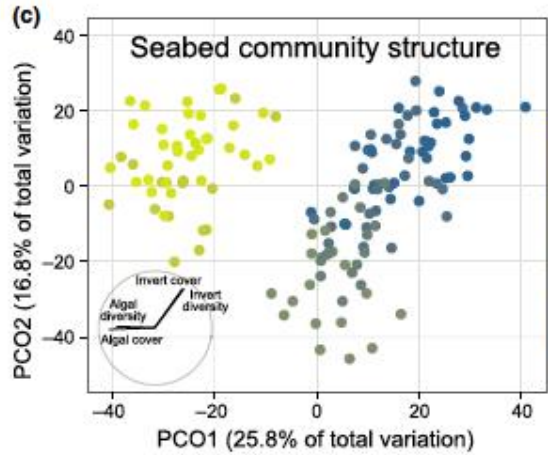
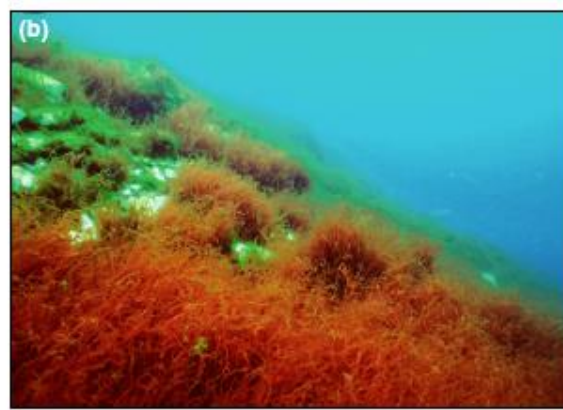
# LIGHT DRIVEN TIPPING POINTS IN POLAR SYSTEMS



Clark *et al.* (2013)  
Global Change Biology







Clark *et al.* (2013)  
Global Change Biology

Clark *et al.* (2015)  
Austral Ecology 40(4)



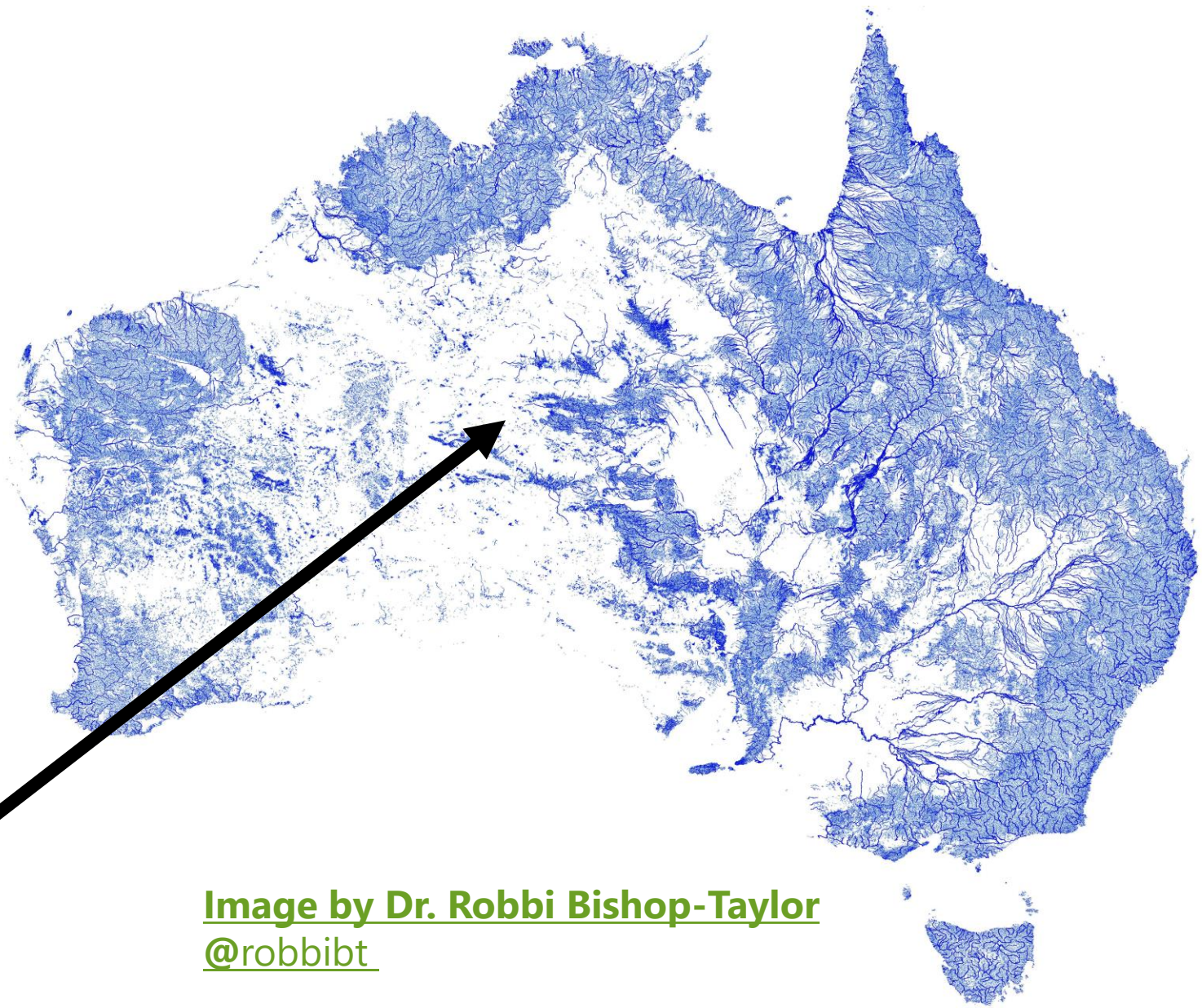
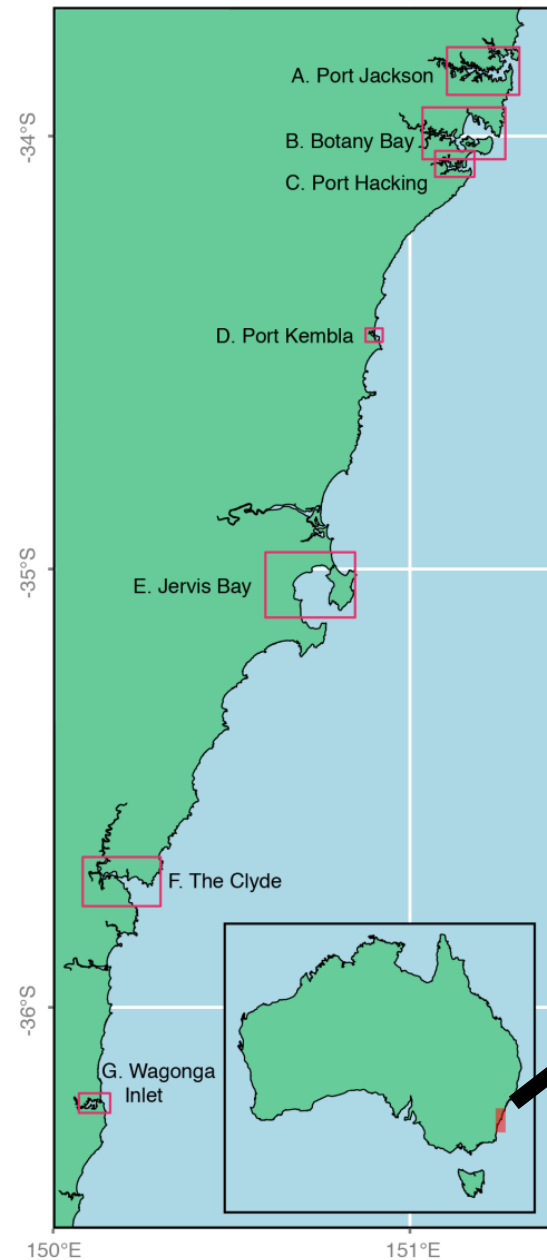


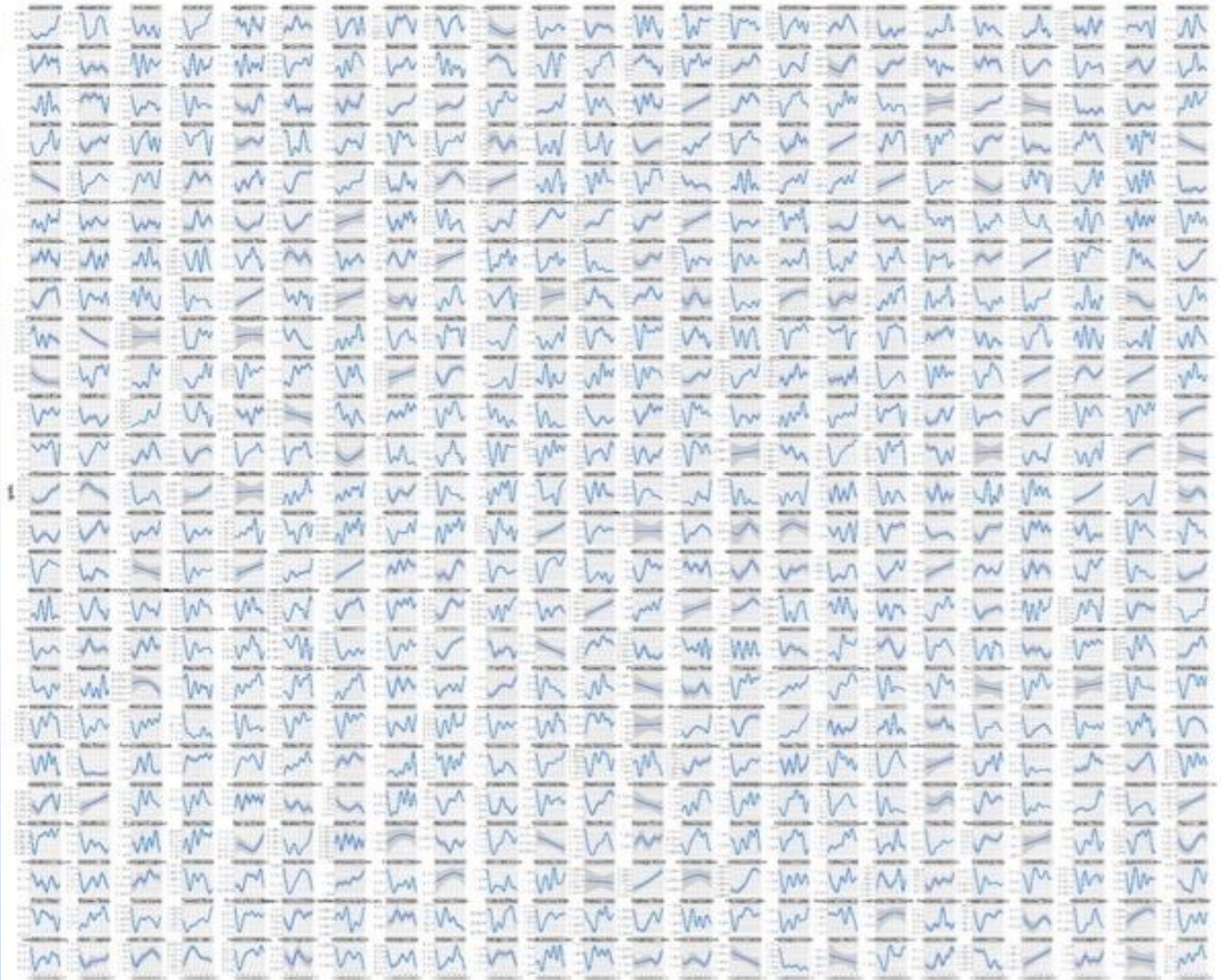
Image by Dr. Robbi Bishop-Taylor  
@robbibt



## Looking back through time-

- Water quality changes in estuaries from 1987 to 2015

Using GA Data Cube for large-scale analysis of water quality change



Bugnot et. al. (2018)

Journal of Environmental Management

[A novel framework for the use of remote sensing for monitoring catchments at continental scales](#)

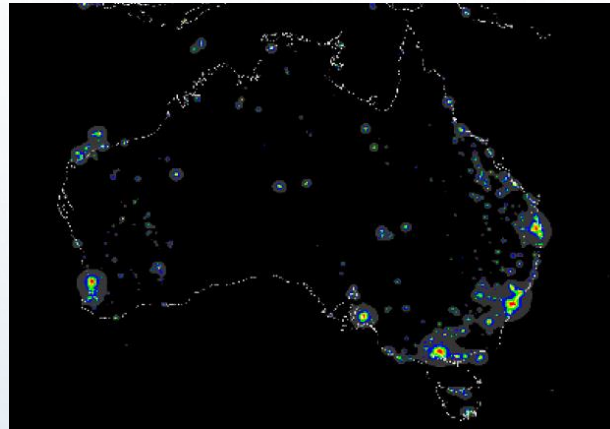
## >500 Estuaries and their trends in water colour change, 1987–2015



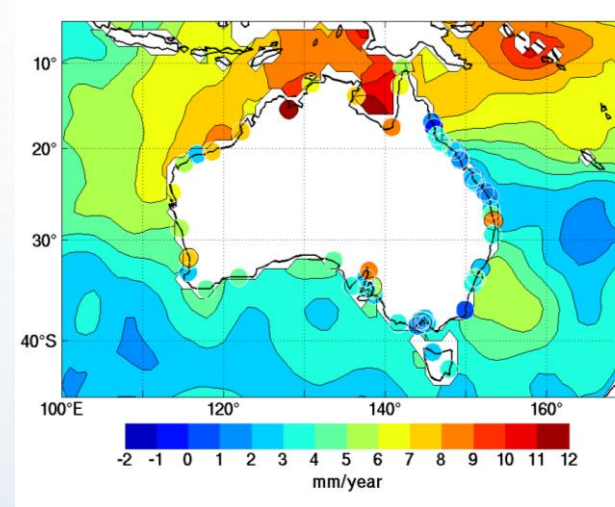
Bugnot et. al. 2018  
Journal of Environmental Management



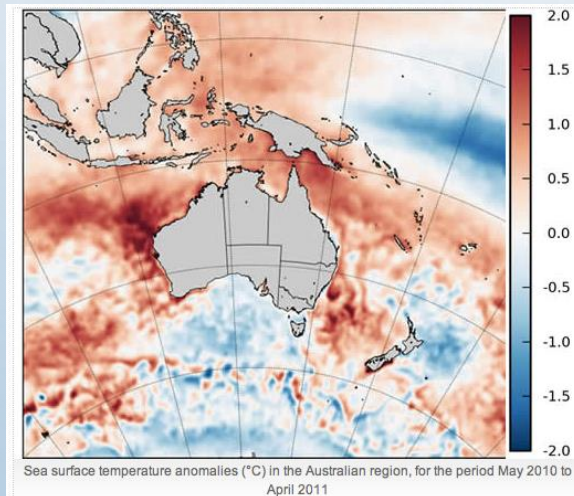
# THE PRESSURES & STATE: WHAT DO WE MEASURE?



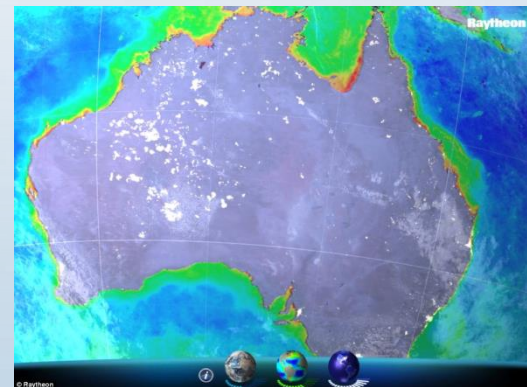
Light



Sea Level Rise



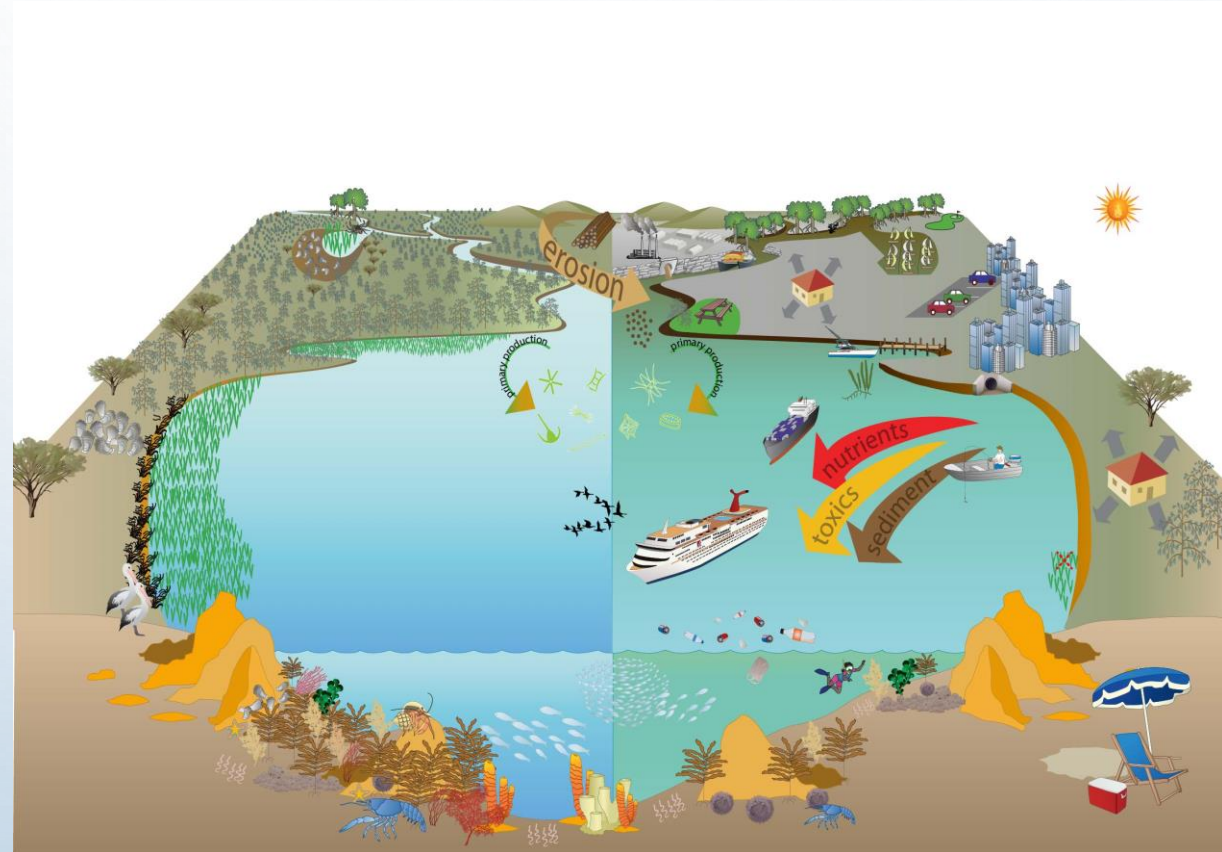
Heat anomalies



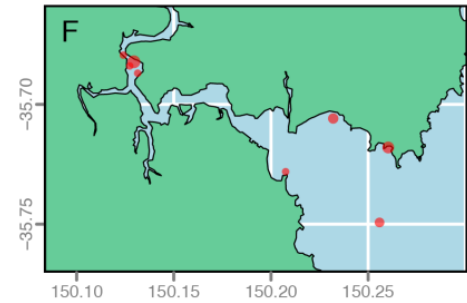
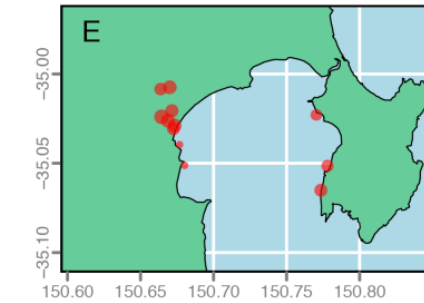
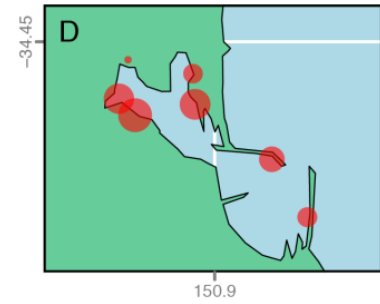
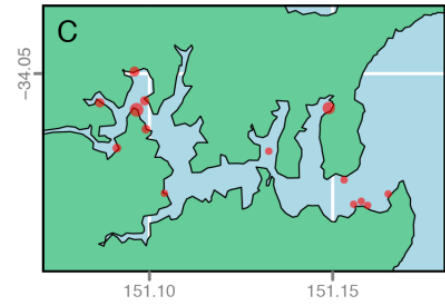
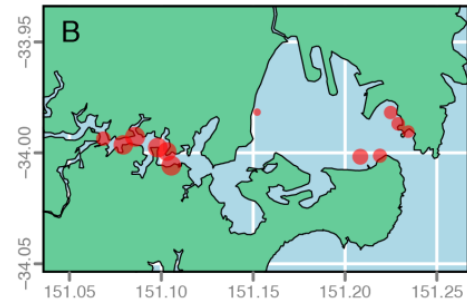
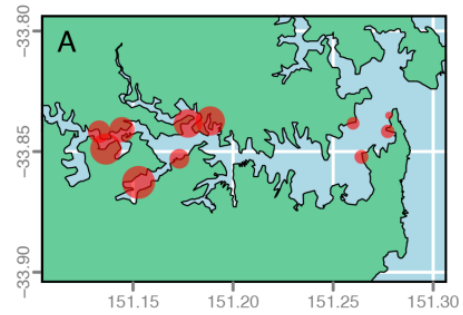
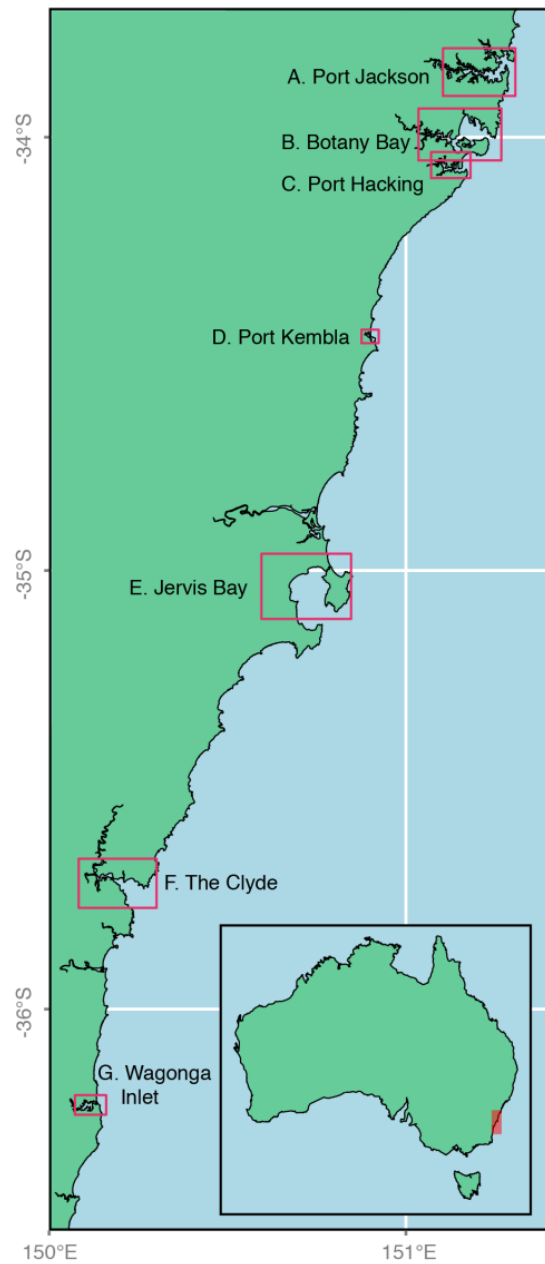
Chl-a

# ECOLOGY ON STEROIDS

- NEW TOOLS FOR BIODIVERSITY MONITORING AND FUNCTIONAL RATE MONITORING
- MOLECULAR & REMOTE SENSING TOOLS ARE OUT THERE - AND READY TO USE







Copper concentration in benthic sediments ( $\text{mg kg}^{-1}$ )







# CLASSIFICATION PHYLOGÉNÉTIQUE DU VIVANT

D'après H. Le Guyader, G. Lecointre, P. Lopez-Garcia

- = photosynthétiques
- = méthanogénétiques
- = chimiosynthétiques
- = connus seulement par leur ARNr

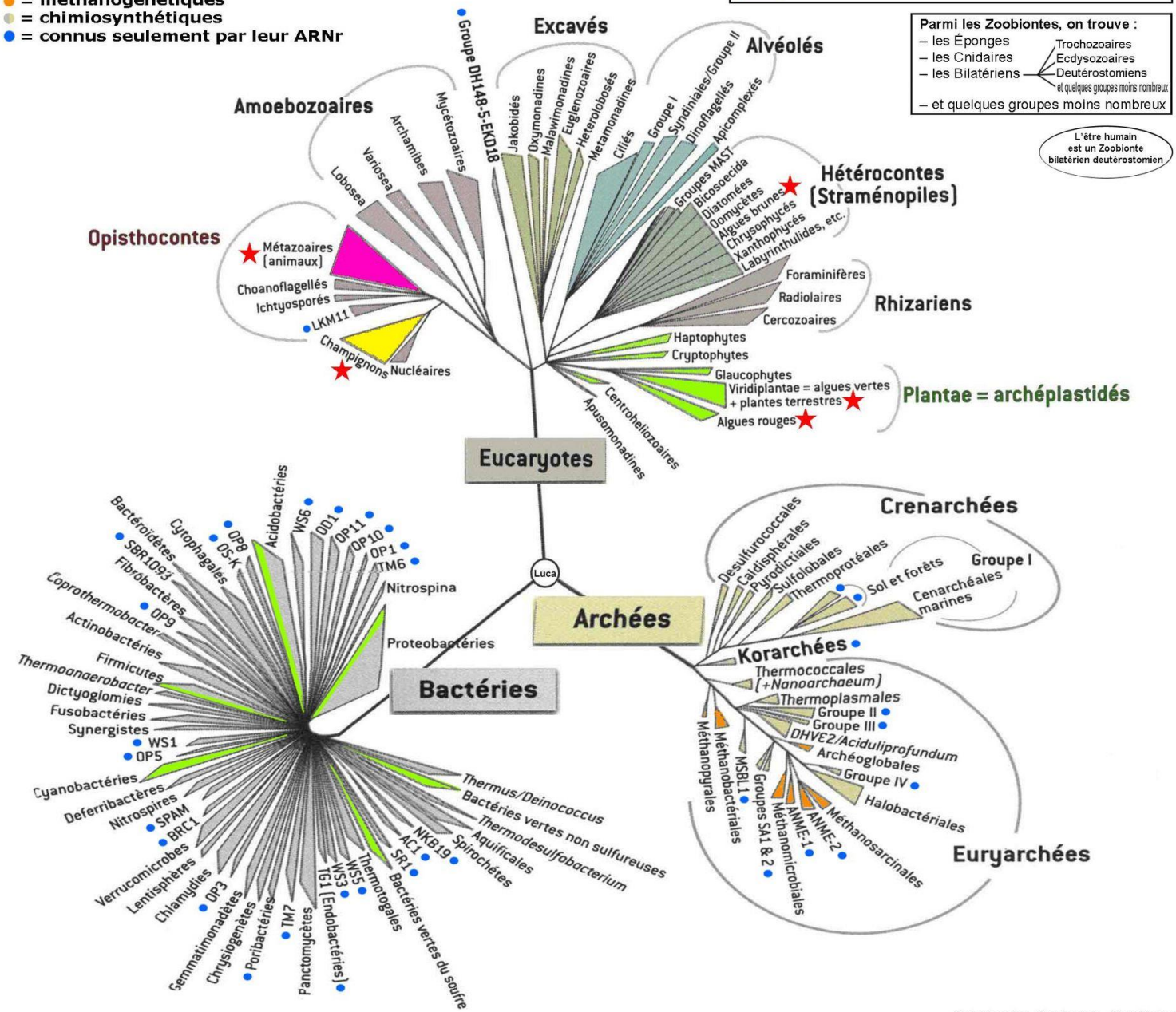
**Eucaryotes pluricellulaires : ★**

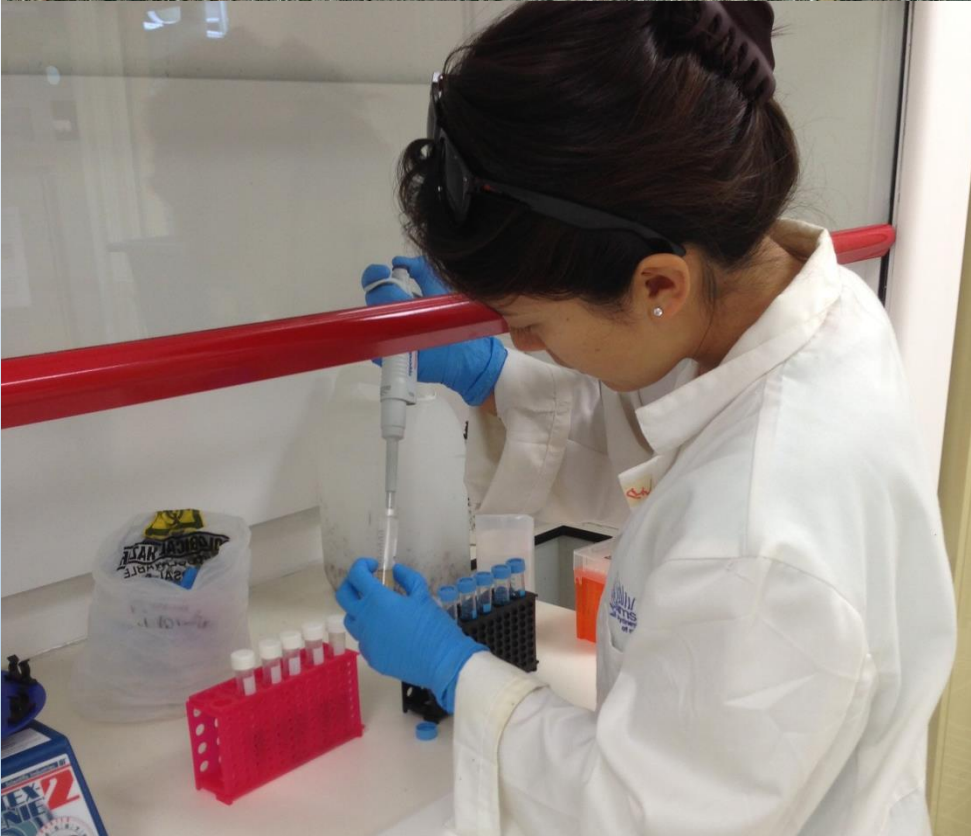
- = Zoobiontes (Animaux)
- = Mycètes (Champignons et Myxomycètes)
- = Chlorobiontes (Végétaux)

Parmi les Zoobiontes, on trouve :

- les Éponges
- les Cnidaires
- les Bilatériens
- et quelques groupes moins nombreux

L'être humain est un Zoobionte bilatérien deutérostomien





## Ecological proxies

Microbes, infauna, sessile invertebrates, zooplankton  
larval fish, adult fish,  
biomarkers

## CONTAMINANTS

SEDIMENT METALS (INCL. TRAPS)  
POLYCYCLIC AROMATIC  
HYDROCARBONS (PAHS)

## Nutrient proxies

Sediment Chlorophyll a  
Sediment TOC

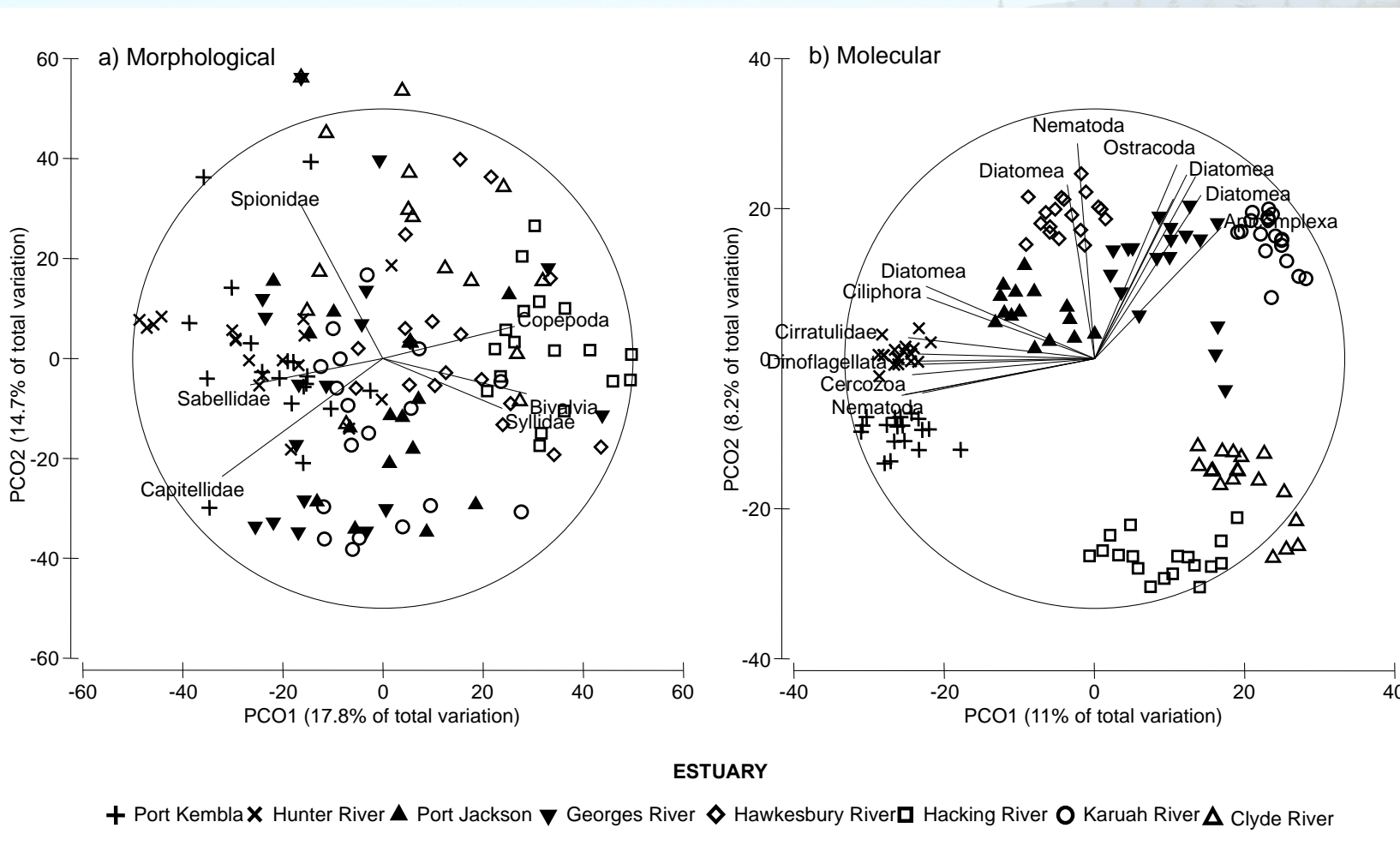
## Environmental parameters

Salinity  
Temperature  
Dissolved oxygen  
pH  
Sediment %silt  
DIC  
Latitude

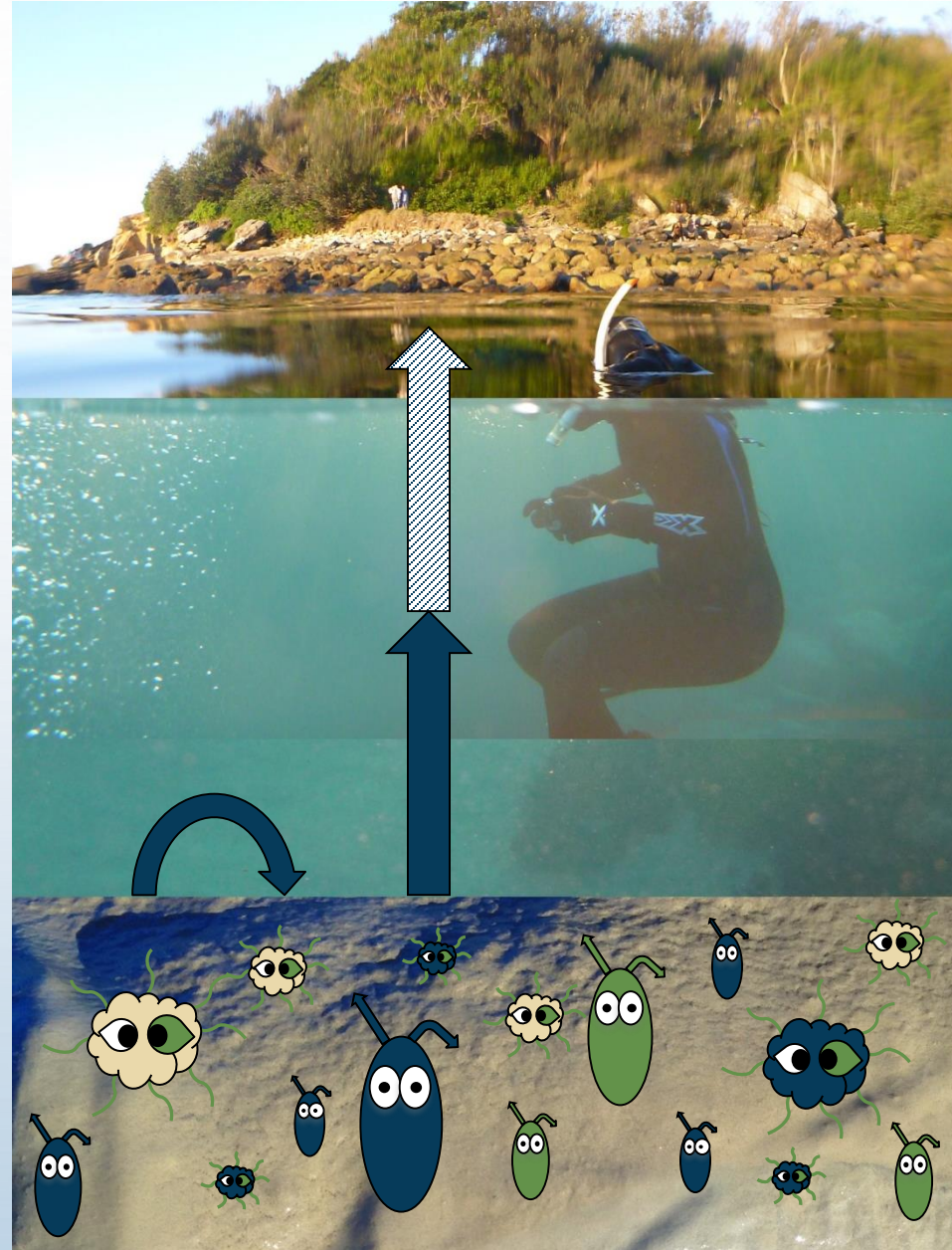




# HIGHEST RESOLUTION AND FULL DATASET

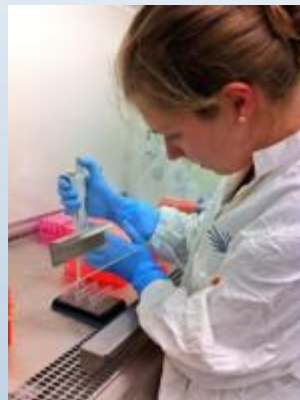


Soft sediment communities  
perform major  
biogeochemical processes

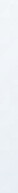




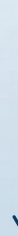
# Sampling – microbial community



total  
RNA

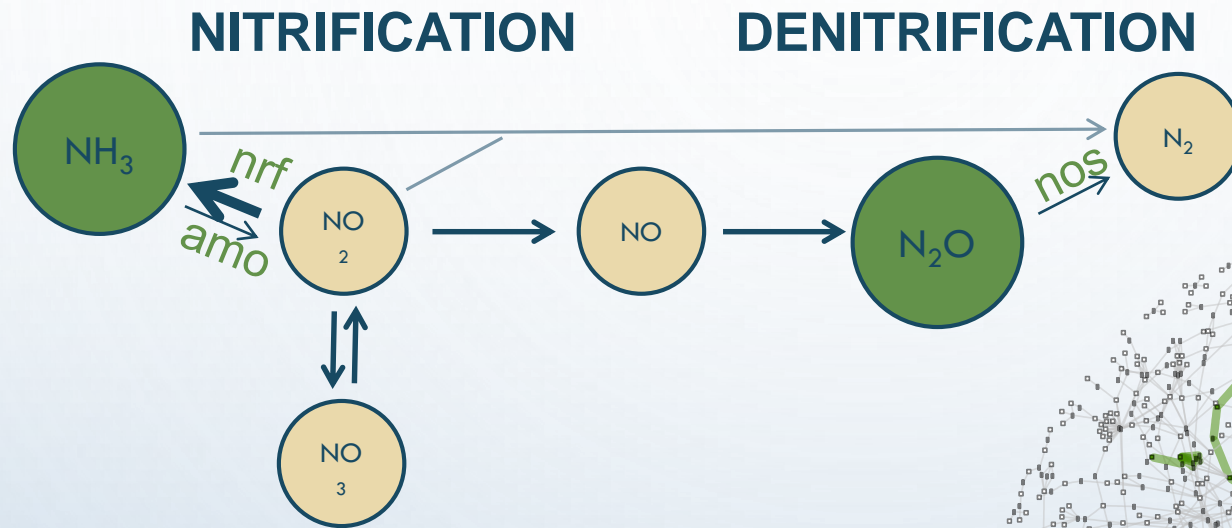


Metatranscriptomics



Metabolic functions

# Impact of nutrient enrichment in sediment microbial function



Birrer et. al. in press  
Environmental Microbiology

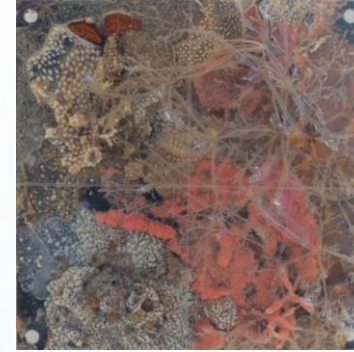
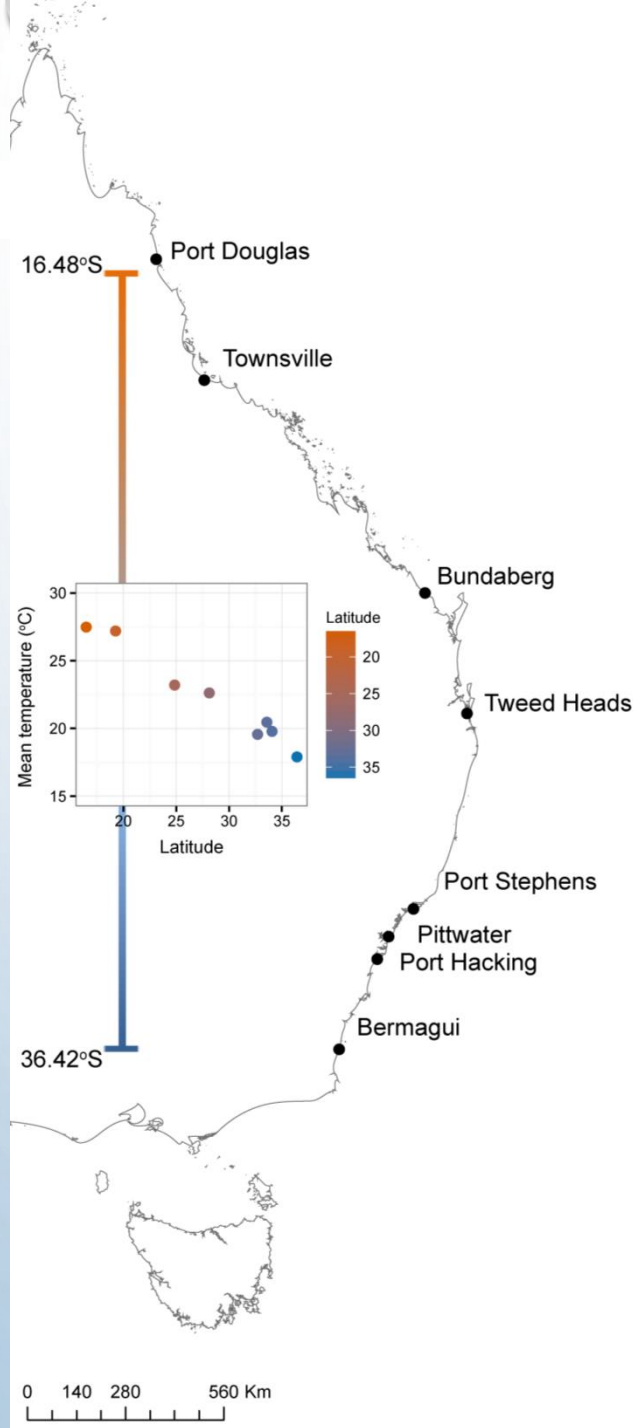
Nutrient enrichment leads to accumulation of:

- Ammonia
- $\text{N}_2\text{O}$



And disruption of nitrogen metabolism gene network





Bracewell *et al.* 2017. *Ecology Letters*  
 Bracewell *et al.* 2018. *Ecology*  
 Lavender *et al.* 2017 *Ecology*

**A lot of our ‘rules’ of community assembly  
 will need to be calibrated –  
 and then constantly recalibrated as we  
 speed up ecological processes**



*Only by understanding spatial and temporal ecology will we be able to estimate ecological boundaries and advise on how best to prevent further biodiversity loss*





Photo Antonia Cooper





Image - Peter Southwood