Catherine Lovelock

- BSc (Agric) University of Western Australia
- PhD James Cook University, QLD (1992)
- Post Doc #1, Research School of Biological Sciences, ANU
- Post Doc #2, Smithsonian Tropical Research Institute, Panama
- Post Doc #3, Smithsonian Environmental Research Center (SERC), Maryland
- Senior Research Scientist (SERC)
- University of Queensland (2004)
Human influences on the biosphere

% increase due to human activities

Human influences on the biosphere

- A lot of the nutrients end up in the marine environment
- Impacts of nutrient enrichment?
- Interactions with climate change?
Plant ecophysiology

- A “bottom – up” perspective
- Explores the physiological mechanisms underlying species distributions or the “occupation of ecological space” (Rickliffs 2008) – Niche theory
- Establishing “fundamental” and “realized” niches
- Tolerances and resources. Traits important for growth, reproduction, water loss, nutrient uptake and loss, competition, herbivory, mutualisms, etc…
- Phenotypic plasticity, adaptation
Challenges

- Implications for understanding patterns of diversity, productivity and resilience of ecosystems (David Tilman)
- Predictive: e.g. the effects of environmental change (Ecological Niche Models etc…read Soberon, 2007)
- Reconciling large scale patterns in diversity with the idea of the niche, e.g. Neutral Theory – importance of scales
The first picture of a ribosome.


Ecological Stoichiometry

The study of the balance of energy and multiple chemical elements in ecological systems

• e.g. competition, herbivory, mutualism, food webs, biogeochemistry, etc.

Biological Stoichiometry

The study of the balance of energy and multiple chemical elements in biological systems

• e.g. cellular metabolism, growth and development, physiological homeostasis, behavior, evolutionary change, ecology, etc.

2002
Alfred C. Redfield


**Redfield Ratio**

- Plankton \[106C:16N:1P\]
- Deep water OM \[105C:15N:1P\]
- Seawater \[1000C:15N:1P\]
The requirements of phytoplankton

Redfield ratio has been useful

- $N:P > 16$ limitation by WHAT?
- $N:P < 16$ limitation by WHAT?
The Growth Rate Hypothesis

Variations in rDNA (IGS, copy #) → Natural selection on growth rate → Cellular investment (ribosome content) → Biochemical investment (RNA:protein) → Body C:N:P

- Food quality constraints on growth / reproduction
- Resource competition
- Trophic efficiency
- Nutrient recycling

Cellular components

- Organisms are ~ 30 – 75% protein
- Average N content of protein 17%
- Nucleic acids, DNA, mRNA, tRNA, rRNA are rich in P
- RNA:DNA is about 5:1, rRNA dominates

N is essential for protein synthesis, P is essential for replication, cell division
Ribosomal RNA

- 50-60% of the ribosomes
- 80-90% of cell RNA
- 10 million of them required for protein synthesis
- P is important for growth
Review

Biological stoichiometry from genes to ecosystems

Elser et al. 2000

Elser et al. 2003

Growth rate–stoichiometry couplings in diverse biota

Global trends in terrestrial forests:

Authors favour global geochemical signature

Reich and Oleksyn 2004
Cold temperatures lead to increases in N and P of tissues

- Cold temperatures require increases in the “catalytic capacity”
- Reductions in efficiency

Woods et al. 2003
P resorption efficiency shows a decline with increasing latitude. 

- C, N and P treatments not sig. different over latitude 
- Both Avicennia and Rhizophora behave similarly 

Lovelock et al. 2007
No evidence to support the Growth Rate Hypothesis.
Faster growth at higher latitudes

Evidence supporting the Growth Rate Hypothesis. Higher growth rates demand higher nutrient contents at high latitudes.
Implications

• Evidence for the role of low P availability in determining traits in the tropics
• Some evidence for Growth Rate Hypothesis (intrinsically higher rates of growth in temperate species)