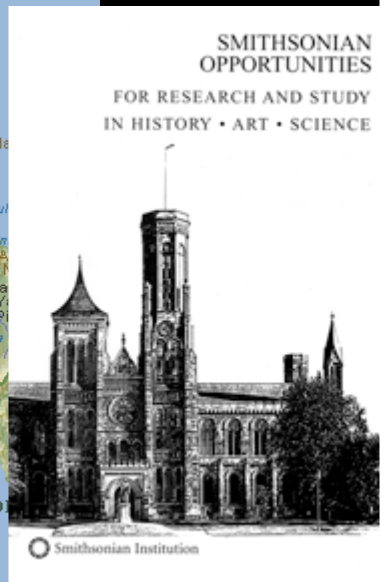
Catherine Lovelock

- 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)

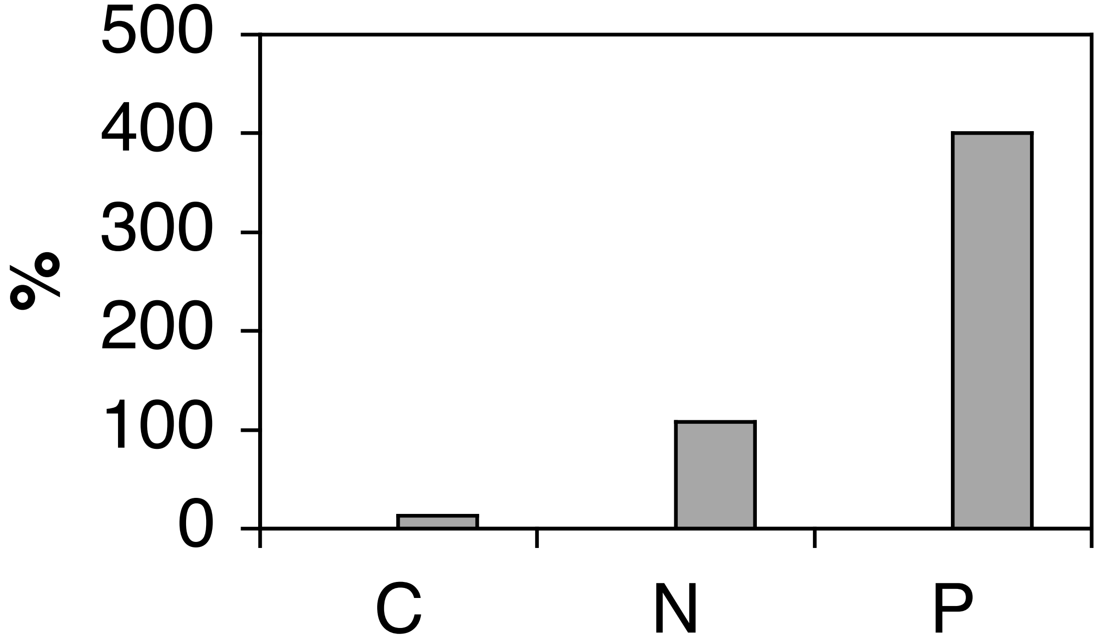
Smithsonian Tropical Research Institute



http://www.stri.org/english/education_fellowships/fellowships/index.php

Human influences on the biosphere

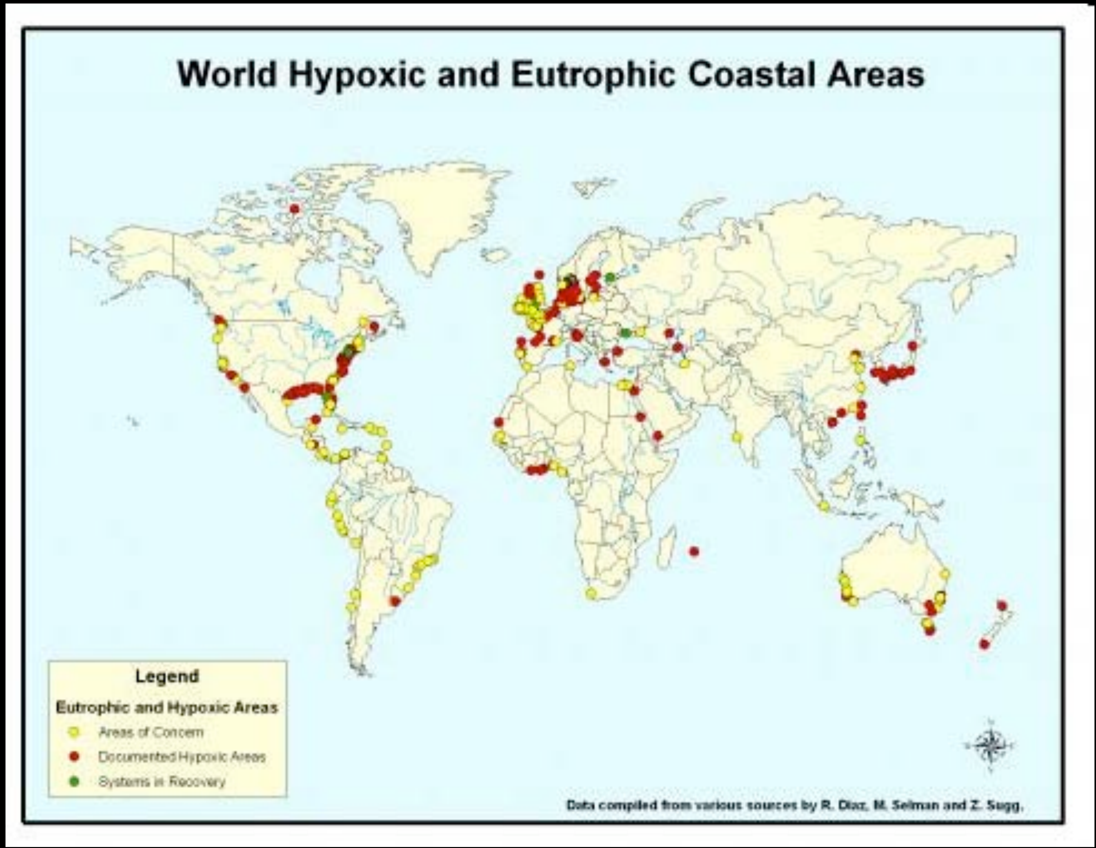
% increase due to human activities



FALKOWSKI, P. and others 2000. The global carbon cycle: a test of our knowledge of Earth as a system. Science **290:** 291-296.

Human influences on the biosphere

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

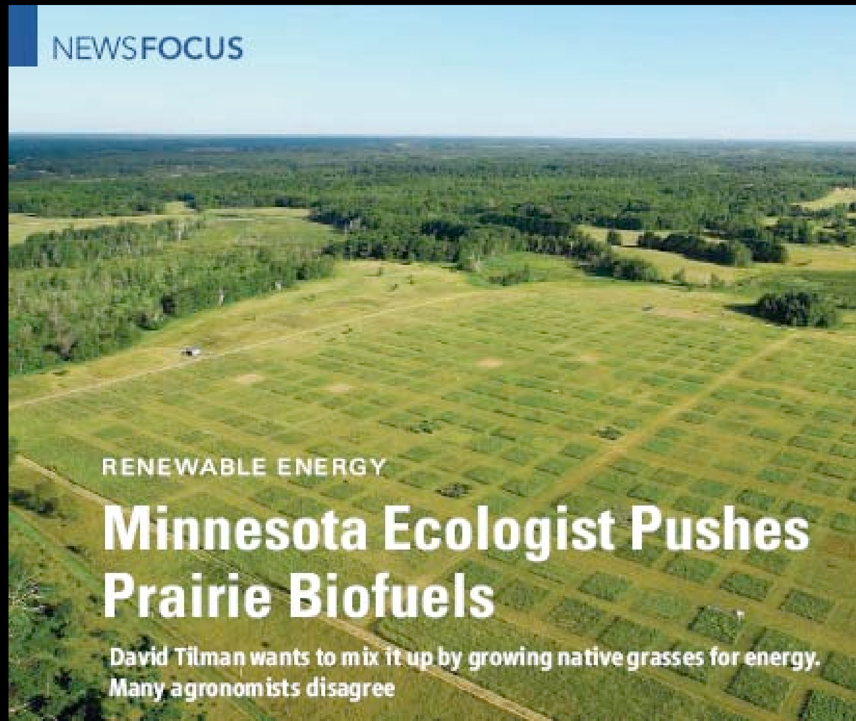


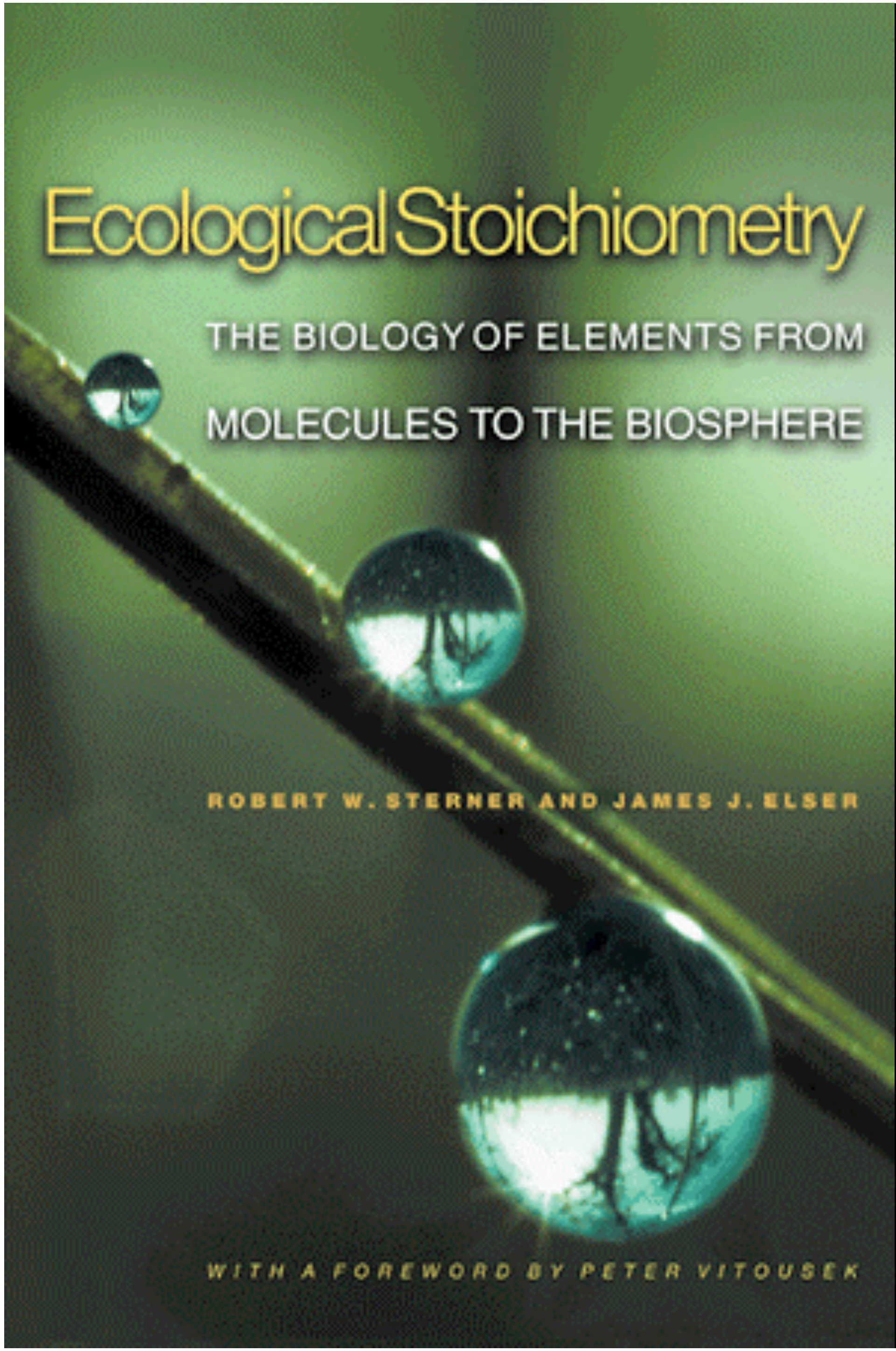
Plant ecophysiology

- 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





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.

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.

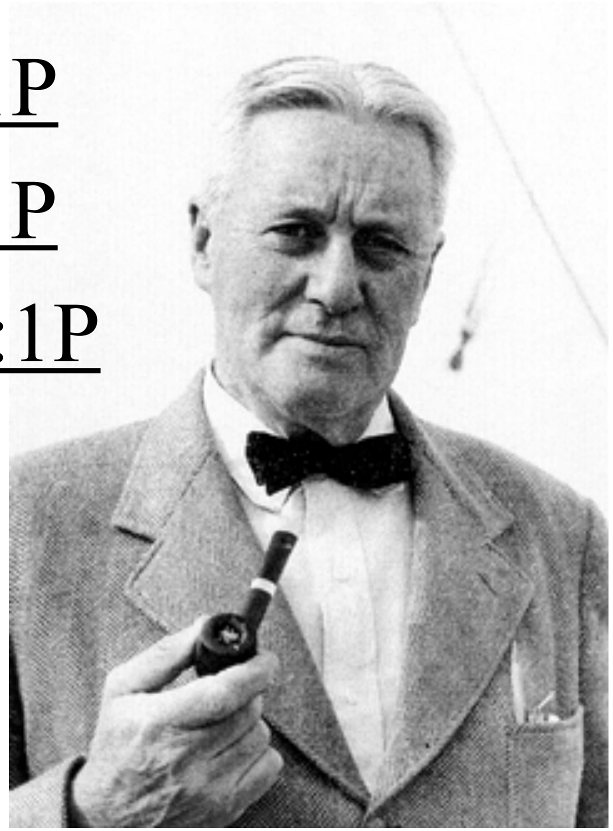
2002

Alfred C. Redfield

1934 On the proportions of organic derivatives in sea water and their relation to the composition of plankton. In *James Johnstone Memorial Volume*, pp. 176-92. Liverpool: University of Liverpool.

Redfield Ratio

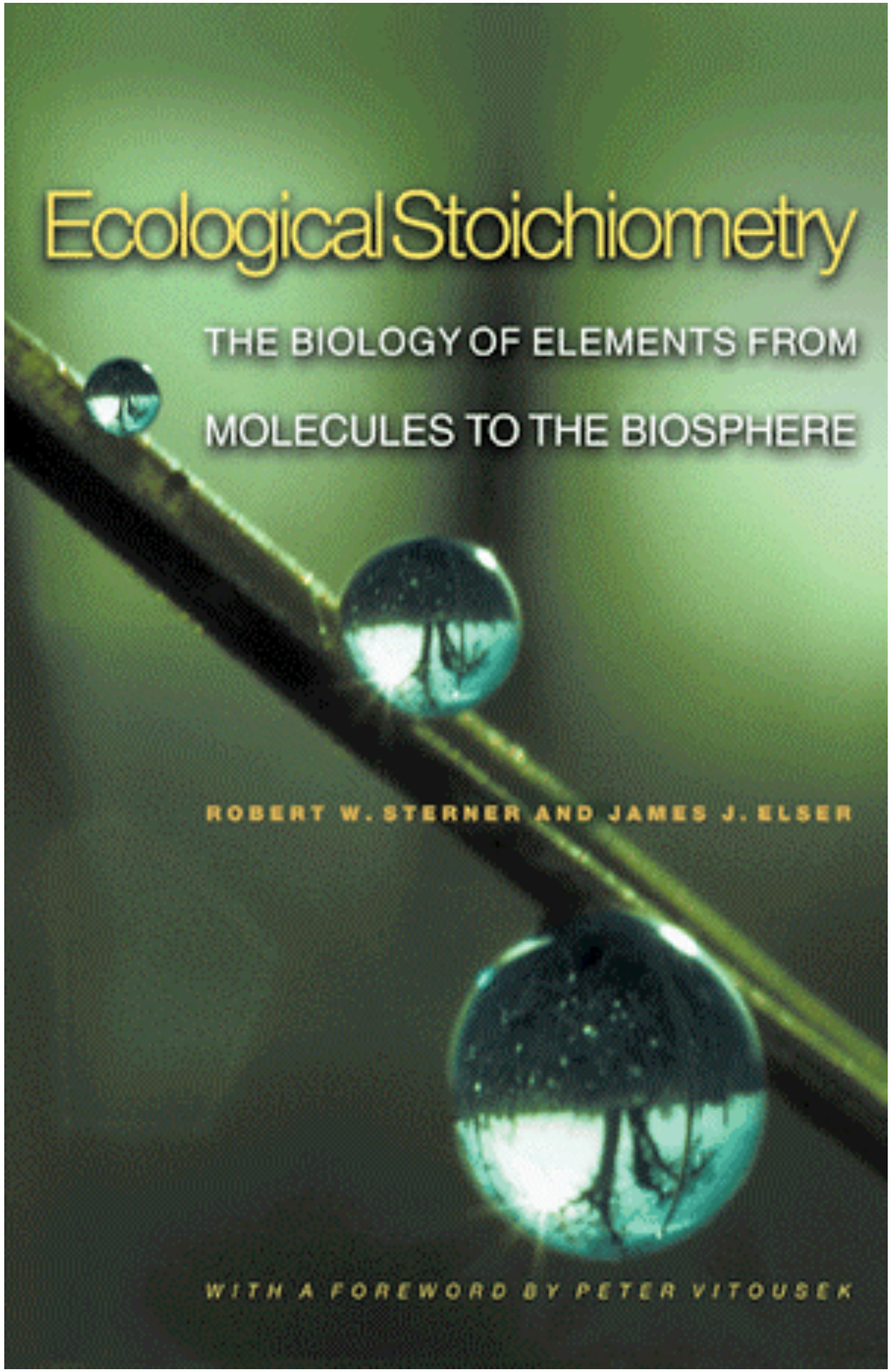
- Plankton 106C:<u>16N:1P</u>
- Deep water OM 105C:<u>15N:1P</u>
- Seawater 1000C:<u>15N:1P</u>



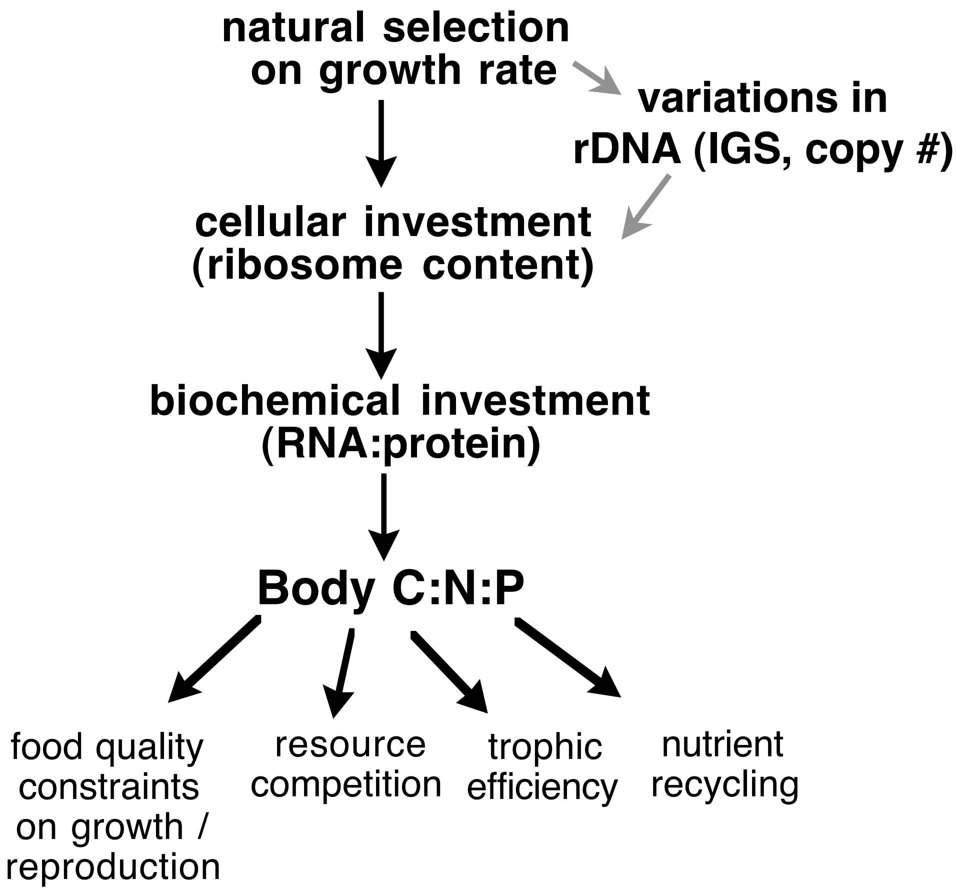
The requirements of phytoplankton

Redfield ratio has been useful

- N:P > 16………….limited by WHAT?
- N:P < 16………….limited by WHAT?



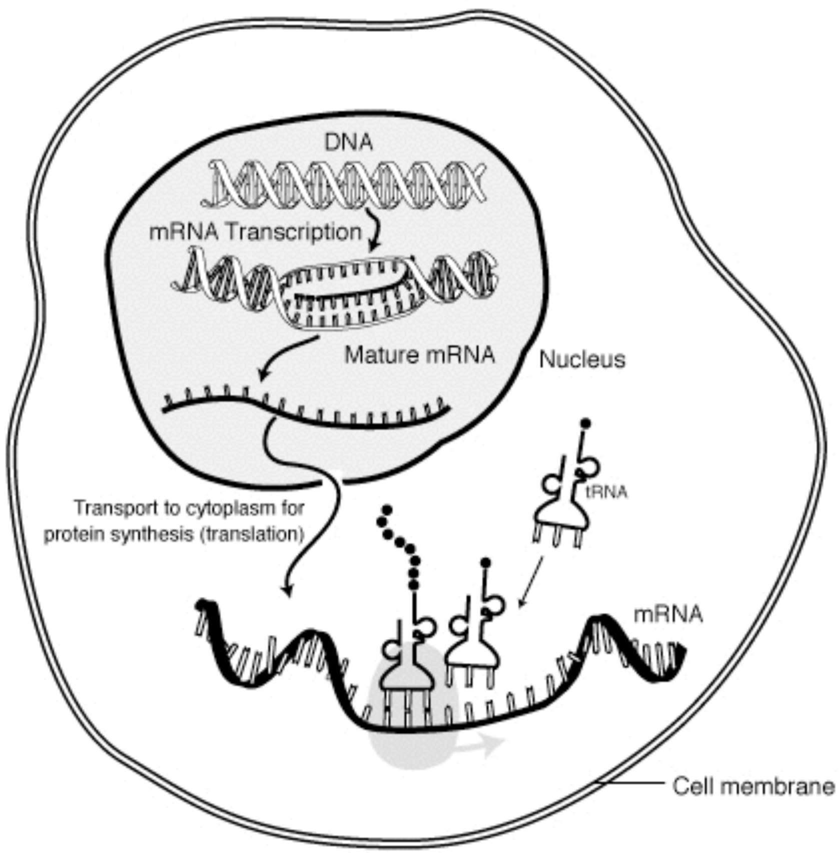
The Growth Rate Hypothesis



Based on: Elser, J.J., R.W. Sterner, E. Gorokhova, W.F. Fagan, T.A. Markow, J.B. Cotner, J.F. Harrison, S.E. Hobbie, G.M. Odell, L.J. Weider. 2000. Biological stoichiometry from genes to ecosystems. Ecology Letters **3**: 540-550.

Cellular components

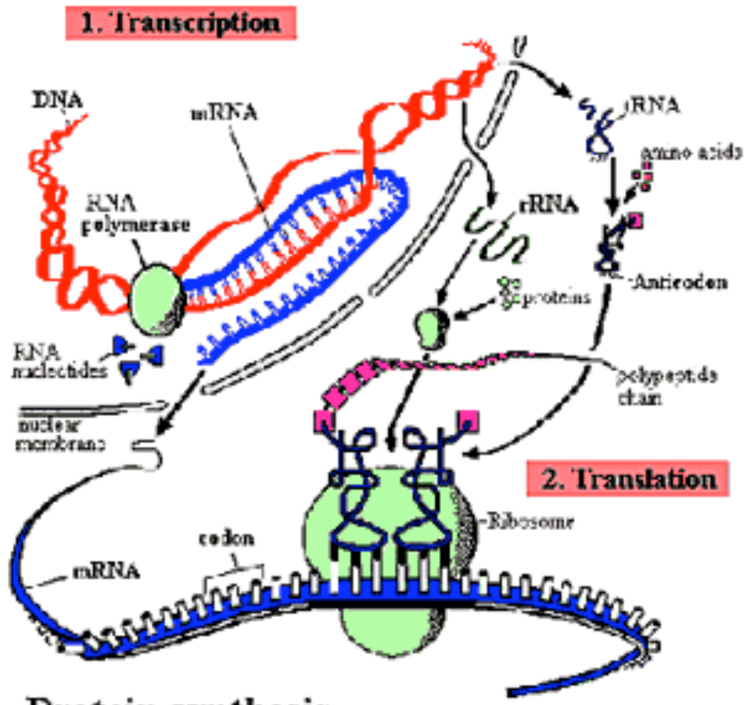
- Organisms are ~ 30 – 75% protein
- Average N content of protein 17%
- Nucleic acids, DNA, mRNA, tRNA, rRNA are rich in P
- RNA:DNA is about 5:1, rRNA dominates



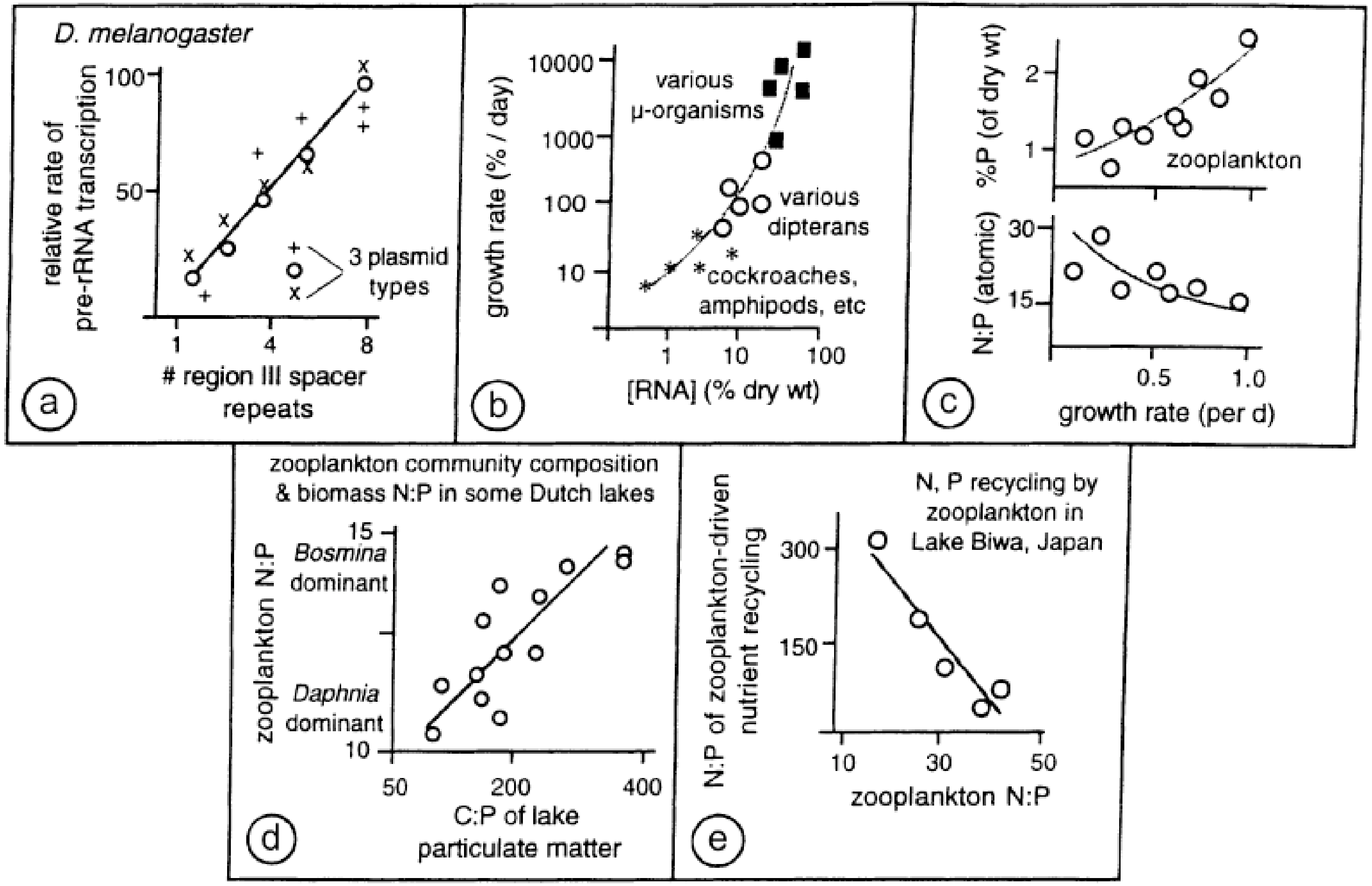
N is essential for protein synthesis, P is essential for replication, cell division

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



Protein synthesis

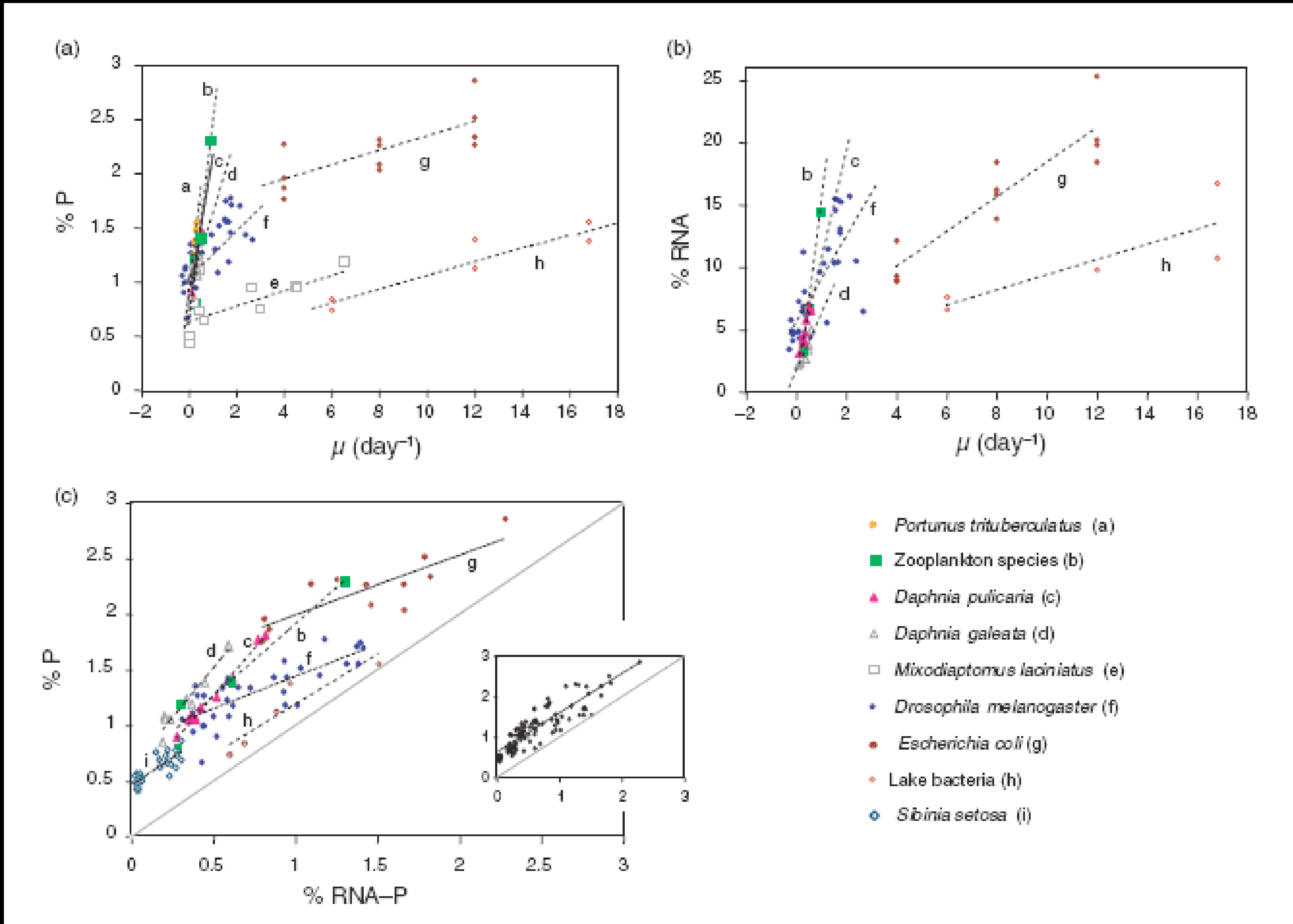


Ecology Letters, (2000) **3**:540–550

REVIEW

Biological stoichiometry from genes to ecosystems

Elser et al. 2000



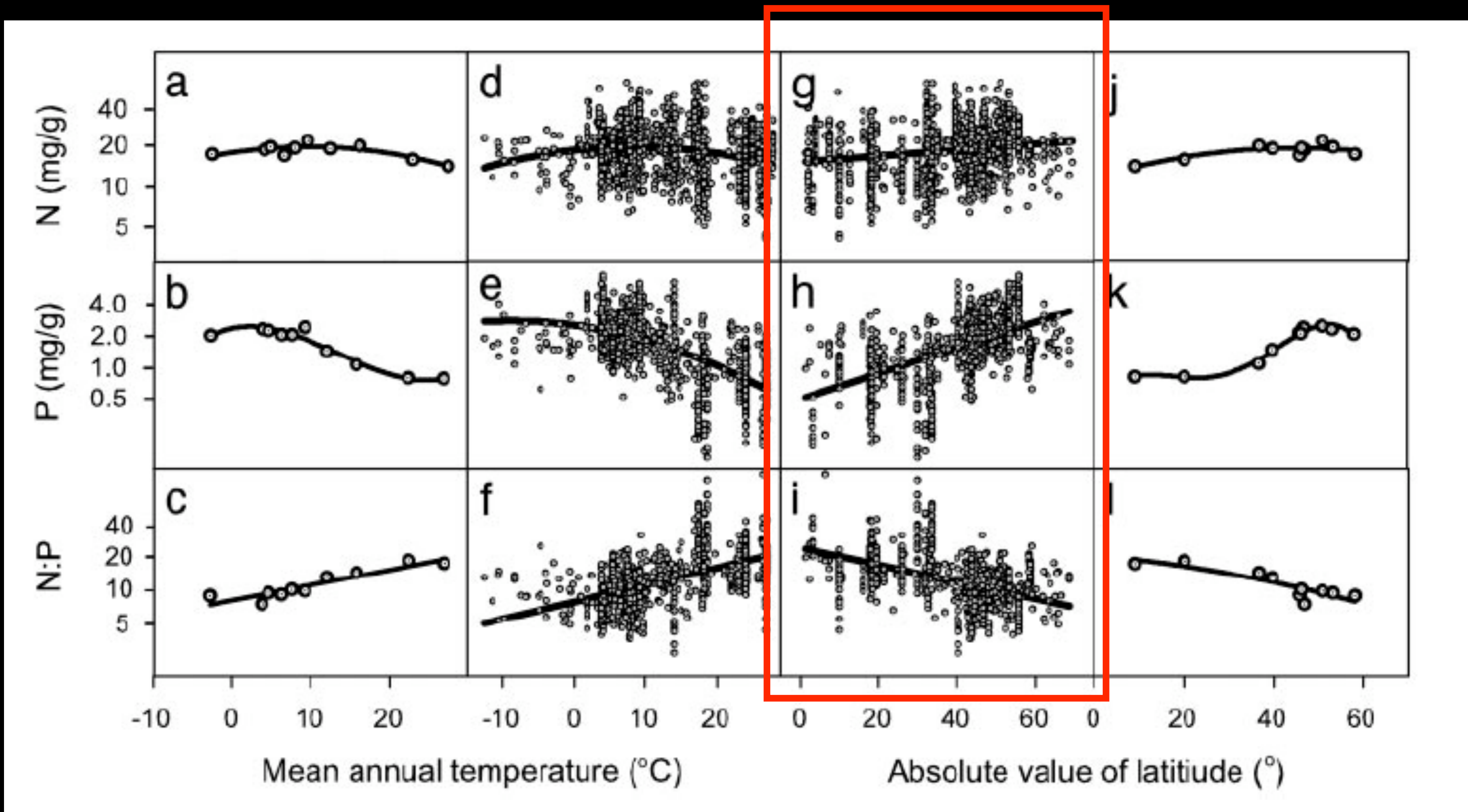
Ecology Letters, (2003) 6: 936–943 doi: 10.1046/j.1461-0248.2003.00518.x

REPORT

Growth rate–stoichiometry couplings in diverse biota

Elser et al. 2003

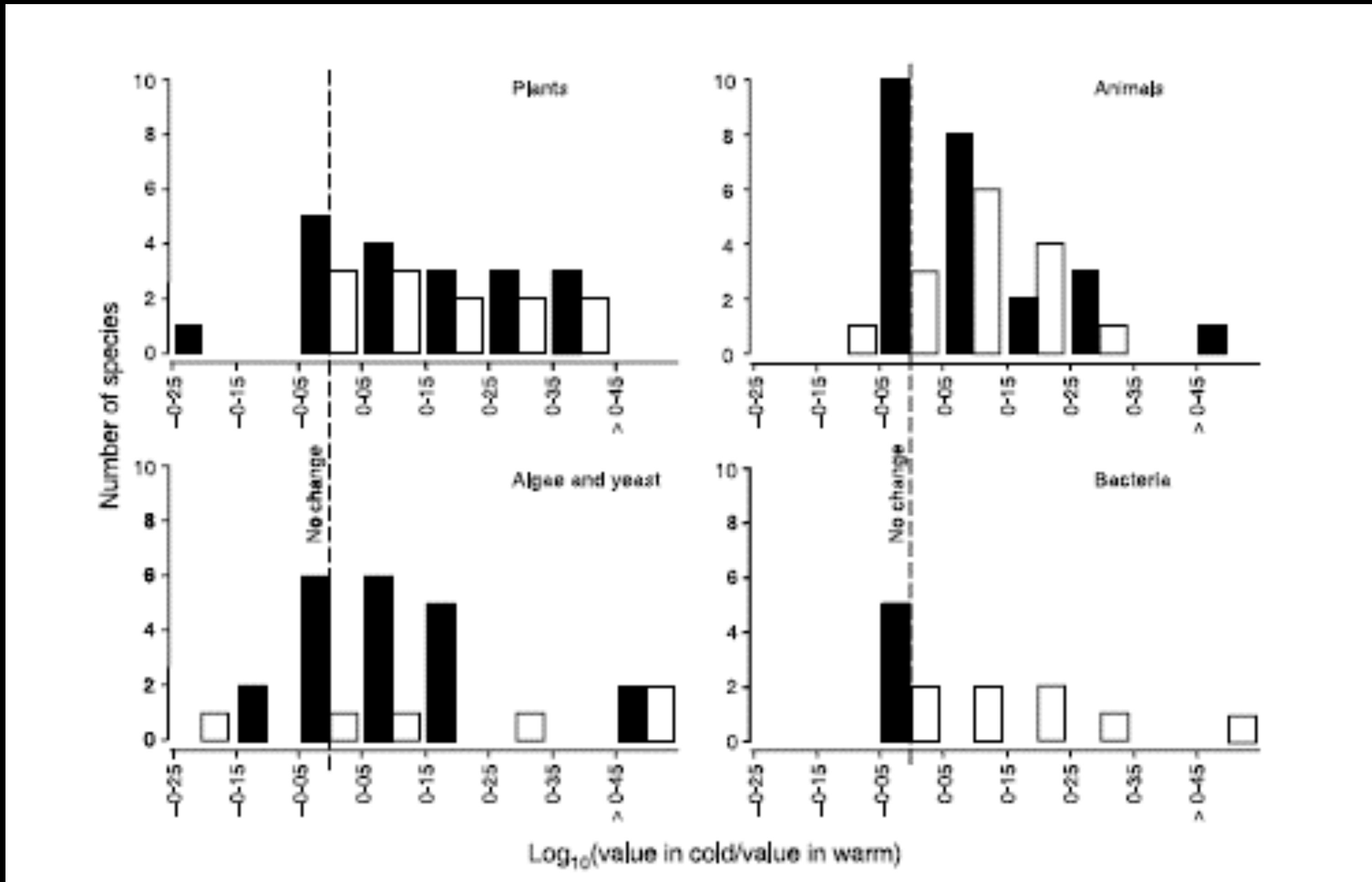
Global trends in terrestrial forests:



Authors favour global geochemical signature

Reich and Oleksyn 2004

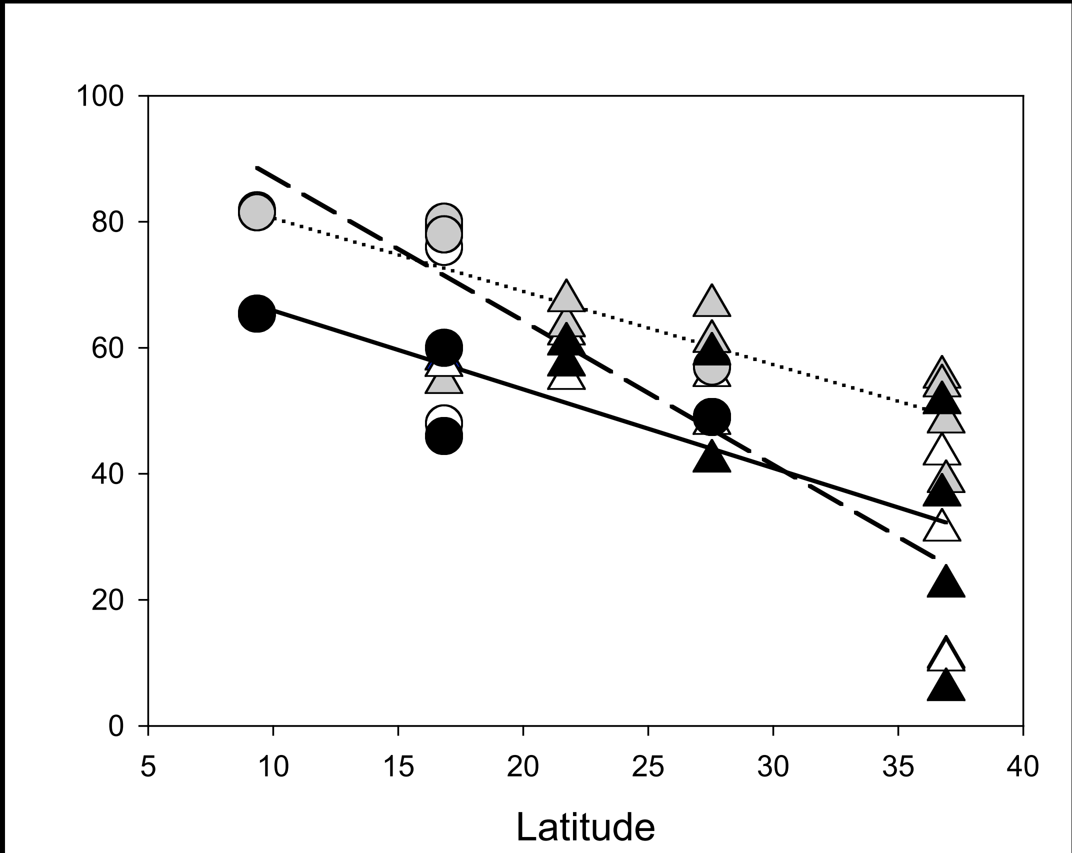
Cold temperatures lead to increases in N and P of tissues



Dark bars = N, Light = P or RNA

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

Woods et al. 2003



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

Lovelock et al. 2007

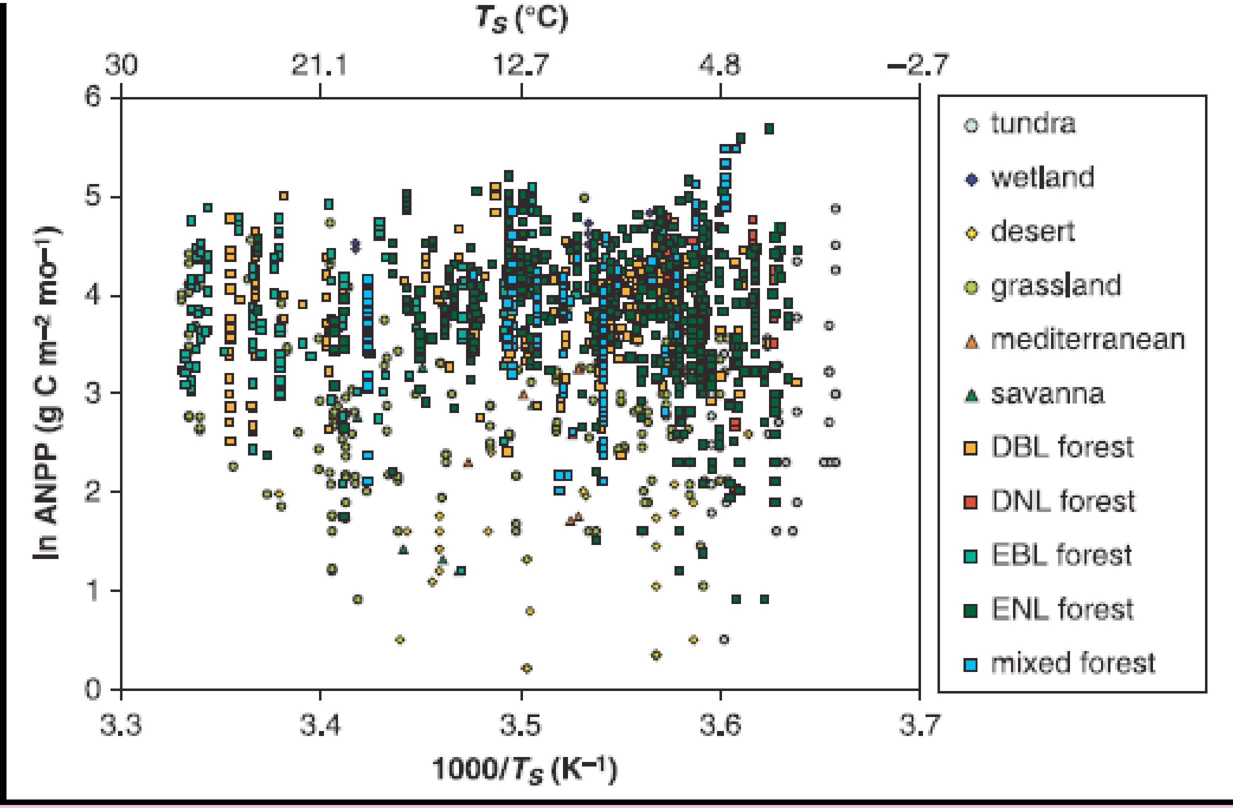
P resorption efficiency shows a decline with increasing latitude

Global Ecology and Biogeography, (Global Ecol. Biogeogr.) (2005) **14**, 585–598

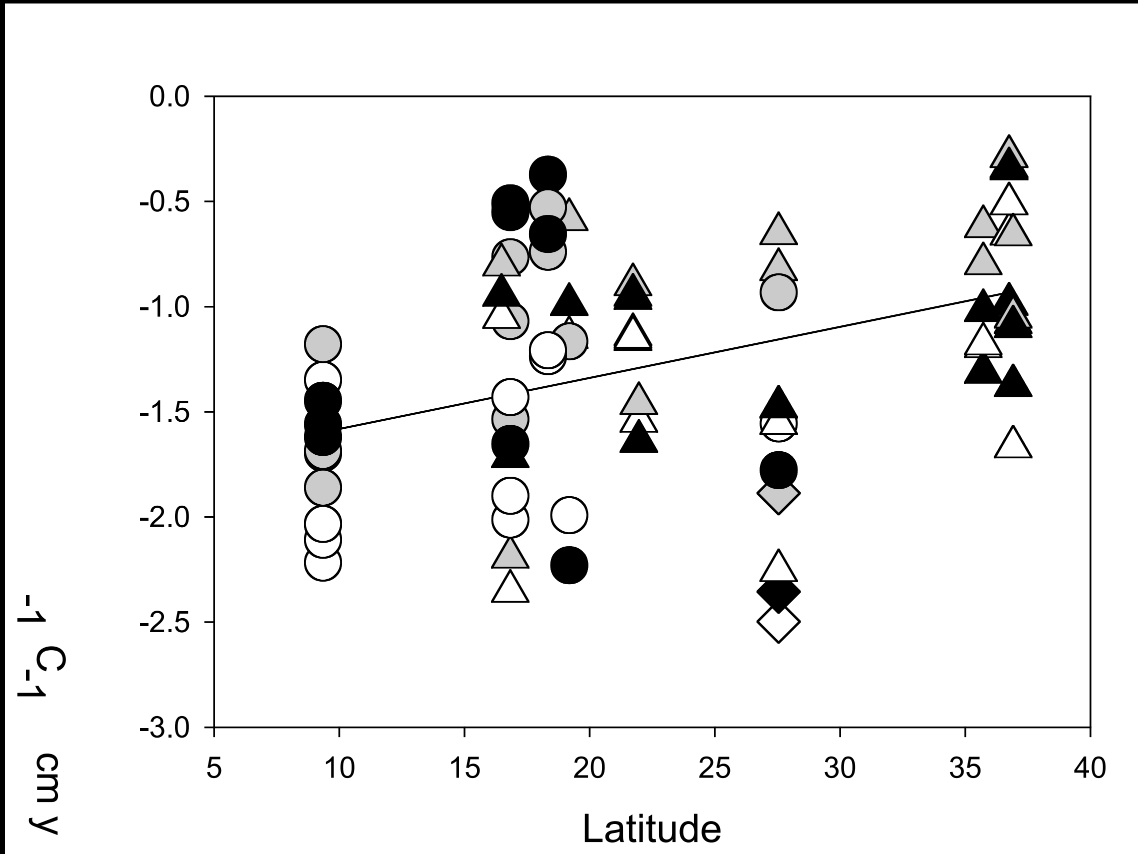
RESEARCH PAPER

Plant allometry, stoichiometry and the temperature-dependence of primary productivity

Andrew J. Kerkhoff[1,*], Brian J. Enquist[1], James J. Elser[2] and William F. Fagan[3]



No evidence to support the Growth Rate Hypothesis.



Faster growth at higher latitudes

Lovelock et al. 2007

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)