Evolutionary trade-offs may constrain responses to N enrichment

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Linkages among species traits

Global change

N response
Decomposition

Community composition

Ecosystem function

Lavorel & Garnier 2002
Evolutionary trade-off: Hypothesis

Tolerance of low N habitats

Use of recalcitrant organic carbon
Evolutionary trade-off: Hypothesis

Organic N use

Use of recalcitrant organic carbon
Substrate use profiles

- 71 organic substrates
- Cyclic & non-cyclic
- 46 to 1302 g mol\(^{-1}\)
- 0 to 32% N
519 bacterial taxa

- Firmicutes
- Actinobacteria
- Proteobacteria
- Bacteroidetes
Traits for each taxon

Recalcitrant compound use:
- Proportion cyclic compounds
- Avg. molar wt
- Cyclic carbohydrate genes

Nitrogen use:
- Avg. organic N concentration
- Inorganic N genes

Nitrogen requirements:
- Ocean nitrate concentrations
- Latitudinal distribution in soil
Global ocean sampling: 29 sites

Rusch et al. 2007
Soil synthesis: 80 sites

Millet et al. unpubl. data
Phylogeny of functional groups

Blue = labile users
Red = recalcitrant users

Firmicutes

Actinobacteria

Proteobacteria

Bacteroidetes
*Pseudomonas* tolerates lower ocean nitrate

![Graph showing comparison between Micrococcineae and Pseudomonas (Recalcitrant vs. Labile users)]
**Pseudomonas at mid-latitudes in soil**

The graph compares the latitude in soils (degrees north) of two groups: Micrococcineae and Pseudomonas. The y-axis represents latitude ranging from 0 to 35 degrees north. The x-axis categorizes the groups into Recalcitrant users and Labile users. The graph shows that Pseudomonas has a significantly higher latitude range compared to Micrococcineae, indicating a higher tolerance or adaptation to mid-latitudes in soil.
Relationships among traits

- Inorganic N
- Soil genes
- Substrate [N]
- Cyclic carb. genes
- Cyclic substrates
- Ocean NO_3
- Molar
- wt

**Summary of traits**

**Labile users:**
- Non-cyclic compounds
- Smaller substrates
- Higher organic [N]
- Lower ocean nitrate
- Higher soil latitudes

**Recalcitrant users:**
- Cyclic compounds
- Larger substrates
- Lower organic [N]
- Higher ocean nitrate
- Lower soil latitudes
Acknowledgements

Eric Millet
Jennifer Martiny
Steve Allison
Jim Randerson
Matt Whiteside

Jenny Talbot
Sandra Dooley
Rebecca Aicher
GOS investigators
NSF, DOE, Kearney