



Analysis of cold-temperature crude oil-degrading bacterial communities

Susan Rowsell, M.E.Des, M.Sc.,
HydroQual Laboratories Ltd.

Angus Chu, Ph.D., Department of Civil
Engineering, University of Calgary

Research

- Purpose

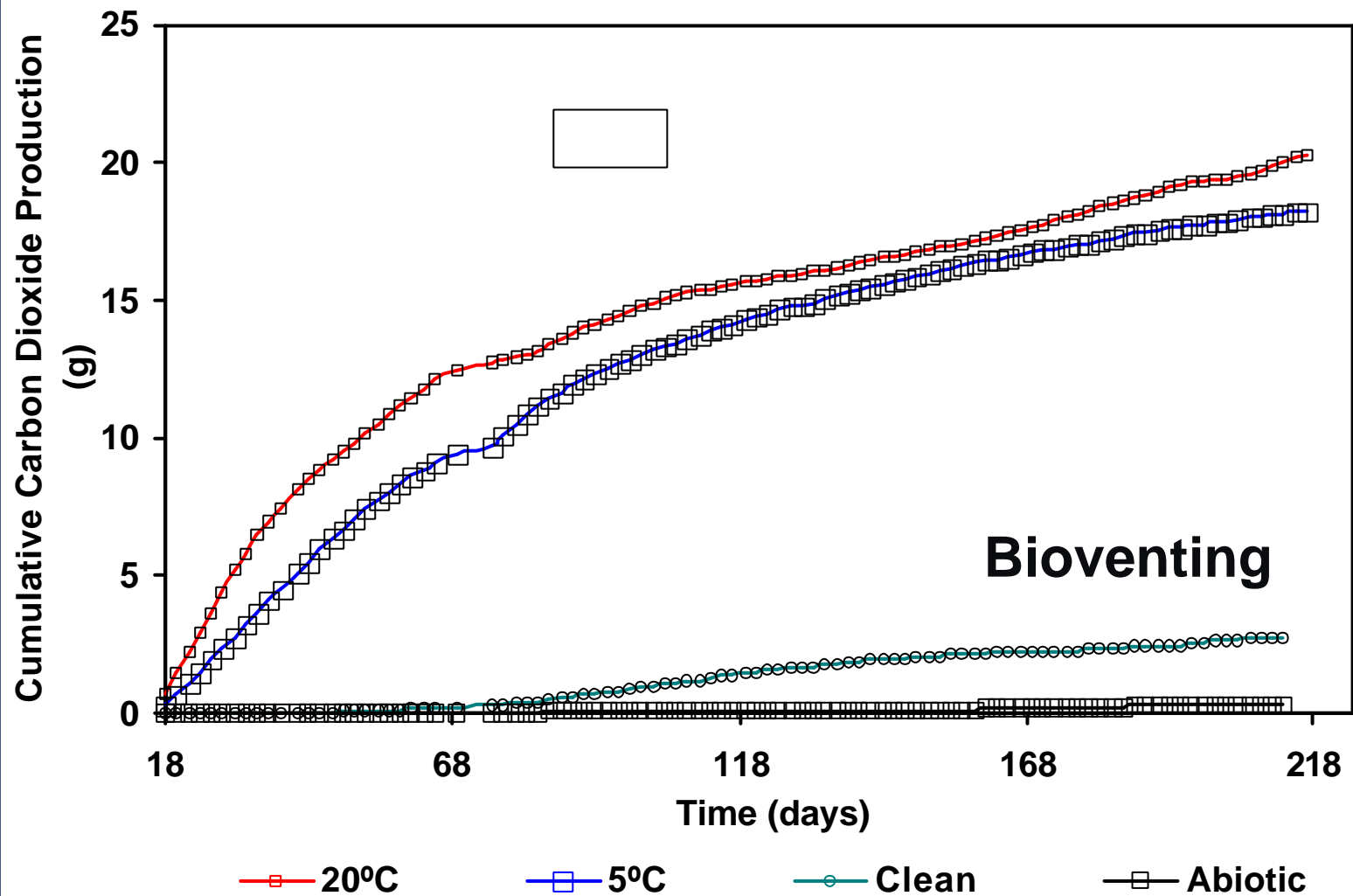
- To gain a greater understanding of cold-temperature bioremediation processes

- What is the effect of temperature on:
 - the bioremediation of hydrocarbons?
 - the bacterial community?

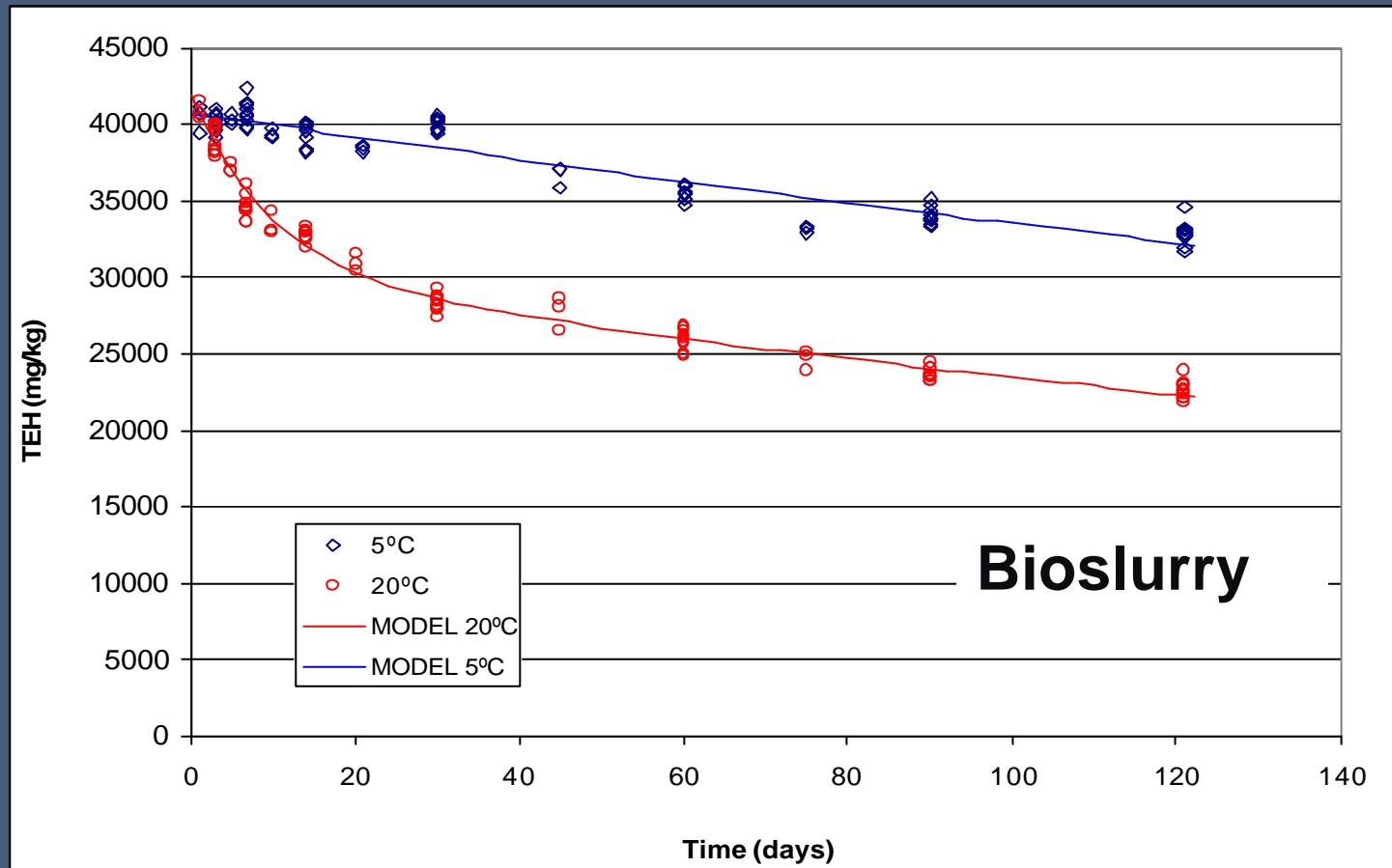
Biodegradation Approach

Study	Goal
Bioventing	Determine biodegradation rates at 5°C vs. 20°C
Bioslurry	Investigate the differences in the biodegradation rate and extent at 5°C vs. 20°C
Bioslurry	Observe the differences in biodegradation rates of various distillate fractions at 5°C vs. 20°C

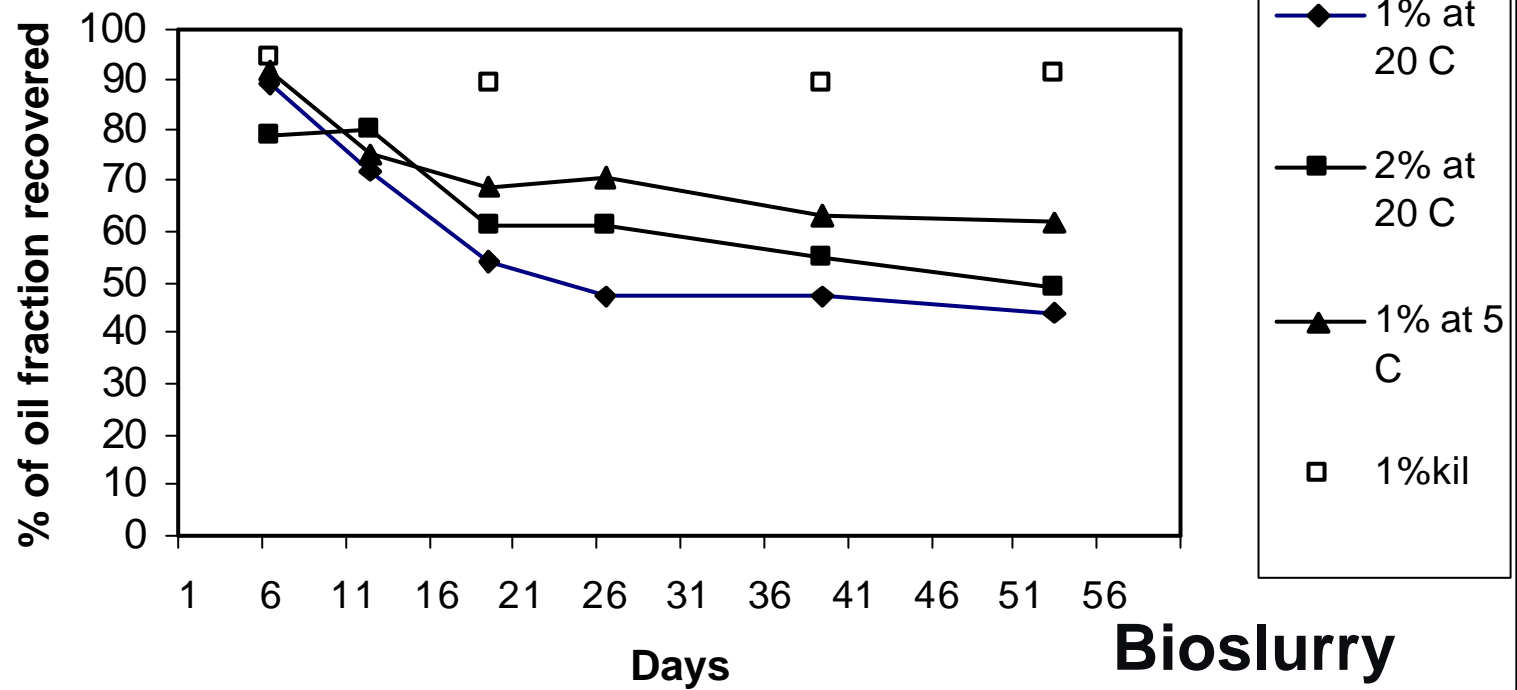
Biodegradation Curves



Biodegradation Curves

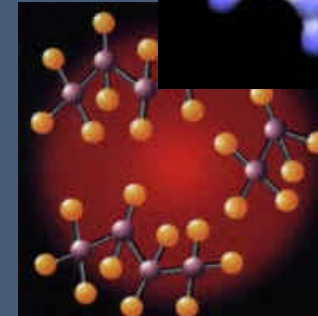
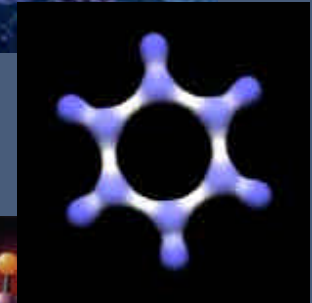


Biodegradation Curves



Community Approach

- Species diversity
- Gram ratios
- Metabolic capabilities
- Physiological changes



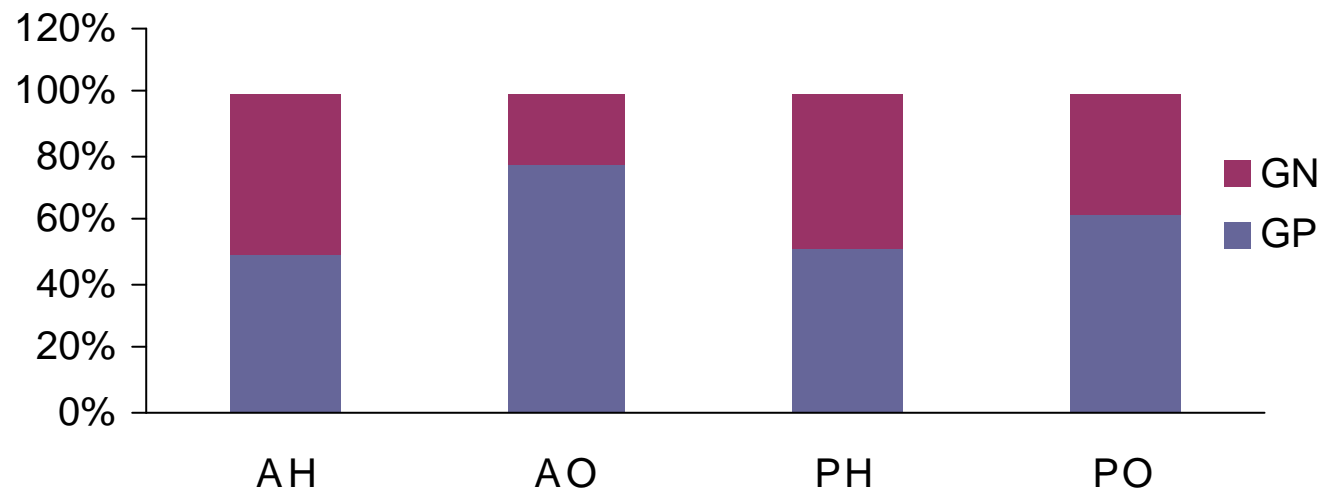
Species Diversity

- In cold-contaminated soil:
 - Lower total species diversity
 - Similar species diversity in cold-temperature oil-degraders
 - Possible competitive adaptations in cold-temperature community



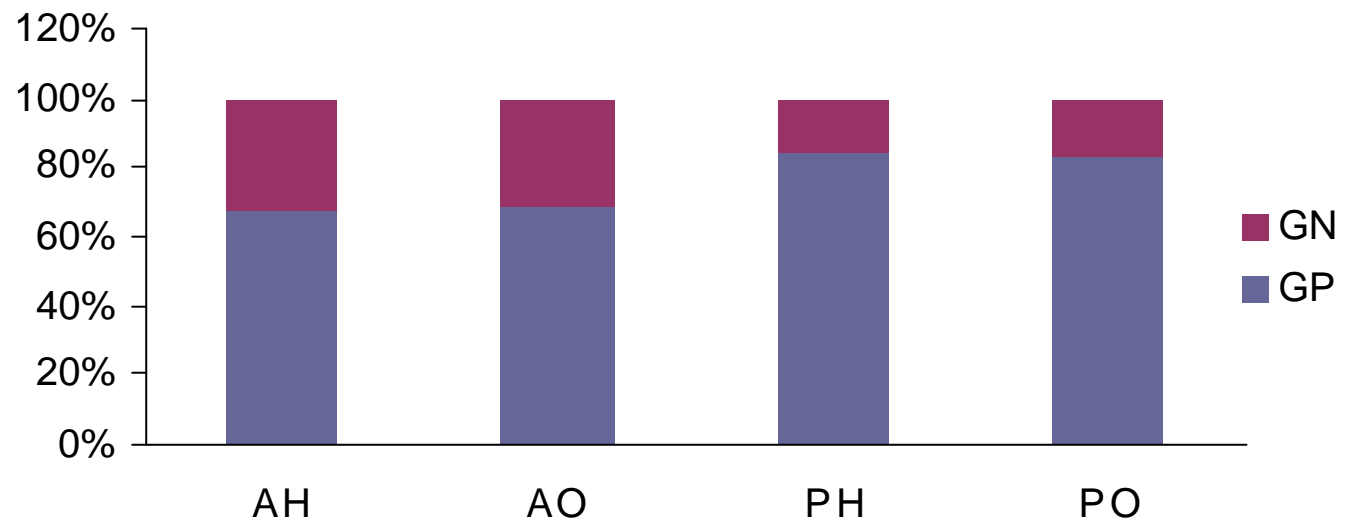
Gram Ratios

Gram distribution in ambient contaminated soil



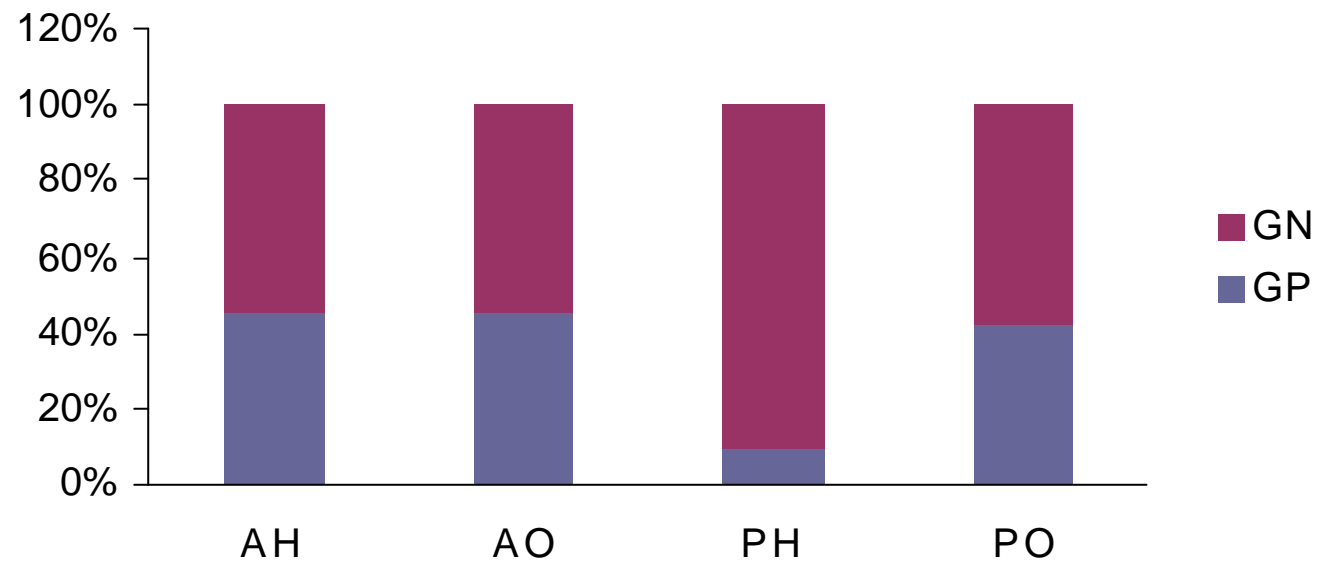
Gram Ratios

Gram distribution in cold uncontaminated soil



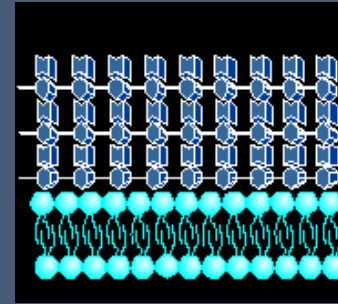
Gram Ratios

Gram distribution in cold contaminated soil

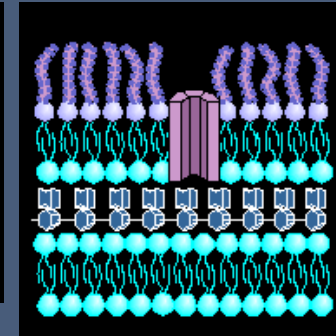


Gram Ratios

- GNs favoured due to ability to withstand hydrocarbons better

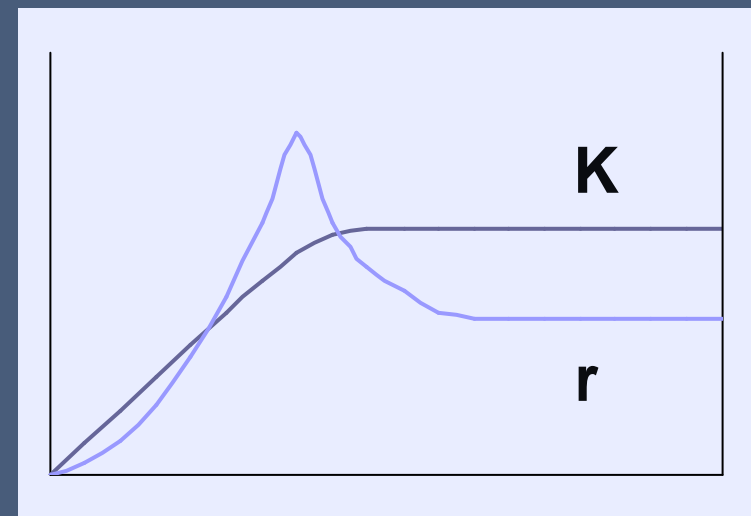


GP



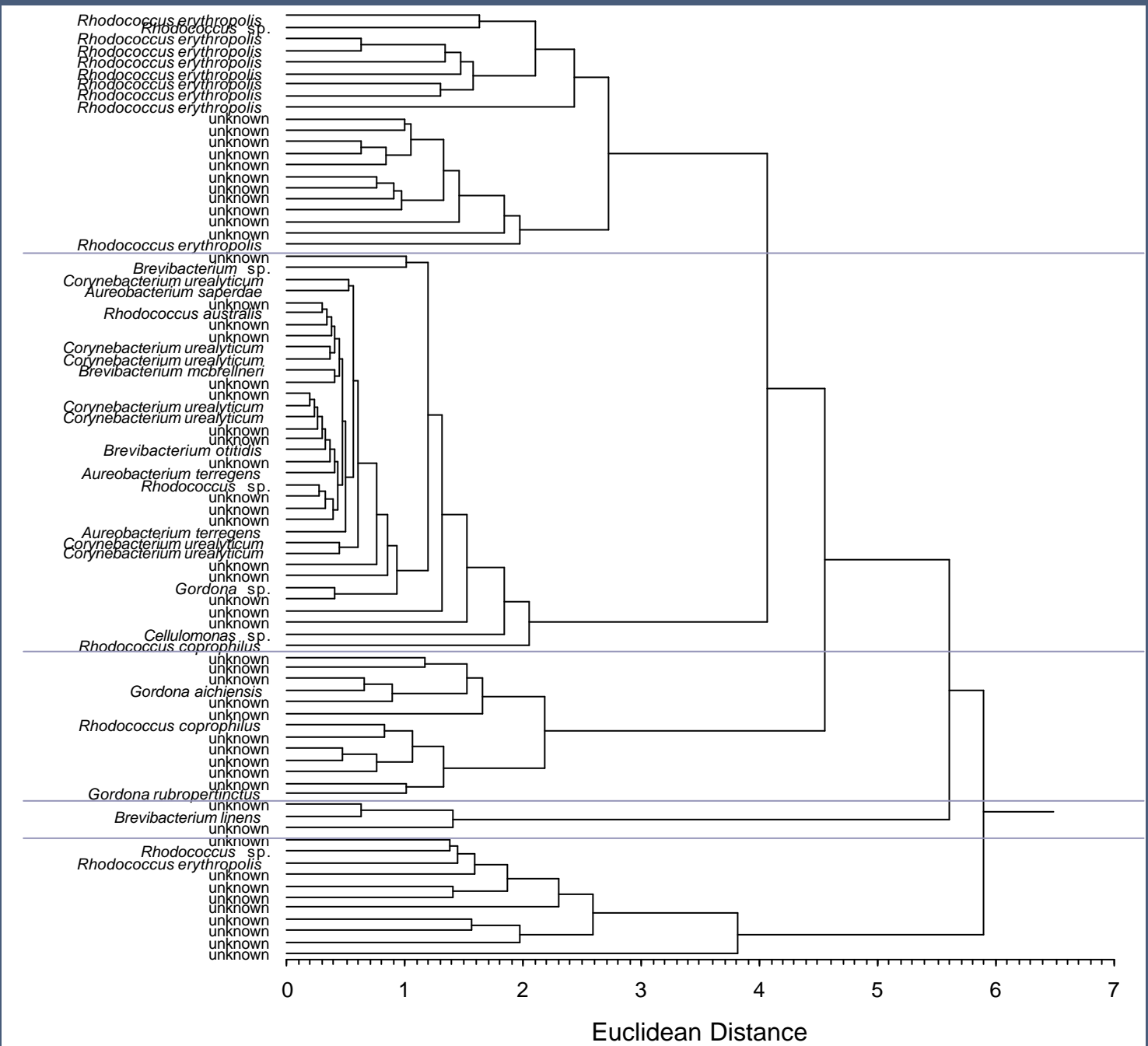
GN

- GP can represent climax community
 - r/K strategist theory



Community Function

- Clustering metabolic traits
 - Functionally distinct groups



Community Function

- Warm vs. cold-contaminated soils
 - Some GP isolates common to both soils
 - Some GP isolates unique to cold soil
- Cold temperature produces functionally similar GP groups, regardless of the presence of crude oil

Community Function

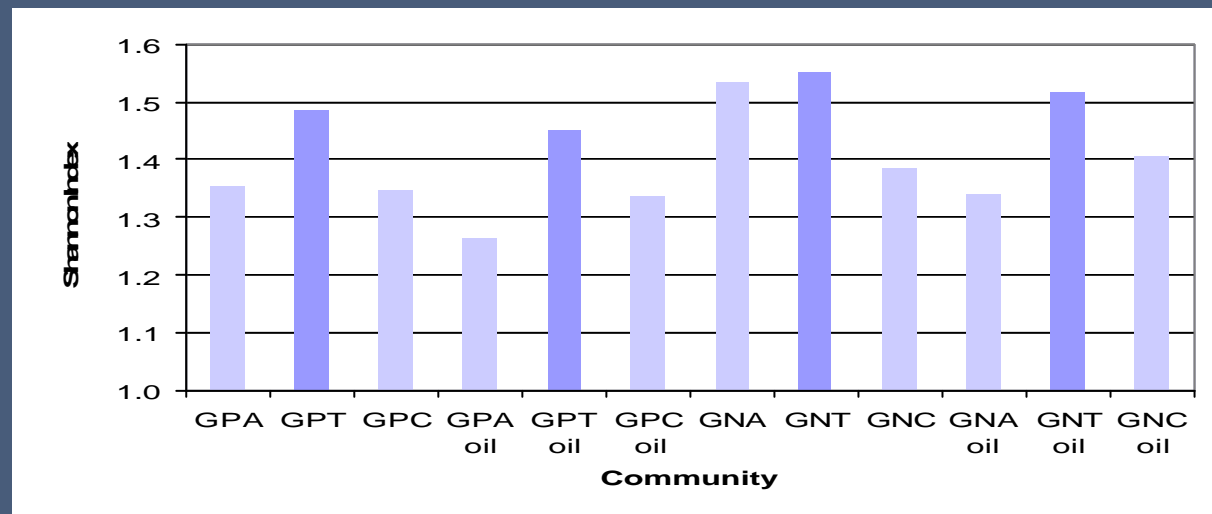
- Warm vs. cold-contaminated soils
 - GN isolates common to both soils
- Cold temperature produces functionally different GN groups in contaminated soil

Community Function

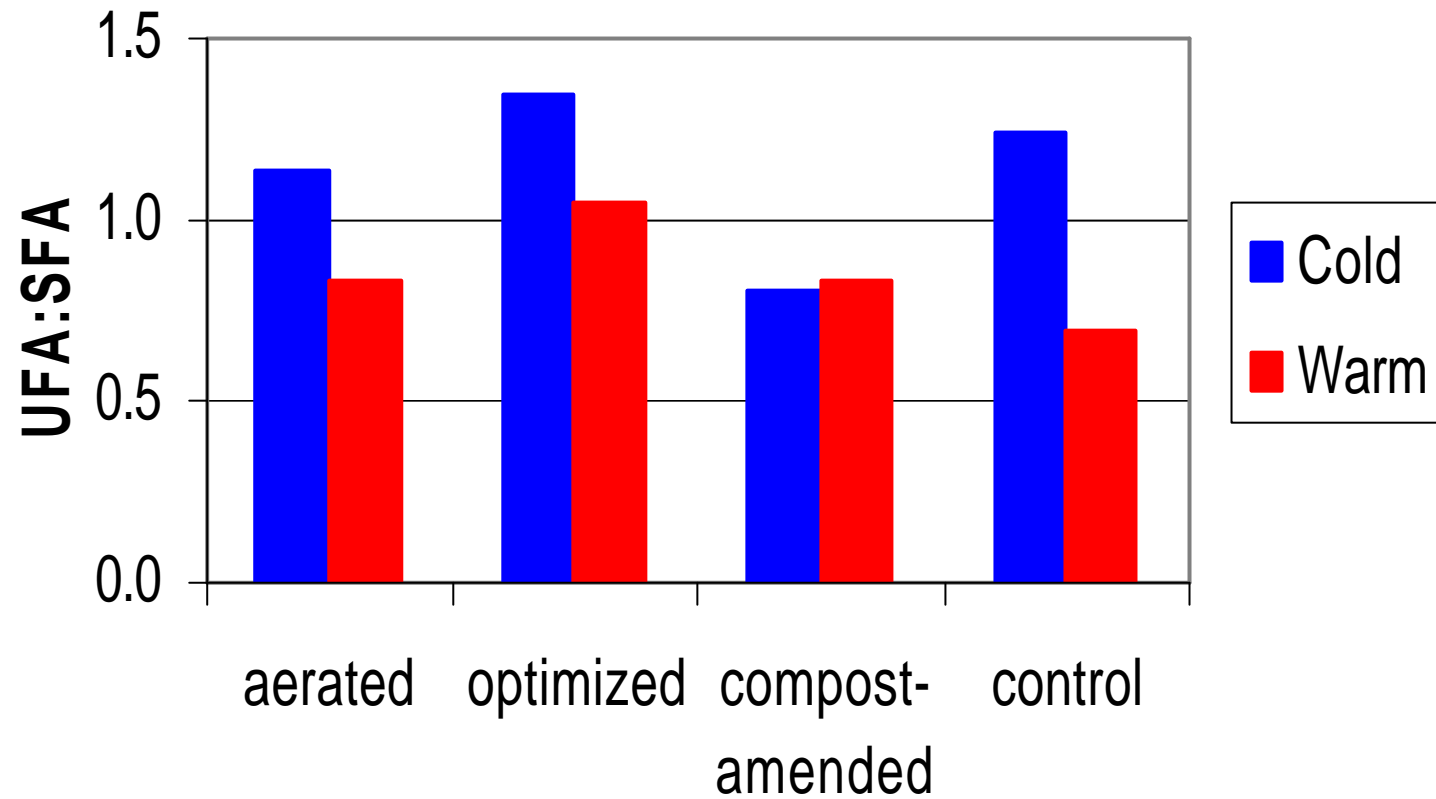
- In cold-contaminated soil
 - Oil-degraders had higher substrate richness and functional complexity
- Differences due to
 - Previous exposure to different substrates
 - Degradation pathway

Community Function

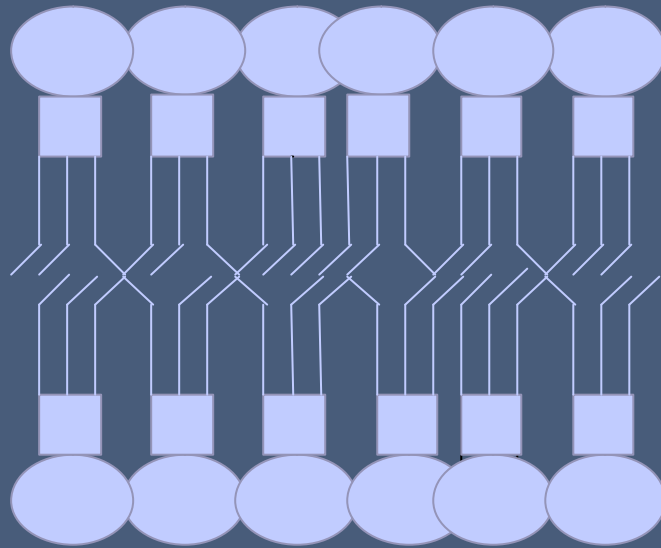
- Diversity
 - Higher functional diversity in cold-contaminated soil
 - Significant difference among all soils and oil-degrading communities



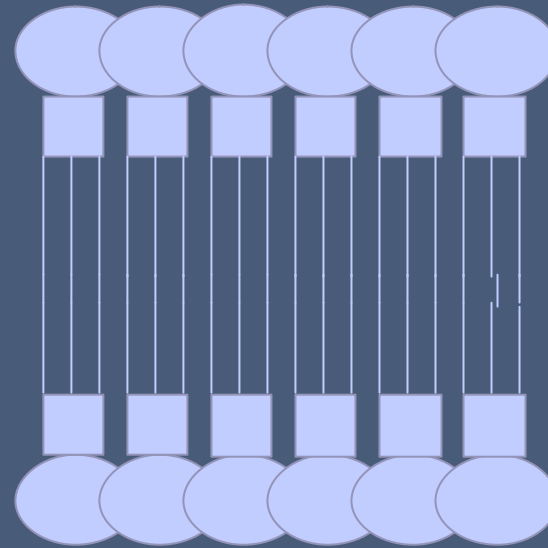
Community Physiology



Community Physiology

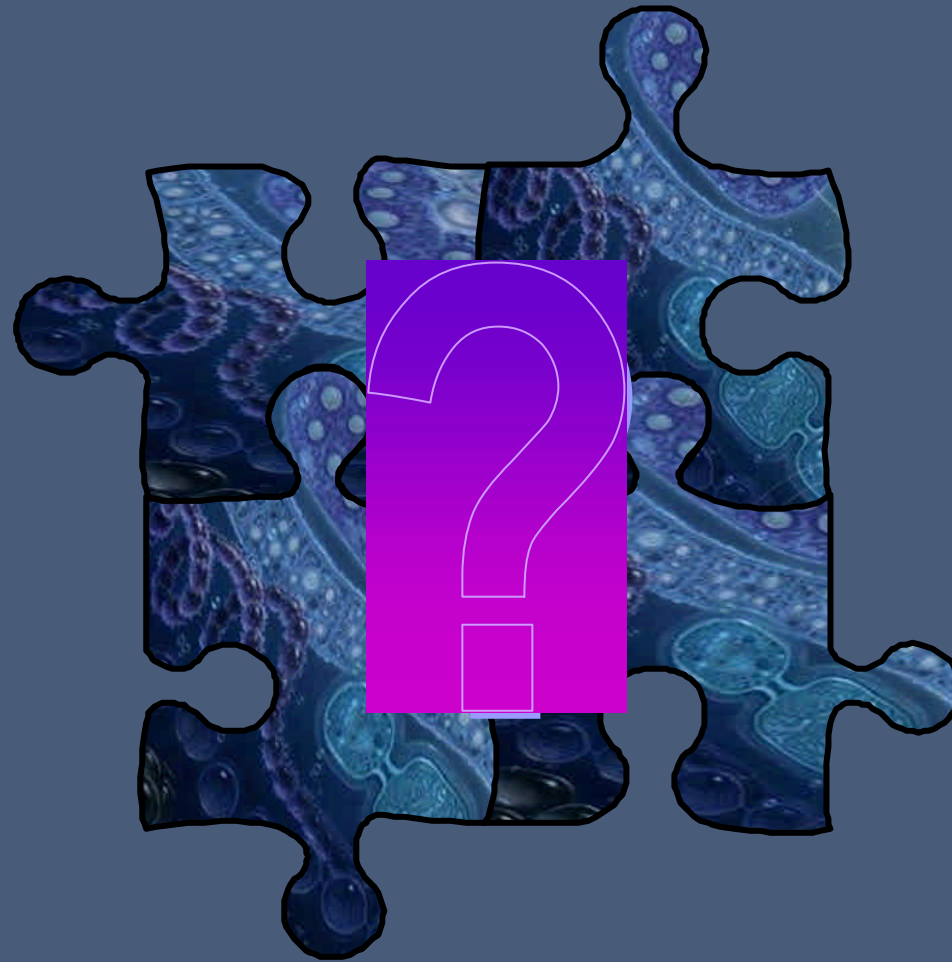


UFA



SFA

Bioremediation Context



Bioremediation Context

- Kinetics
 - Different in cold-contaminated soils
 - 2-stage degradation curve
 - Bioavailability and/or biodegradability differences



Bioremediation context

- Community
 - Lower functional redundancy → adapting community
 - Increased functional diversity → robust community



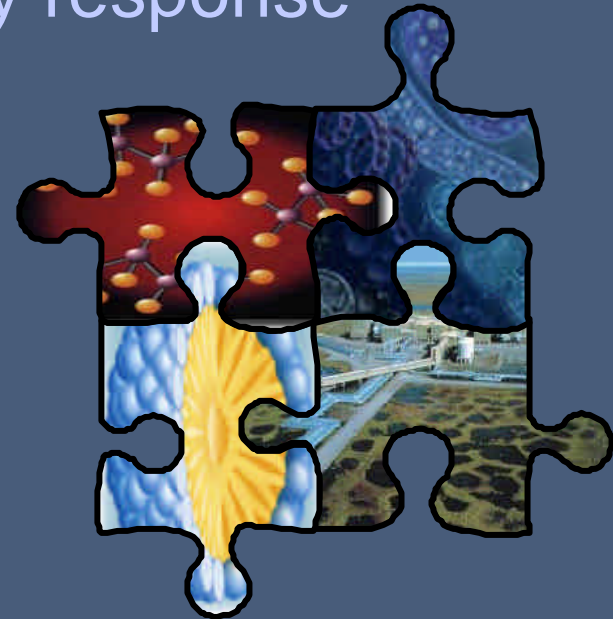
Bioremediation context

- Community adaptation
 - GN \rightarrow GP
 - Increased UFA
 - Unique hydrocarbon-degrading groups



Bioremediation context

- Biodegradation
 - Hydrocarbon type
 - Temperature effects on hydrocarbons
 - Temperature effects on kinetics
- Bacterial community response



Conclusions

- In cold-contaminated soils,
 - Hydrocarbon degradation can be significant
 - Bacteria adapt
 - Bacterial communities adapt
- Different kinetics at cold temperatures likely due to a combination of bacterial ecological processes and hydrocarbon properties

Acknowledgements

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Questions