

Molecular Sequencing of the Humus Layer in Catskill Soils: Using Deep Sequencing to Characterize Resident Bacterial and Fungal Communities



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Sampled Catskill Humus Forms

Moder

**Beech dominant, mixed
northern hardwoods**

Giant Ledge 845m

Panther Mtn. 829m

Mor

Old growth hemlock

Tsuga Top 940m

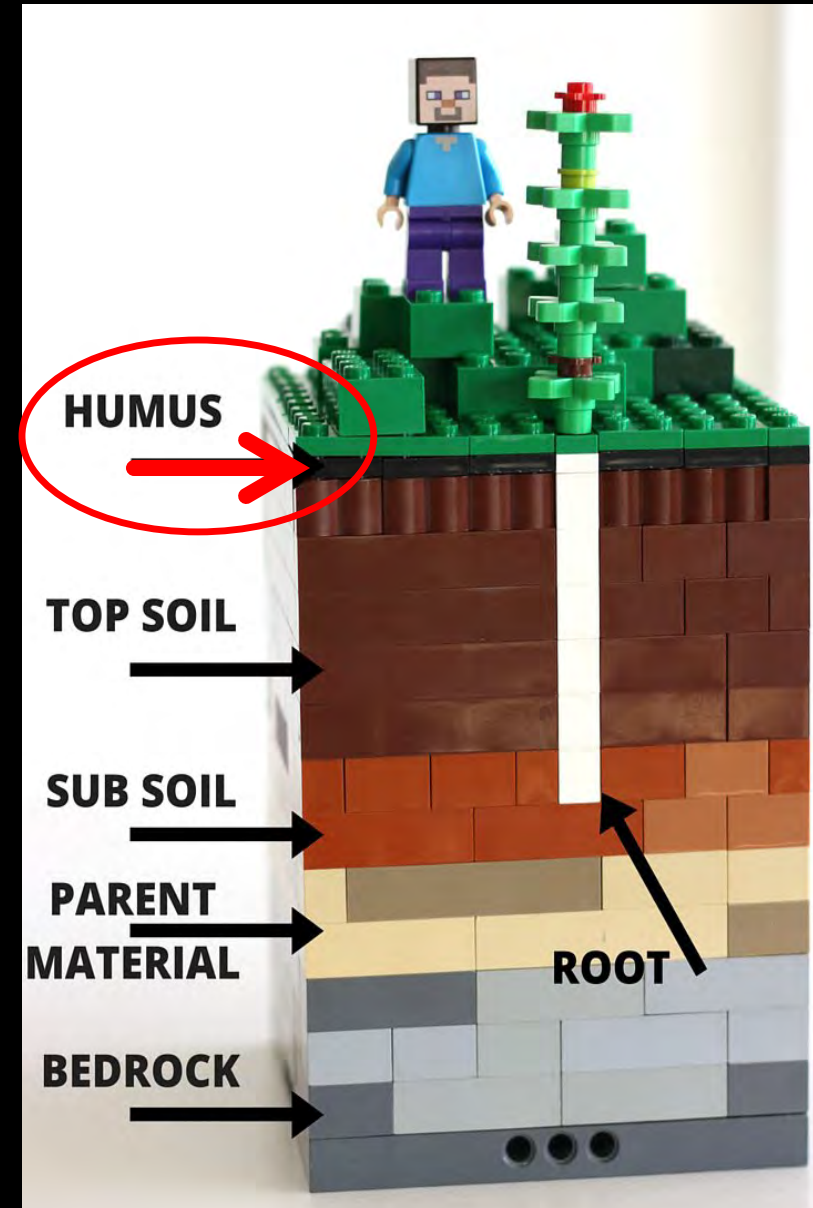
Millbrook Road. 681m

Mull

**Rich mesic northern
hardwoods**

Pakatakan Mtn. 477m

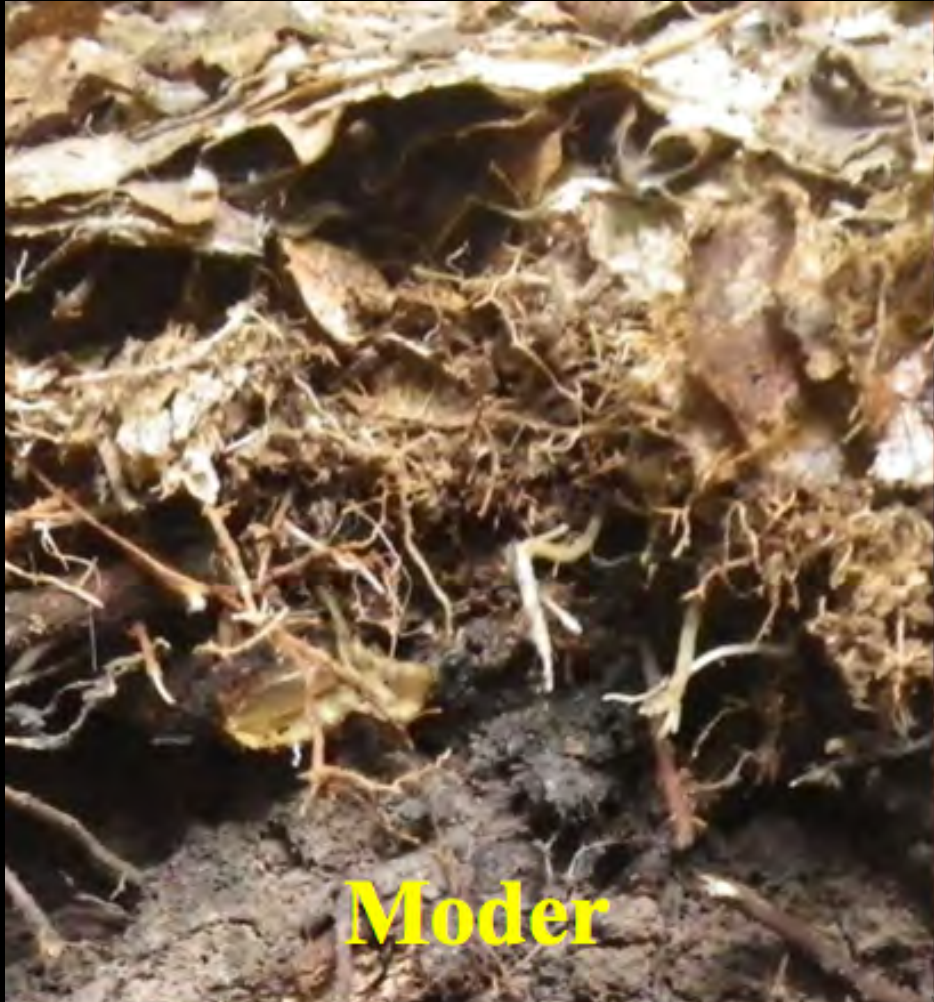
Romer Mtn. 428m



Sampled Catskill Humus Forms

Moder

Strongly acidic



Sampled Catskill Humus Forms

Mor

Very strongly acidic



Sampled Catskill Humus Forms

Mull

Weakly acidic



Overview

Characterize bacterial and fungal communities of sampled humus forms

Extracted DNA from 18 soil samples:

Moder: 3 samples x 2 sites

Mor: 3 samples x 2 sites

Mull: 3 samples x 2 sites

PCR amplified region of:

16S rRNA (bacteria) – 515F / 806R primers

18S rRNA (fungi) – Euk1391F / EukBr primers

**Sequenced libraries on Illumina MiSeq at
NC Museum of Natural Sciences**

Results

Sequencing

Successful for 17 of 18 samples

Same Mor sample failed for bacterial and fungal sequences

Bacteria:

After filtering: 293,311 seqs total

Mean/sample: 17,253 (4410 – 28,661)

Rarefied to 4410 seqs/sample

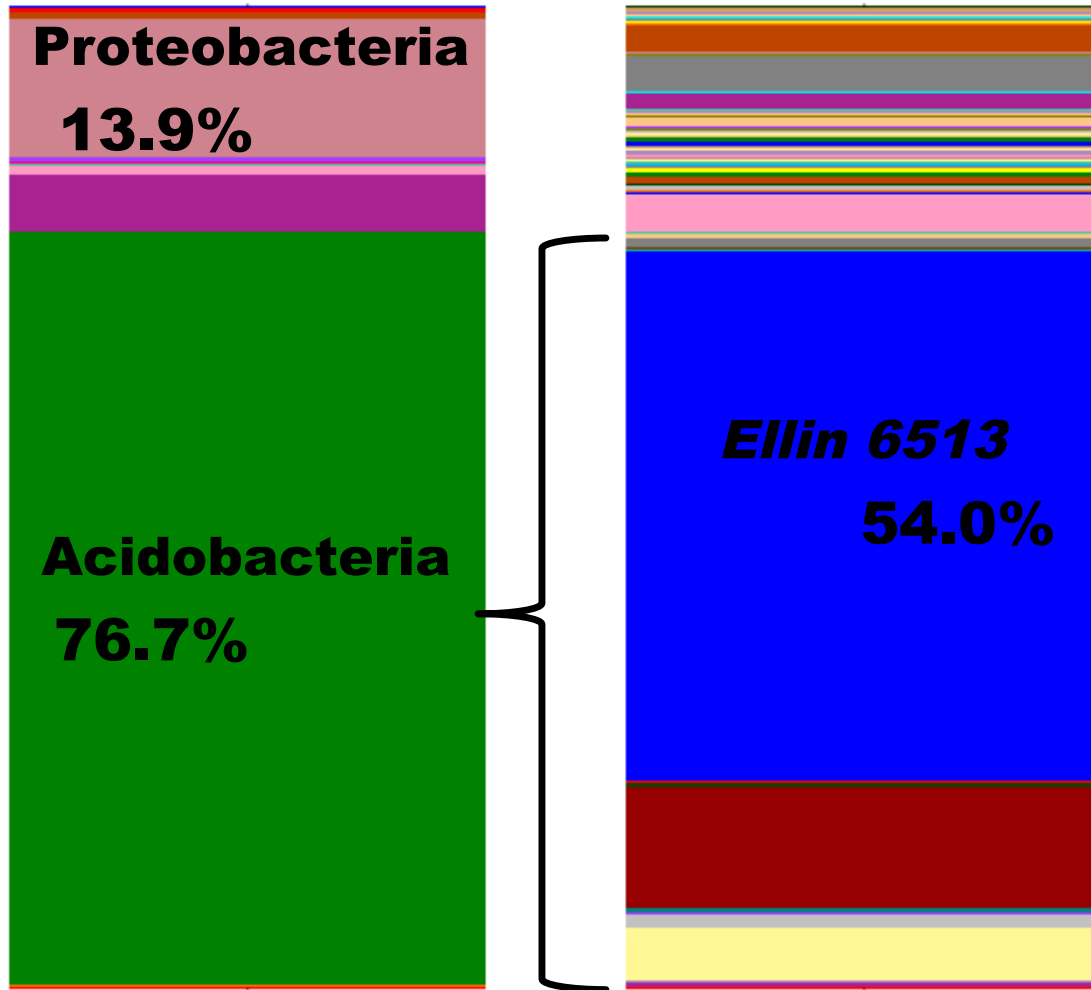
Fungi:

Preliminary analysis: >2,000,000 seqs (?!?)

Analysis currently underway

Bacterial Results

Moder Humus Samples: phylum vs. genus level



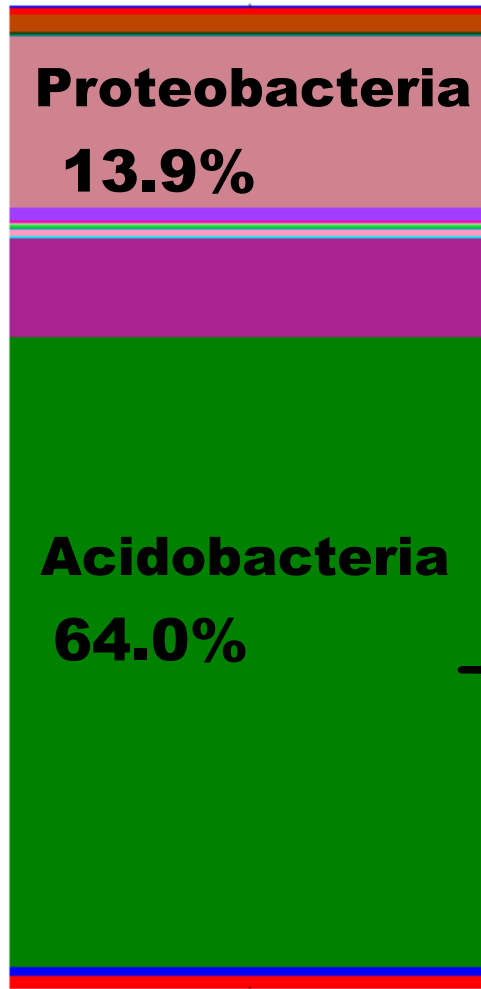
Phylum-level

Genus-level

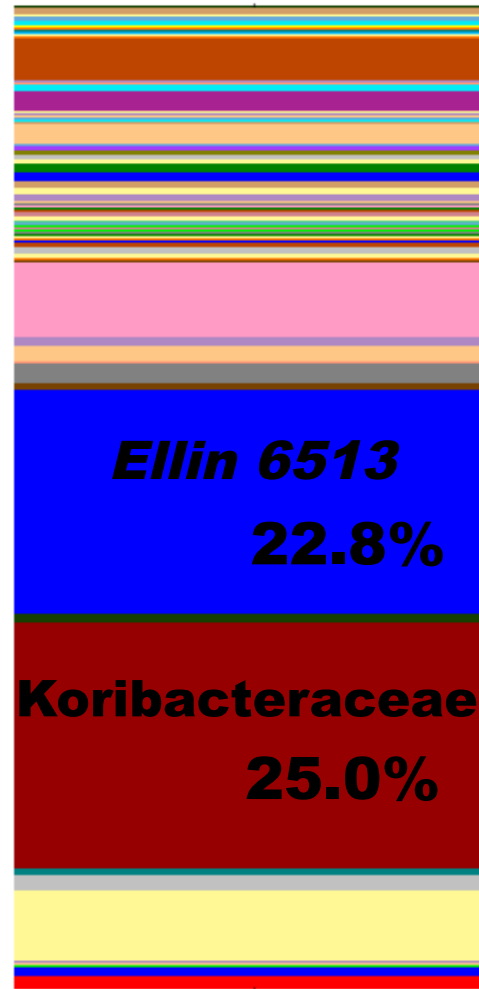
**Acidobacteria
present mosly as
*Ellin 6513***

Bacterial Results

Mor Humus Samples: phylum vs. genus level



Phylum-level

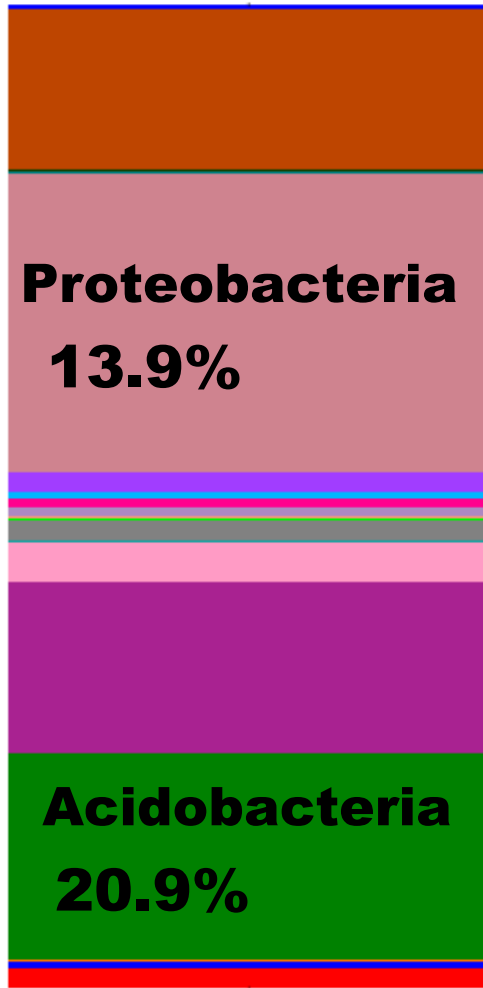


Genus-level

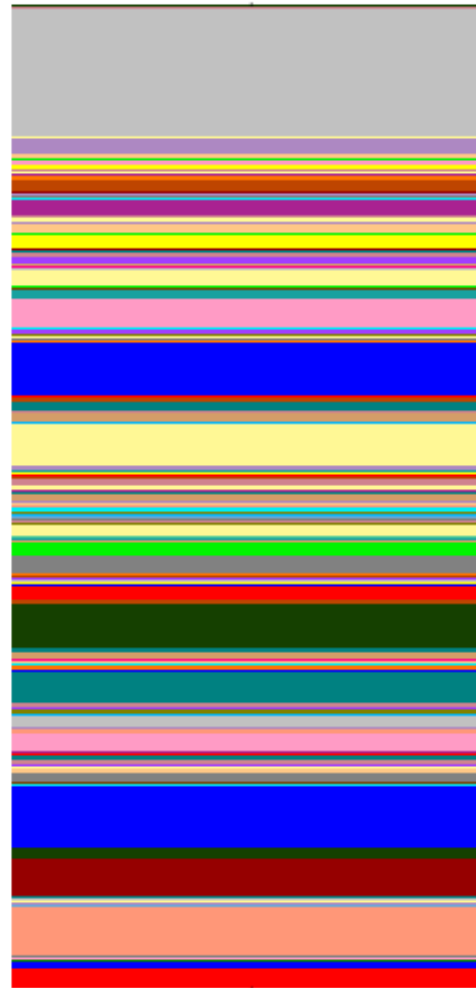
**Acidobacteria
present mosly as
Ellin 6513
and
Koribacteraceae**

Bacterial Results

Mull Humus Samples: phylum vs. genus level



Phylum-level



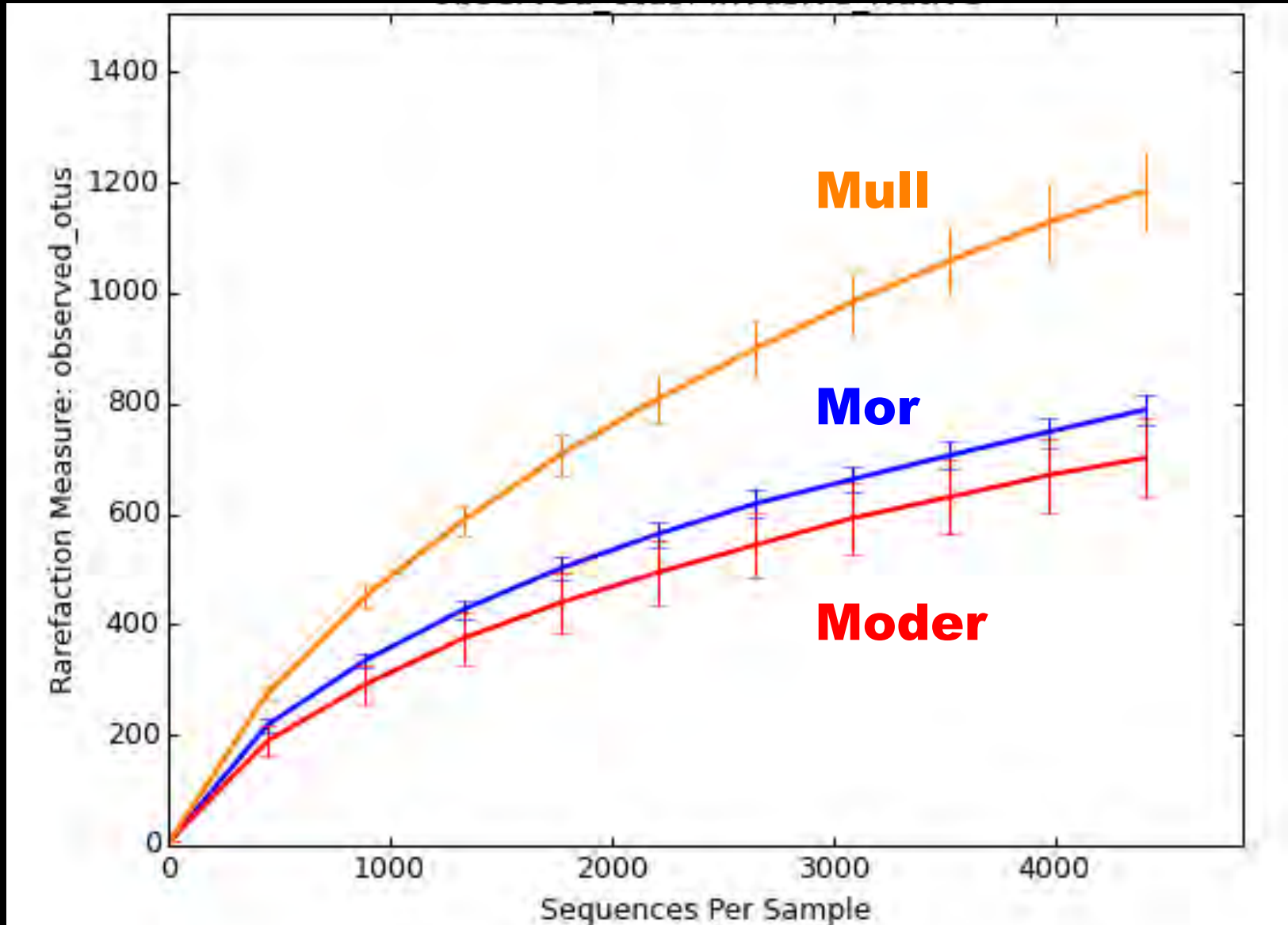
Genus-level

**Acidobacteria
are diverse**

**All groups
diverse**

Bacterial Results

Rarefaction Curves



Bacterial Results

Higher Bacterial Diversity in Mull Humus Soils



**pH levels the
least extreme
sampled**

**High biological
activity**

↑ nutrients

↑ aeration

Bacterial Results

Abundance of Acidobacteria in Moder and Mor Humus Soils – Why???

“The Ecology of Acidobacteria” (Kielak et al., 2016):

- one of most widespread and abundant group
- unculturable (traditional methods)
- comprises ~20% of microbial community across soil environments
- dominant in acidic soils
- can survive in soils polluted with uranium, petroleum, PCBs, etc.
- insights gained from DNA sequencing

Bacterial Results

Insights into Acidobacteria from DNA Sequencing:

Have broad range of genes encoding transporters

-- may allow for nutrient uptake in nutrient limited soils

May use bacterial-produced polymers

-- some can break down gellan gum

Have genes encoding ammonia transporter channel

-- direct uptake of ammonium

-- no clear evidence of role in N-cycle processes (N fixation, nitrification, denitrification)

Bacterial Results

Resistant to antibiotics

Some known to synthesize exopolysaccharides (EPS)

-- may allow for survival in harsh soils

Numerous functions of EPS in soil

-- involved in formation of soil matrix

-- may act as nutrient and water trap

-- may be involved in bacterial adhesion that helps form soil aggregates

Diversity of Acidobacterial communities is lower in soils with more extreme pH

-- may require greater specialization (enzyme stability)

Conclusions

Mull humus bacterial communities significantly more diverse than those in moder or mor

Likely due to nutrient level

Moder and Mor humus communities dominated by Acidobacteria

Acidobacteria able to survive harsh conditions

Role of Acidobacteria in soils largely unknown

May be involved in formation of soil matrix, soil aggregates, trapping of nutrients and water (EPS)

May produce secondary metabolites, form biofilms, degrade pollutants (speculative)

Conclusions

SCIENCE

WISCONSIN BECOMES FIRST STATE TO NAME OFFICIAL MICROBE, HONORING CHEESE-PRODUCING BACTERIUM

ONLY 49 TO GO

By Jeremy Hsu April 19, 2010

Depending on what our Acidobacteria can do, maybe New York should be the 2nd!

Acknowledgements

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