Nathan Gavin
Ecology Reading Proposal

I propose to read a series of papers that focus upon methods used to reveal the biodiversity of bacterial soil communities, why such rich species diversity exists in this environment and what factors are most important in determining their structure. Bacteria soil are very diverse, very numerous, and have many important functional roles including the cycling of nitrogen and degradation of pesticides and heavy metals. The soil is an important resource to humanity and all terrestrial life forms yet we have a very poor understanding of the quantity or quality of the bacterial soil community and what functions these bacteria perform.

The first paper I wish to examine is titled "High diversity in DNA of soil bacteria" by Torsvik et al., 1990. In this paper a new method studying soil bacteria diversity through the annealing properties of DNA isolated from soil samples is introduced. This is a landmark paper which greatly expanded upon the isolation and pure culture methods previously utilized to study microbial biodiversity. The new method was required because only small fraction of bacteria are able to be cultured in the lab. The diversity of bacteria in soil that was revealed by this study were staggering as the authors suggested a single gram of soil may contain up to 10,000 bacterial types. Subsequent work and creation of new methods have supported a high diversity of soil microbes and helped clarify how to adapt the biological species concept to a more appropriate method for description of bacterial diversity. Given this diversity of microbes question I propose we next examine is how such diversity is maintained. The second paper I propose we read addresses this question and is titled "Santa Rosalia revisited: Why are there so many species of bacteria?" by Dykhuizen, 1998.

In this review article Dykhuizen estimates the number of species of bacteria there might be in the world and provide reasons why there are so many. After discussing the results of several studies Dykhuizen suggests high diversity of soil bacteria exists "simply because speciation in bacteria is easy and extinction difficult …which leads to an ever increasing number of species over time." Despite a better understanding of how so many species can coexist, Dykhuizen recognized there remains much to be discovered about the structure of these communities and the processes that may affect it.

The final paper I propose we consider is titled "Microbial biogeography: putting microorganisms on the map" by Martiny et al. 2006. In this more recent review the authors discuss the structure of bacterial communities and ask whether "microbial assemblages differ in different locations (do microorganisms have biogeography); and, if microbial assemblages do differ by location, is the spatial variation due to present-day environmental factors, historical contingencies, or both?" Although the questions raised in this article remain an area of debate in microbiology the author's conclusions have remained the current working theory of prokaryotic biogeography and diversification.

I believe these papers will provide the reader with a better understanding of differences and similarities between the ecology of micro organisms and macro organisms and how methods used in microbial research have been used to examine and describe the ecology of a community that continues to be underappreciated by most ecologists.

Citations for proposed papers:

Torsvik V, Goksøyr J, Daae FL. High diversity in DNA of soil bacteria. *Appl Environ Microbiol.* 1990;56:782 Link

Daniel E. Dykhuizen, 1998. Santa Rosalia revisited:Why are there so many species of bacteria? *Antonie van Leeuwenhoek* 73: 25–33, 25. Link

Martiny JBH, Bohannan BJM, Brown JH, Colwell RK, Fuhrman JA, Green JL et al. (2006). Microbial biogeography: putting microorganisms on the map. Nat Rev Microbiol 4: 102–112. Link