



INSTITUTIONEN FÖR MARINA VETENSKAPER

Biodiversity and Ecosystem Functioning

What Diversity? Which Functioning?

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Akademisk avhandling för filosofie doktorsexamen i Naturvetenskap, inriktning biologi, som med tillstånd från Naturvetenskapliga fakulteten kommer att offentligt försvaras fredag den 2 juni 2017 kl. 10.00 i Hörsalen, institutionen för marina vetenskaper, Carl Skottbergsgata 22B

ISBN: 978-91-629-0195-0, tryckt version

ISBN: 978-91-629-0196-7, pdf nätet

Tillgänglig via <http://hdl.handle.net/2077/52128>

Abstract

We share our planet with an estimated 8.7 million eukaryotic species and an uncountable number of bacteria and archaea. But that amazing diversity is under threat from overexploitation, habitat destruction and climate change. This realization has led ecologists to study the consequences of species loss. The consensus after 30 years of research is that biodiversity can have many benefits. More diverse communities tend to be more productive and more stable. But the research has mostly focused on diversity at the level of species, in relatively species-poor ecosystems, and often measured diversity as the number of species - independent of their identity or relative abundance. In this thesis I leverage the advancements of modern sequencing technology to use mega-diverse bacterial communities as a model system. The thesis includes four chapters.

Chapter I shows that bacterial freshwater communities sustain ecosystem functioning despite extensive reductions in diversity. A literature review corroborates the results - only 25 % of the reported experimental manipulations show a positive effect of bacterial diversity on ecosystem functioning.

In Chapter II, we investigate the effects of habitat diversity on ecosystem functioning. We use experimental landscapes of shallow bay sediment habitats. Depending on the season, both greater habitat diversity and greater bacterial diversity increased landscape ecosystem functioning.

Chapter III, in which we related the diversity of microbial denitrifiers to nitrogen fixation rates in natural marine sediments, shows no connection between diversity and functioning. Nor can other microbial community metrics be related to nitrogen fixation rates, including the diversity of the general bacterial community and the abundance of certain species. In a previous study, nitrogen fixation was correlated to the abundance of the genes that encode the protein involved in the process (*nifH* genes). Yet, that model fails to predict nitrogen fixation rates in our study.

Chapter IV is about the “functioning” part in biodiversity and ecosystem functioning research. It has been suggested that while biodiversity is only weakly important for single functions, its importance increases when multiple functions are considered simultaneously. The logic is intuitively appealing: if species perform different functions, more species are needed to perform more functions simultaneously. Nonetheless, it is wrong. We show that considering multiple functions does not *per se* change the biodiversity ecosystem functioning relationship.

In concert, the four chapters included in this thesis call into question some of the broad claims that have been made in the field of biodiversity and ecosystem functioning. The number of species *as such* is unlikely to be generally related to ecosystem functioning, especially in highly diverse systems. Claims that any species loss will result in loss of ecosystem functioning cannot be justified. Jointly considering multiple functions does not change that conclusion. Nevertheless, protecting diversity is a moral imperative, and inflicting irreversible changes to nature without understanding the consequences is careless and shortsighted. As human impact is unavoidable, we need the best possible knowledge base to make evidence-based and informed decisions. Research in ecology is crucial to provide this knowledge. To be reliable it must be as rigorous as possible. This thesis hopes to provide some small steps in the right direction.