Research topics

Effect of cloud and chronic wind on diversity and species composition of forest vegetation in Taiwan. Taiwan as a subtropical island exposed to East-Asian monsoon system offers a unique opportunity to study vegetation along with two peculiar ecological factors, cloud and chronic wind. Frequent cloud and persistent winds have remarkable ecological effects on vegetation and require species to develop unique adaptations, resulting in a high number of endemic and relict species. We use cloud and monsoon forest as a model system to describe the influence of cloud and wind on community assembly, and use various approaches for that, from purely descriptive (vegetation–environment association) to more mechanical (trait-based community assembly).

The trait-based approach in vegetation ecology. Functional traits are measurable properties of plants that considerably influence their ecological performance in a community. Different species have different strategies on how they adapt to the environment they are living in. For example, species on nutrient-poor habitats are growing slowly, invest a lot of biomass to leaf and wood tissues, build resistant leaves that can last longer and do not need to be renewed so often. If nutrient availability is not a problem, species may grow fast, build thin and cheap leaves and soft wood, to use as many resources as possible (live fast, die quickly). We measure various traits on trees and ferns and ask which of them are essential for plants to grow where they do. This, in turn, helps us to understand the mechanisms behind ecological requirements of individual species, and potentially also predict what happens with species in a community if the environment changes.

Ellenberg-type indicator values for the flora of Taiwan. Heinz Ellenberg was an experienced German vegetation ecologist, who elaborated an old idea that plants are excellent indicators of the environment in which they grow. He developed a system of indicator values for Germany, which for each plant species quantifies its optima along major ecological gradients (moisture, light, nutrients etc.). This system represents unique knowledge about the ecology of individual plant species, and European vegetation ecologists frequently use it to estimate environmental conditions of habitat from species composition of the community growing on it. We hope to introduce this concept to Taiwan, and compile available ecological knowledge about species distribution and ecological requirements into a set of Ellenberg-type indicator values for the flora of Taiwan (e.g. for temperature, light, nutrients, cloudiness or wind intensity). To complete this for the whole flora would be too ambitious for the beginning, but to test this approach on a smaller subset of species in a small area is realistic.

Diversity pattern of vegetation along important environmental gradients and effect of spatial scale. Why there are more species over there and less here? Why these species occur here but not the others? Is it because the environment is different and species reflect that or is it simply a result of random events like dispersal limitation, neutral community dynamics or random ecological drift? We study patterns of alpha diversity (species richness) at fine- to broad-scale spatial level, changes in beta-diversity along environmental and spatial gradients and diversity of vegetation types

at the landscape level (vegetation classification). Although not perfect, diversity is a useful indicator of processes acting in nature, and as such, it deserves detailed research attention.

Methodological aspects of analysing community-ecology data. It is always good to try new methods to analyze data, but at the same time, it is essential to critically ask whether these methods are really doing what we expect them to do. Modern community ecology cannot exist without advanced numerical methods able to handle often large and complex community datasets, but we need to be aware that even the most advanced of them have certain limitations. In the lab, we focus on several methods which are commonly used by vegetation ecologists and which seems to suffer from severe limitations (community-weighted mean analysis, the effect of undersampling, beta diversity analysis).