Rehabilitation of degraded ecosystems and reintroduction of rare and endangered plant populations: An introduction to the ecological restoration research and practice at the South China Botanical Garden

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The ecological restoration programs at South China Botanical Garden (SCBG) date back to 1950s when forests in the country were extensively destroyed due to timber harvesting, firewood collection, and the conversion of woodland to farmland. Researchers at SCBG experimentally practiced forest restoration on the severely eroded coastal lands, abandoned hilly slopes and karst regions of southern China. We here briefly introduce the research activities and major knowledge obtained from these restoration programs which mainly involved two biological organization levels: community or ecosystem level and population or species level.

At the community level, SCBG researchers planted pioneer tree species such as *Eucalyptus spp.*, *Acacia spp.*, and pine species as a first step towards forest restoration on the severally eroded coastal and hilly lands. With limited human aids such as fertilization and irrigation during the planting, these pioneer species had high adaptability to the red soils and warm-humid climate of southern China. They grew fast in the first ca. 30 years since planting, largely improved soil nutrient conditions and controlled soil erosion, and accumulated a large body of biomass. However, the micro-habitats under these pioneer plantations were not favorable for further succession of native tree species and therefore retards the restoration of the regional forest – monsoon evergreen broadleaved forest. SCBG researchers then deliberately introduced over 60 native tree species into some of the pioneer plantations; the structure and functioning of the forests were monitored ever since. The plantations subjected to the structural retransformation have now developed into secondary forests dominated by native tree species; whereas the plantations not being recruited with native species still remain the mono-species dominated plantation forest, which is considered not suitable for biodiversity conservation although the functions are similar to the secondary forests.

At the population or species level, SCBG researchers reintroduced nearly 30 endangered species such as *Primulina tabacum* Hance into the habitat of their historical distribution (Combination of biotechnology and ecological restoration technique (Seedling production + habitat restoration + restoration of the relationship among species) is one way to implement reintroduction of rare and endangered plants). The investigation of their natural distribution showed that all their populations were shrinking, with low genetic diversities as a result of human disturbance and climate change. We also found that nurse plant species (e.g., moss) could play a key role in the successful reintroduction of the target species (e.g., *P. tabacum*). We have established the following protocol for the reintroduction of rare

and endangered plants: firstly, select the appropriate target plant species; secondly, conduct basic research on their breeding and other aspects of their biology and ecology; and then, reintroduce them to the wild while also developing their market-oriented production. By consulting with regional and national agencies concerned with ecological planning, we have promoted this protocol for the reintroduction of rare and endangered plants throughout China.

This restoration research provide models and technical guidance for local people and government agents to the rehabilitation of degraded ecosystems and conservation of endangered species.

Dr. Weijun Shen, a research professor have worked at SCBG for nearly 20 years. Dr. Shen received his master's degree of forest ecology at the Northwest Agricuture and Forestry University in 1997 and hidocas PhD of ecology at the University of Chinese Academy of Sciences in 2002. He also did postdoctoral studies at Arizona State University and Duke University in the US in 2002-2007. His research mainly focuses on how soil microbial communities and soil ecological processes respond to global environmental changes such as precipitation regime changes and elevated nitrogen deposition. He is particularly interested in the mechanisms of how soil microbes adapt and feedback to climate changes, the interactions between microbial community structure and function under global environmental changes, the mechanisms of how soil microbes regulate soil C, N and P cycling, and the modeling of microbe-mediated soil processes such as greenhouse gas emission and soil organic matter decomposition.

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Dr. Hai Ren received his doctorate in Plant Ecology from South China Institute of Botany in 1997. Subsequently he joined South China Institute of Botany as research scientist. He was a senior visiting scholar of Arizona State University in 1999 and Wageningen University & Research Center in 2001. His research has focused on Forest Restoration and Plant Conservation. Specific current research includes the structure, function and process of degraded forest ecosystem during the restoration and the reintroduction of rare and endangered plants. He has published more than 100 English papers and has authored 3 books.