# Floristics and Distribution of Spiny Bamboo (*Bambusa blumeana* J.A. and J.H. Schultes) Stands in Cebu Island, Philippines

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# ABSTRACT

The woody bamboos of the subfamily Bambusoideae play a critical role in the ecology of their forest habitats and have long been of economic importance to humans. However, there is a lot that still needs to be studied as the propagation and proliferation of these bamboos may lead to adverse effects. This study followed an observational/descriptive research design using naturalistic observational methods of field measurements and utilized random sampling method along the boundaries of fragmented forest remnants of Cebu Island. Quadrat sampling method was employed with an area of 20m by 20m and a total of thirty (30) quadrats were randomly surveyed per area with a total of four municipalities. A survey of different areas in Cebu Island was done from August 2014 to March 2015 to observe the occurrence of natural bamboo stands in the island and the municipalities of Balamban, Tuburan, Barili, and Moalboal with only *Bambusa blumeana* J.A. and J.H. Schultes stands included. Floristics of bamboo stands includes community analyses and various indices of ecological significance which were used to determine biotic and abiotic associations and correlations to aid in determining species composition and distribution. In all four areas, *B. blumeana* J.A. and J.H. Schultes is one of those with the highest Importance Value which means that is contributes much to the productivity and biomass of the area. For the similarity index, Tuburan is the most dissimilar to all the sampling areas. Species richness ($D_{mg}$) and diversity (H') were relatively low. Low values were also obtained for Simpson's Diversity Index (D) but since this focuses on dominant species, diversity increases as the value nears zero. Floral association values show tendencies towards indigenous species although the values are low. The Floristic Quality Index show values between 3 to 5, which shows a trend towards disturbed environments and association with flora that are either invasive or higher tolerance to disturbance. All the natural bamboo stands exhibited heights ranging from 17 to 20 m and DBH ranging from 5 to 8 cm. The number of culms was very varied from 10 to almost 60. Basal area were usually more than 10% of the 20×20 m quadrat. Biomass ranged from 150 to 250 kilograms where Moalboal had the highest values. MODIS products showed that bamboos stands have low LAI as the bulk of their bodies are the culms but with variable FPAR, GPP and Net Photosynthesis. It was also found that the ecologically younger soils are more suitable for growth of most bamboo species and this was observed with most of the bamboo stands found Pliocene-Pleistocene soils. Most of the natural bamboo stands were found in tropudalfs with tropepts that are the most fertile tropical soil but can suffer acidification. Slopes up to $30^{o}$ are favorable to bamboo stand growth and majority of the bamboo stands in this study fall within this range. One of the ecological functions of natural bamboo stands is soil erosion control and majority were found in areas designated with moderate to severe erosion. Many bamboos prefer soil with good water holding ability (high SMI) and water permeability for optimum rhizome growth but cannot tolerate water logging (low NDWI and MNDWI). High NRI values denote presence of nitrogen in high levels. Multiple correlations were analyzed and of all the physiognomic characters, biomass had the most correlations with the other factors especially with species richness and diversity. Principal Component Analysis was utilized as a dimension reduction procedure. The community, physiognomic and physico-chemical parameters were reduced to six principal components namely (1) reflectance-based (soil physico-chemical) parameters, (2) productivity, (3) temperature regime, (4) species richness and diversity, (5) floristic quality, and (6) water availability. These parameters contribute most to the distribution of natural bamboo stands.

Table of Contents

# List of Figures

# List of Tables

Chapter I

# INTRODUCTION

## Background of the Study

Bamboos are remarkably robust forest grasses that consist of more than 1400 described species in 115 genera (Kelchner *et al*., 2013). Most familiar and useful are those with ‘‘woody’’ (lignified) stems that belong to the tribes Arundinarieae (temperate woody bamboos) and Bambuseae (tropical woody bamboos). The roughly 1,300 woody species often play critical roles in the ecology of their forest habitats and have long been of economic importance to humans. Less popularly known are the herbaceous bamboos (tribe Olyreae), a lineage of about 120 non-woody understory species found in tropical forests, predominantly in the New World. Together the three tribes constitute the grass subfamily Bambusoideae (Kelchner *et al*., 2013).

Bamboos are gaining increasing importance as a non-timber forest product (NTFP) or non-wood forest product (NWFP) (Lacuna-Richman, 2002; Muler *et al*., 2013). They are utilized as raw materials for infrastructure and furniture (H. T. Li, Zhang, Huang, & Deeks, 2013; Pabuayon, 2004; Zea Escamilla & Habert, 2014) as well as a host of other uses such as food, medicine, and fiber (Badwaik, Borah, & Deka, 2014; H. T. Li et al., 2013; X. Li et al., 2014; Pabuayon, 2004; Sasaki et al., 2013). Furthermore, they are known to have phytoremediation properties (Collin, Doelsch, Keller, Panfili, & Meunier, 2011; Jha, 2010). These grasses grow very fast and so are a viable agents of carbon biosequestration and partial mitigation for climate change (Lasco & Pulhin, 2000; Lobovikov, Schoene, & Yping, 2011; Walther et al., 2002).

Bamboos are found in abundance in Asia and South America. In many Asian countries bamboo has not been explored fully to its extent although it is considered as natural engineering material. Historically, this sustainable material has evolved as backbone for socio-economic status

of society as it takes only a few months to fully grow. Traditionally bamboo has been used in various infrastructure, furniture and tools (Abdul Khalil et al., 2012). Presently, bamboos are becoming an important crop plant in the Philippines (FAO, 2006). Methods have been and are currently being studied and updated in order to obtain the full potential of these plants. Studies on the natural habitats of Philippine bamboo species can give a better understanding of the optimal growth conditions of these economically important plants. In addition, they are becoming more dominant in the Visayas at least in areas of regeneration and this needs specific and careful documentation (Walpole, 2010). However, there is still a lot that needs to be studied as the propagation and proliferation of these bamboos may lead to adverse effects (Larpkern, Moe, & Totland, 2011; Montti et al., 2011; Rother, Rodrigues, & Pizo, 2009). Floristic studies on the ecological aspects of bamboos especially in the local scale is necessary before these can be used for economic or climate change mitigation purposes (FAO, 2012b). Furthermore, Walpole (2010) suggested that there is a need to look at the most pragmatic areas of change and one of these is the identification of bamboo as dominant vegetation.

**Objectives of the Study**

This study aims to determine and map out the distribution and associated species composition of natural bamboo stands in Cebu Island, Philippines.

Specifically, this study attempts to:

1) evaluate the natural bamboo stands based on:
    a. community characteristics – importance values, similarity, species richness, evenness and dominance, floristic quality;
    b. association of bamboo species to indigenous and exotic non-bamboo species using an index of ecological association;

c. physiognomic parameters - above ground biomass and basal area;– leaf area index (LAI), gross primary productivity (GPP), net photosynthesis

2) determine the different physico-chemical parameters, such as temperature, moisture, water availability, edaphic factors, etc., through processing of satellite images and maps, that define the species distribution and floristic characteristics of natural bamboo stands

**Significance of the Study**

Currently, the world is facing two dilemmas: the increasing population of humans and the rise of temperatures due to global climate change. Natural resources are dwindling in order to meet the growing demands of people for food, infrastructure, and raw materials. Furthermore, environmental problems such as improperly disposed chemicals that ruin soil and freshwater sources and global warming due to the rising greenhouse gases. A partial solution for these problems can be found in one clade of plants: the bamboos of the grass family Poaceae, subfamily Bambusoideae.

Philippine studies on bamboo have focused more on the economic side (Lacuna-Richman, 2002; Lasco & Pulhin, 2000; Manalo & Acda, 2009; Pabuayon, 2004) and relatively few on the ecological aspects of bamboos (Dierick, Hölscher, & Schwendenmann, 2010). This floristic study will present an aspect of the ecology of Philippine bamboos with regards to diversity, distribution, importance, and conservation status. This study has the potential to be beneficial to the following sectors:

1. Local communities:

This study will provide the local communities a better understanding of the bamboo species in their locality. For use as agroforestry crops, the data on the environmental parameters can offer

insights on how to best grow these bamboo species and obtain a high yield. This in turn can boost the local economy as well as providing a sustainable livelihood. This floristic study can also show to the community if these invasive species can detrimentally effect the biodiversity in their area and thereby degrade the potential for eco-tourism, another possible income-generating activity for the community.

2. NGO's, LGU's and the national government -

This study will contribute to the knowledge of the diversity and distribution of bamboos in Cebu Island. Additionally, the concept of floristic data also covers, to some extent, anthropogenic disturbance and association with invasive species which are two very pressing issues in the Philippine setting. This study can help in policy-making especially in reforestation programs, phytoremediation projects and biodiversity conservation and enhancement.

3. Global scientific community -

With the objective aimed towards improving conservation planning and action for bamboos, the International Network for Bamboo and Rattan (INBAR) and the UNEP World Conservation Monitoring Centre (UNEP-WCMC) have initiated a project to improve the information available on the magnitude and distribution of bamboo resources within remaining forested areas and the distribution of forest likely to contain threatened bamboo species. In the first stage of the project, information on the distribution of bamboo species in the Asia-Pacific region, including threatened ones, were compiled and these data were combined with the regional data on remaining forest cover to map their likely present distributions and estimate the total area of forest potentially containing bamboo. Maps showing regional patterns of potential bamboo species and generic richness have been generated to support decision making on forest management and