

Potential distribution of woody bamboos in Africa and America

Working Paper 43

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UNEP-WCMC
Cambridge
2002

SUMMARY

This study was designed to produce regional distribution maps of all species of woody bamboos occurring in Africa; North, Central and South America. Qualitative data on distribution of woody bamboos were combined with data on existing forest cover. In the course of the study, 378 individual bamboo species and subspecies, and 32 genera of Bambuseae were mapped. The highest figures of potential species richness (35 spp per square km) were recorded in Sao Paulo State, Brazil.

INTRODUCTION

Despite their economic and social significance, statistics on bamboo resources, especially in natural stands, are very limited. Classified as a "non-timber forest product", bamboo is not routinely included in resource inventories. A good, transparent estimate of bamboo resources has yet to be developed.

As a first step to improving the information available, the International Network for Bamboo and Rattan (INBAR) and the World Conservation Monitoring Centre (UNEP-WCMC) have jointly initiated a project to estimate the magnitude and distribution of bamboo resources within natural stands. The first stage of the project is to combine information on the distribution of bamboo species with the global data on forest cover to determine distribution and estimate the total area of forest containing bamboo. The study was confined to woody bamboos, as these are most important from the socio-economic point of view, and the present section focuses only on those species that naturally occur in Africa and America.

SCOPE OF THE STUDY AND METHODOLOGY

The subfamily Bambusoideae (of the family Poaceae, or Gramineae) comprises both woody and herbaceous bamboos with altogether 1575 species. According to the most recent classification (Annals of the Missouri Botanical Garden, 2001), it is divided into 1 tribe of woody bamboos (Bambuseae) and from 1 to 3 tribes of herbaceous bamboos.

In total, nearly 400 species of woody bamboos are distributed in Northern, Central and South America and in Africa (Table 1). Coastal regions of the Atlantic side of South America are believed to be one of the main centres of diversity of bambusoid grasses together with the monsoon belt of South-East Asia and south China (Ohrnberger, 1999).

Table 1.

Subtribes and genera of woody bamboos that naturally occur in Africa and America (Ohrnberger, 1999).

Subtribe	Genus	Number of species, distribution
Arundinariinae	Arundinaria	1 species : North America
Thamnocalaminae	Thamnocalamus	2 species : South Africa and Madagascar
	Yushania	6 species : Tropical Africa and Madagascar
Bambusinae	Bambusa	1 species : Madagascar
	Oreobambos	1 species : Tropical Africa
	Oxytenanthera	1 species : Tropical Africa
Melocanninae	Cephalostachyum	5 species : Madagascar
	Ochlandra	2 species : Madagascar
	Schizostachyum	3 species : Madagascar
Hickelinae	Decaryochloa	1 species : Madagascar
	Hickelia	4 species : Tropical Africa and Madagascar
	Hitchcockella	1 species : Madagascar
	Nastus	12 species : Madagascar
	Perrierbambus	2 species : Madagascar
Guaduinae	Criciuma	1 species : South America
	Eremocaulon	1 species : South America
	Guadua	37 species : Central and South America
	Olmecca	2 species : Central America
	Otatea	2 species : Central America
Chusqueinae	Chusquea	138 species : Central and South America
	Neurolepis	22 species : Central and South America
Arthrotyliidiinae	Actinocladum	1 species : South America
	Alvimia	3 species : South America
	Apoclada	3 species : South America
	Arthrotylidium	22 species : Central and South America
	Athrostachys	1 species : South America
	Atractantha	5 species : South America
	Aulonemia	33 species : Central and South America
	Colantheia	7 species : South America
	Elytrotachys	3 species : Central and South America
	Glaziophyton	1 species : South America
	Merostachys	34 species : Central and South America
	Myriocladus	13 species : South America
Rhipidocladum	19 species : Central and South America	

For each species bibliographic sources were searched to acquire data about its distribution. These data were principally political units (country, province, locale), altitudinal range and forest type. They were entered into an Access database containing 10 fields and multiple records for each species (a total of 1180 records). 966 records (82%) contain information about altitudinal range, while 1004 records (85%) have data about species distribution on the provincial level.

Initially, the data were stored in an Access table, which was then converted into a DBF file. Only 6 fields of the original data spreadsheet were used to generate individual grids in the Arc View format. For each species listed in the initial table, a single grid (potential distribution) was generated. Individual grids were shaped according to the information about species natural distribution on the country and province levels and altitudinal range (minimum and maximum altitude) available in bibliographic sources. The information about the distribution of existing forest cover provided by UNEP-WCMC was used as a mask to eliminate areas not forested. In cases where there was no information about distribution of a species within the country, the whole country was regarded as a smallest distribution unit. When multiple data on altitudinal range existed for the same species, the broadest range was applied.

Individual grids for each species were sorted and merged by genus. Integration of 378 species and subspecies in a single grid generated a potential species richness map for the whole region. Integration of all 32 genera in a single grid provided a regional potential generic richness map.

Information from the attribute tables associated with the species richness maps was used to calculate the total area potentially containing bamboo species and the potential species richness per square km.

RESULTS

In total, the final regional database covers 394 individual bamboo species and subspecies. The largest national complement of species was for Brazil, which had 134 described species, followed by Venezuela (68 species) and Colombia (56 species) (Table 3).

Table 3. Number of Bambuseae species in the countries of North, Central and South America.

Country	Number of species	Region
Brazil	134	South America
Venezuela	68	South America
Colombia	56	South America
Ecuador	41	South America
Costa Rica	36	Central America
Peru	35	South America
Mexico	32	Central America
Bolivia	20	South America
Panama	19	Central America
Chile	14	South America
Cuba	13	Central America
Guatemala	12	Central America
Argentina	12	South America
Honduras	8	Central America

El Salvador	7	Central America
Haiti	7	Central America
Nicaragua	7	Central America
Trinidad and Tobago	7	Central America
Dominican Republic	6	Central America
Paraguay	6	South America
Puerto Rico	5	Central America
Guyana	5	South America
Uruguay	5	South America
Surinam	4	South America
Belize	3	Central America
Bahamas, The	1	Central America
Dominica	1	Central America
Guadeloupe	1	Central America
Jamaica	1	Central America
Martinique	1	Central America
Virgin Islands	1	Central America
United States	1	North America
French Guiana	1	South America

The largest number of species in Africa (34 species) was recorded for Madagascar (Table 4).

Table 4. Number of Bambuseae species in the countries of Africa

Country	Number of species	Region
Madagascar	34	Africa
Tanzania	4	Africa
Malawi	3	Africa
Uganda	3	Africa
Zambia	3	Africa
Cameroon	2	Africa
Congo	2	Africa
Democratic Republic of Congo	2	Africa
Ethiopia	2	Africa
Sudan	2	Africa
Zimbabwe	2	Africa
Angola	1	Africa
Benin	1	Africa
Burundi	1	Africa
Central African Republic	1	Africa
Comoro Islands	1	Africa
Eritrea	1	Africa
Gambia, The	1	Africa
Ghana	1	Africa
Guinea	1	Africa
Guinea-Bissau	1	Africa

Ivory Coast	1	Africa
Kenya	1	Africa
Mozambique	1	Africa
Nigeria	1	Africa
Reunion	1	Africa
Rwanda	1	Africa
Senegal	1	Africa
Sierra Leone	1	Africa
Togo	1	Africa

The potential current distributions of 378 individual bamboo species and subspecies were mapped using Arc View tools. 16 species distributed outside existing forest cover or outside map extension were not mapped. Each map shows the distribution of an individual species as it was described in the available bibliographic sources and derived from the geographic and forest cover data available at UNEP-WCMC. Due to space limitations individual species distribution maps are not provided in the report.

In addition, potential distribution maps were generated for the 32 genera of the subfamily Bambusoideae that occur within the region. Most genera have limited distribution. Only few genera – *Guadua* (Map 1), *Chusquea* and *Oxytenanthera* – are distributed across several countries.

The regional map of potential bamboo species richness (Map 2) shows a total of 18,884,000 km² of forest in Africa, North, Central and South America that potentially contains bamboo. The maximum potential species richness in Africa, 7 species/km², was recorded in Northern Madagascar. The highest potential species richness in America, 35 species per km², was recorded for a total area of 506 km² in the coastal region of Brazil. Nearly 80% (15,084,000 km²) of the total area of forest potentially containing bamboo has potentially from 1 to 5 species per km² (Chart 1).

The regional map of potential generic richness (Map 3) shows that the potential distribution density of 32 genera of subfamily Bambusoideae in the region follows a similar pattern to that of potential species richness, with a maximum generic richness of 9 genera per km² found in Brazil, Minas Gerais.

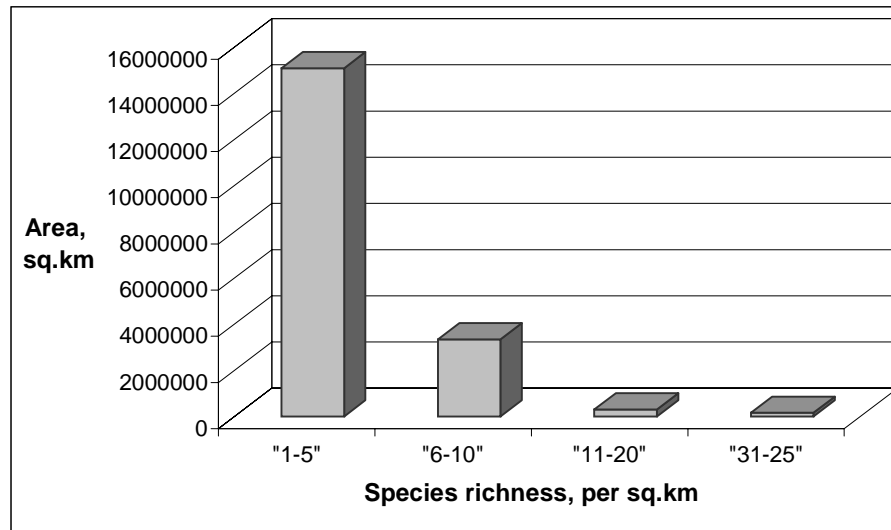


Chart 1. Total area covered by bamboo species richness classes in the selected region.

DISCUSSION

The results of the study should be regarded as a first approximation of the regional distribution of bamboo species in natural forests. Since the study was largely based on the existing bibliographic sources of data (Ohrnberger, 1999), it reflects the present stage of knowledge about taxonomy and distribution of subfamily Bambusoideae in the Asia-Pacific region.

The results support the existing theories of bamboo species distribution:

- the main centres of diversity of the bambusoid grasses are coastal regions of the Atlantic side of South America (Ohrnberger, 1999);
- the highest diversity of bamboos could be found in the coastal region of Brazil (Sao Paulo), where climatic conditions are ideal for bamboo species. According to Londono (2001), Brazil has the greatest bamboo diversity in Latin America.

The highest species richness in Africa could be found in the northern part of Madagascar, although Africa is strikingly poorer in bamboo species compared to South America.

Both American and African continents have substantially lower bamboo species richness compared to Asia: the highest potential species richness recorded in America was 35 species per km², while the corresponding figure for Asia was 144 species per km².

The importance of woody bamboos for the local economies in America and Asia also seems to be different. While in Asia bamboo is a necessity of life in the local communities (Dransfield 1995), in the most countries of Latin America it should be

considered as a resource of little significance for the local economies (Londono 2001). Only in Colombia, Ecuador and Brazil bamboo plays a more conspicuous role. Only one Latin American species (*Guadua angustifolia*) was recognised as a priority species for international action based on its economic importance (Rao 1998).

Both Atlantic coast of Brazil and Madagascar are recognised as hot-spots of diversity of high plants (World Conservation Monitoring Centre 1992).

Although the absolute figures of species richness are rather high, the area with very high richness is correspondingly small.

The results contribute to an understanding of where bamboo is most likely to be a significant contribution of biodiversity. They also provide a basis for developing models of bamboo abundance and socio-economic importance.

The interpretation of the absolute richness data and the distribution patterns is subject to a number of limitations, including:

- Since the large number of records (82%) contain information about altitudinal range, in most cases it was possible to shape individual grids accordingly and thus avoid artificial boundaries of species distributions and high estimates of species richness per square km. Nevertheless, in some cases due to the lack of ecological information and location details in the species descriptions, the boundaries of (sometimes rather large) administrative units were used for species mapping.
- It is important to recognise that many species persist outside forest and the study did not address this. Therefore, absence of bamboo in some countries is explained by the fact that the data on distribution of homestead bamboos and plantations are incomplete.

Future work in this area will need to focus on a number of ways forward:

- 1) Identifying the few forest inventory data sets that include bamboo and investigating their application in estimating bamboo abundance and extrapolating overall resource quantification;
- 2) Identifying ways to attach economic value to the resource;
- 3) Identifying information gaps, for instance in taxonomy of subfamily Bambusoideae and sources of improved information to fill them;
- 4) Identifying alternative methods of mapping species distributions, for example modelling of species distributions on the basis of climatic parameters.

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ANNEX 1.

Map 1. Potential distribution of *Guadua*.

Map 2. Potential species richness.

Map 3. Potential generic richness.