FINAL REPORT

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Project Title: SUSTAINABLE USE, DIVERSITY, CONSERVATION STATUS, AND ECONOMIC POTENTIAL OF BOLIVIAN PALMS

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EXECUTIVE SUMMARY

Our hypothesis was that plant resources could be exploited in a sustainable and non-destructive manner, and that the way to achieve this goal was by a thorough knowledge of the natural history of that resource, and using this to develop sustainable management practices. We used palms (Palmae) as study organisms for the testing of our hypothesis. The specific objectives of this research were fourfold. Firstly, we concentrated on two economically important species, Parajubaea torallyi and Geonoma deversa. For these species we discovered how harvesting practices could be reconciled with continuing reproduction of the palms. Secondly, we carried out an inventory of all naturally occurring palms in Bolivia. Thirdly, we made an assessment of the conservation status of each species. Fourthly, we described the actual or potential economic value of each species.

As a result of this project, significant botanical skills exist in Bolivia. The National Herbarium in La Paz, in part at least as a result of this project, is an active center of botanical research in Bolivia. Knowledge of the Bolivian flora has increased dramatically over the last few years. Local awareness of the importance of useful plants, and their sustainable use has greatly increased. During the life of this project Moraes has worked for a Ph.D. degree from Aarhus University. As a result of this, and successful

completion of the palm project, she is now in a strong position to continue to develop Bolivian botany.

RESEARCH OBJECTIVES

The overall aim of this project was to seek sustainable use practices for two particular species of palms; and to assess the diversity, conservation status and economic potential of all Bolivian palms. The specific research objectives were fourfold.

The first objective was to concentrate on two economically important, but relatively poorly known, species, Parajubaea torallyi and Geonoma deversa. The second objective was to produce an inventory of all Bolivian palms with correct nomenclature and descriptions, this based on previous and proposed fieldwork. The third objective was to assess the conservation status of all Bolivian palms. The fourth objective was to assess their actual or potential economic value.

Other organizations supported the project in Bolivia. There was close collaboration between the personnel of the project and the National Herbarium in La Paz, and between the project and the Museum of Natural History in Santa Cruz.

METHODS AND RESULTS

Parajubaea subproject:

In the Parajubaea subproject a student, Israel Vargas, from the Museo de Historia Natural in Santa Cruz, has been

carrying out work under the supervision of Mónica Moraes. Vargas laid out permanent plots near Vallegrande and tagged each individual palm. Data on leaf production and fruit production were obtained. A paper on palms in interandean valleys of Bolivia was published Moraes and Vargas (1994, see Appendix I). A summary of the results is presented below.

Sustainable Uses of Parajubaea sunkha

Israel Vargas and Monica Moraes

This palm species - formerly known as ***Parajubaea torallyi*** - is endemic to Bolivia (Moraes, 1996). It is found in narrow interandean valleys covered with low semideciduous forests in the Province of Vallegrande, SW Department of Santa Cruz. Its population ranges between 1700 and 2200 m elevation. This species is locally exploited for its fruits, leaves and leaf fibers. Several products are weaved such as matresses, baskets, fans, and ropes (Vargas, 1994).

Because past and current harvesting practices affected negatively to its reproduction, studies are needed to involve a sustainable management to enhance its productivity and conservation at a long term level by local communities.

Methods

Since 1993, the whole valley of Vallegrande has been visited in order to survey the extension and representativeness of this palm species.

Two plots were inventoried in the valley of Vallegrande. In El Palmar (E of Vallegrande) an area of 200 m^2 (10 x 20 m) intensively harvested was studied. While a non harvested plot of 500 m^2 (10 x 50 m) was inventoried in the Quebrada del Zorro (one kilometer south of Vallegrande).

The age structure of the population has been described and measured in relation to classes of vegetative growth, tagging each individual, and recording heigth, diameter, number of leaves, and number of pinnae.

The structure of both harvested and non-harvested plots were compared in order to gather information about the impact of current harvest on the regeneration phases of ***Parajubaea sunkha***.

Between 1993 and 1994, phenological data were registered in both permanent plots. Information included time and frequency of flowering, fructification, and mature fruits.

Fiber production has been recorded following measurements of fallen leaves, width, and dry weight of fibers.

Through interviews to local communities and farmers, basic information was gathered about traditional uses and local profits derived from palm products: fibers and fruits, as well as its commercialization.

For statistical analysis, all the information was processed under EXEL 6.1 for mean results, variance, standard deviation, and coefficient of variation.

Results

Fourteen stands are found in the valley of Vallegrande: El Palmar, Peñones, Collpa, Martín Pampa, Alto Palmar, Mataralcito, Juntas de Guariconga, Rodeo, Río San Blas, Alto La Sequía, Sunchal, Palmas Amarillas, Quina-Quina, and Quebrada La Palma. Both extreme stands, from north to south are distanced by 50 km: from the Quebrada La Palma, north of Vallegrande, to Las Minas near Piraymiri, in the south of Vallegrande. A natural stand of sunkha very close to Vallegrande lies in the Quebrada del Zorro.

In both study sites heigth classes of the sunkha palm were surveyed (see Table 1).

Table 1

Heigth classes of ***Parajubaea sunkha*** in harvested and non harvested plots ([a] El Palmar; [b] Quebrada del Zorro)

Class	Heigth (m)	Individuals[a] %	Individuals[b] %
1	0-0.5	0.0	9.5
2	0.5-1.0	0.0	15.9
3	1.0-2.5	0.0	36.5
4	2.5-5.0	25.0	17.5
5	5.0-10.0	70.0	12.7
6	>10.0	5.0	7.9
	N	20	126
	TOTAL (%)	100	100

The most representative class in El Palmar belongs to adults which range between 5 and 10 m tall (to 70% of the total). Although there are some reproductive individuals which are being left without harvest, no germinated fruits nor seedlings and juveniles are representated in harvested stands. These few plants - locally known as "coroceras" - are identified by farmers as "good individuals for fruit production".

In the case of a closed area, without the invasion of cattle and harvesting practices, in the Quebrada del Zorro all the heigth classes are well typified, even seedlings and adults.

From a seedling to adults, the ***Parajubaea sunkha*** bears 1-8 leaves in the class 1, 9-14 leaves in the class 2, 15-25 leaves in the class 3, and 30-45 leaves in the class 6. Fibers are soft and less resistant when plants reach 2.5 m, and were measured to be 15 x 50 cm; while a high quality fiber with 40 x 100 cm is find in individuals 3-15 m tall.

In the heigth class 4, individuals start flowering. Each inflorescence is subtended by a leaf. The first inflorescences are smaller than mean sizes, and it is said by local people that the sunkha palm reaches maturity when it has about 18-25 years old.

Each plant has 8-12 infructescences in different stages of growth; reaching mature fruits each two months. Annually, five infructescences reach maturity per plant.

Parajubaea sunkha flowers and produces fruits along the whole year. Staminate flowers have their flowering peak in the second week since the peduncular bract was opened. After 25-30 days, more than 50% have been fallen down up til the next 10-15 days. Shortly then, the pistillate flowers start to be receptive during 25-30 days. Simultaneously to the beginning of the pistillate flowers' anthesis, a new inflorescence is at the point of being opened.

Each rachilla bears 2-5 fruits, and each inflorescence has between 35 to 45 rachillae. About 120-160 fruits per inflorescence are produced. If 5-8 inflorescences are yearly produced by each plant, then 840-980 fruits are potentially gathered from each individual per year.

Both study sites were studied to compare total weigth, width and length of ripe fruits (see Table 2). There is no significative difference in quality of fruits produced under natural conditions and in harvested stands.

Table 2

Comparison of total fruit weigths, width and length in harvested and non harvested plots (harvested = El Palmar; non-harvested = Quebrada del Zorro)

El Palmar	Weigth (g)	Width (mm)	Length (mm)
X	32.0	31.7	36.0
S	21.8	8.1	7.0
S^2	4.3	2.8	2.6
CV	13.3	8.9	7.3
Quebrada del Zorro	**Weigth (g)**	**Width (mm)**	**Length (mm)**
X	34.7	37.0	40.2
S	3.9	1.6	1.7
S^2	15.3	2.5	3.0
CV	11.3	4.3	4.3

The comparison between harvested and non-harvested plots gives a general view about leaf, fruits and flower production (see Table 3). In general, individuals growing in Quebrada del Zorro are well developed and reach higher sizes than in the harvested plot. In almost untouched stands, fruits are produced about twice in number than in El Palmar. The majority of fruits found in non-harvested stands reaches ripeness. The production in number of inflorescences does not vary highly, but most inflorescences found in El Palmar are inmature and potentially affected by subsequent extractions. Also, only few old plants are left for seed production.

Table 3

Leaves, inflorescences and infructescences in harvested and non-harvested stands

El Palmar	DAP (cm)	Heigth (m)	# Leaves	# Infl.	# Infr.
Total	663.5	130.8	533.0	19.0	87.0
X	33.2	6.5	26.7	1.4	4.5
S	3.7	1.3	4.6	0.5	2.8
S^2	14.0	1.6	21.2	0.2	7.7
CV	11.3	19.4	17.3	36.6	0.6

Qbrda. Zorro	DAP (cm)	Heigth (m)	# Leaves	# Infl.	# Infr.
Total	965.7	262.0	748.0	21.0	165.0
X	37.1	10.1	28.8	0.8	6.3
S	4.6	3.0	8.9	0.9	4.7
S^2	24.0	8.9	78.9	0.9	25.2
CV	12.4	29.4	31.1	110.8	73.8

Harvesting practices

Formerly, the whole plant was cut down to extract fibers and leaves. Current harvest practices are based in sequenced extractions of outer leaves to inside. Farmers climb on persistent foliar bases up to the crown. Each leaf is cut at the base to get the most developed fiber; this practice is locally called "redondeo".

About 15-20 leaves per plant are being harvested each two years for the extraction of fibers (locally known as "sunkha"). This means, that around (6-)15-25 leaves are being left for the next two years.

After harvest, the stand of El Palmar shows a decrease in number of leaves (see Table 4). Mean values evidence a high significance of harvest selection on leaves. Even considering a high production of leaves per year, current harvest practices of the sunkha palm affects directly on the production of inflorescences, infructescences, and germinated seeds.

Table 4

Number of leaves before harvest and after harvest in El Palmar

	Before harvest	After harvest
Total	533	167
X	256.7	8.4
S	4.6	1.4
S^2	21.6	1.9
CV	17.3	16.6

In the case of fruits, local people do not organize a certain period of harvest. Consumption is neither being commercialized at larger scales.

Uses and production

Fruits, leaves and fibers are exploited for self-consuming economies at a local level. Twelve families were interviewed from a total of 36 in relation to five localities: El Palmar, Chapas, Peñones, Mataralcito and Martín Pampa.

The most important product are different kinds and sizes of matresses. Large matresses (80 x 80 cm) are being built up with 10-15 entire fibers which have 40 x 100 cm in size; they are valued in $US 4-6 each.

Different qualities of ropes made by leaf rachis and leaflet rachis are also locally valued between $US 0.4-0.8, depending of length and thickness. Three sizes of baskets weawed with leaflets are paid for $US 0.4-1; 1-2 baskets are made up with one leave of 3-4 m long.

Discussion

Most exploited stands in the region are mixed with seasonal crops like maize, but also with extensive management of cattle. Direct impact of both activities affects destruction of seedlings by cattle and predation of fruits by pigs and cattle.

Comparing the fruit production between harvested and non-harvested plots, the quality is nearly identical, but not in number of ripe fruits.

Current harvesting practices highly endanger the natural regeneration of harvested stands. Leaf extraction itself affects on the production of inflorescences. There is no management in order to rotate adult reproductive individuals for production of ripe fruits and to allow germination plots inside crops.

Potentially, each individual has an economic value of $US 16-33.

Geonoma subproject:

In the Geonoma subproject a student, Jaime Sarmiento, from the National Herbarium in La Paz, has worked under the supervision of Mónica Moraes. Sarmiento selected four study sites, one southwest of Ixiamas, the second near Sapecho, the third at Tumupasa, and the fourth in the Chimane Forest Reserve. In the first two sites 1 hectare permanent plots were established, and the work was carried out with the collaboration of local ethnic groups (Tacana and Chimane). A summary of the results is presented below.

Uso tradicional de la jatata (*Geonoma deversa*) en el NW de Bolivia

Jaime Sarmiento
Mónica Moraes

La recolección de productos derivados del bosque es una de las actividades principales de diferentes pobladores (originarios o inmigrantes) de las tierras bajas amazónicas en Bolivia. Frecuentemente son utilizados como recursos de recolección que sirven para atender sus requerimientos, aunque ocasionalmente pueden derivar en un uso comercial en diferentes grados, constituyendose de esta forma en una fuente de recursos económicos para estos grupos.

Varias especies de palmeras se encuentran dentro de esta categoría, como fuente de recursos alimenticios, medicinales, de construcción etc. Una de las especies más conspicuas es ***Geonoma deversa*** (jatata), que constituye la más importante fuente de material para la elaboración de techos en medios rurales por su larga durabilidad y resistencia, principalmente de la región NW del país. El uso incluye en cierto grado, centros urbanos menores de la zona y en mucha menor proporción, algunos de los centros urbanos más importantes de Bolivia, (mejorar la desc=pción del área de uso de la jatata para techos) .

Aunque las técnicas de recolección y procesamiento de las hojas de jatata para la construcción de los paños, como se denominan localmente las unidades que se usan en la confección de techos, son facilmente accesibles a cualquiera, ésta puede ser considerada una actividad típica de algunos grupos originarios, como los Chimane, asentados en bosques de las serranías subandinas, donde ***Geonoma deversa*** es una especie característica del sotobosque.

El asentamiento creciente de colonos inmigrantes en esta región, y el crecimiento de algunos centros urbanos donde, principalmente la gente de menores registros, usa de manera importante este material, genera una demanda constante y en cierto grado creciente del producto.

El método de recolección usado por los Chimane y en general en toda el área de uso en Bolivia, consiste en el corte de la corona de la palmera antes de separar la hojas. Bajo este sistema, la "rama" cortada muere (excepcionalmente parece haber regeneración), pero este es el único método empleado, porque es más fácil y rápido, y porque la planta puede generar vegetativamente nuevos tallos, que pueden formar parte de una nueva cosecha luego de un período de descanso.

En el marco del proyecto "Uso sostenible, diversidad, potencial y estado de conservación de las palmeras bolivianas" se ha desarrollado un trabajo para evaluar la sostenibilidad de la recolección de jatata. A través del establecimiento de parcelas permanentes se ha previsto la evaluación de los métodos actuales de recolección de la palma. Adicionalmente, a través de entrevistas con los principales productores, se ha recolectado información adicional sobre costos de producción para obtener una idea preliminar de la importancia económica de la actividad.

Métodos

A través de la participación directa en el proceso de recolección, se ha determinado los métodos y se ha cuantificado la magnitud de recolección del producto en cada campaña de reproducción.

Adicionalmente, se han establecido parcelas permanentes en dos áreas. Utilizando el criterio de la presencia de población humana, se han seleccionado un área donde no se produce recolección y de zonas con recolección actual. Tres? parcelas "testigo" se han estabecido en la región de Alto Madidi (Fig. 1.), zona con muy baja densidad de población humana donde práctcamente no existe recolección. En la región de Pilón-Lajas (Fig.1), con una importante presencia de inmigrantes y de comunidades del pueblo originario Chimane, se han establecido una parcela en una zona no recolectada en los últimos años, y una segunda parcela en una zona de cosechada durante el desarrollo del trabajo.

El primer sitio se encuentra en una zona de acceso muy difícil (solo un camino de extracción maderera en muy mal estado). La segunda ubicada en las proximidades de una importante zona de colonización, es de relativamente fácil acceso, ya que se encuentra en la proximidad de caminos carreteros.

La jatata (***Geonoma deversa***) tiene un hábito cespitoso, presentando individuos con 5 hasta más de 30 tallos, que pueden cercer más de 4 m. Individuos con un solo tallo son relativamente raros y han sido considerados como un individuo de un solo tallo.

En cada plot se ha contado el número total de individuos y de ttalos por individuo, asignando a cada tallo una etiqueta (marca), y registrando la siguiente información:

1. Distribución por clases de tamaño de los tallos, de acuerdo a categorías basadas en rangos de alturas y fase de crecimiento de los individuos.

2. El número de hojas por cada tallo.

3. La presencia de botones florales, inflorescencia o infrutescencias en cada tallo.

Para comprobar el uso sustentable de la jatata, se ha "intentado" controlar que la recolección no afecta la densidad de individuos, la distribución por clases de los tallos en individuos, y la presencia de estructuras reproductivas en cada individuo, y el número de individuos cosechables.

RESULTADOS

Densidad

El número de individuos (cespitosos con varios tallos) varía entre 7 y 21 por 1/10 ha en el área de Alto Madidi no sometido a recolección. En la región de Pilón-Lajas, la densidad es de 208 individuos (clumps) por 1/10 ha. La densidad es claramente superior en el área de Pilón-Lajas, donde ***Geonoma deversa*** forma stands densos denominados jatatales.

Si se compara la parcelas no cosechadas y la recientemente cosechadas en la región de Pilón lajas, las densidades registradas son de 208 por 1/10 ha y 36 por 1/10 ha respectivamente, mostrando diferencias significativas.

Clases de tamaño

Cuatro clases de tamaño han sido definidas: 0-0,5m; 0.5-1m; 1-2m; y >2m.

En parcelas no cosechadas y recientemente cosechadas, cada individuo de ***Geonoma*** presenta de 5 hasta más de 30 tallos en diferentes estados de crecimiento

La clase dominante en parcelas no cosechadas es la 3 con 45% de tallos y en parcelas cosechadas la clase 4 con 35% de tallos. La clase con menor número de tallos es la 1 en ambos casos.

Tabla 1.

Clases de tamaño de tallos en parcelas cosechadas y no cosechadas (a: No cosechada, b: Recientemente cosechadas)

Clases	Rangos (m)	No cosechadas	Cosechadas
1	0-0.5	12	1
2	0.51-1.0	21	12
3	1.01-2.0	32	45
4	>2.0	35	43
		N=1521	N=101

Producción de hojas

La producción de hojas ha sido determinada en la parcela no cosechada. El número de hojas varía de 1-3 en la clase de 0-0.5 m, aumentando hasta 10 a 15 en la clase >2m

De acuerdo al número de hojas, los individuos de las clases 3 y 4 se encuentran entre los que son objeto de recolección.

Tabla 2. Número de hojas por clase de tamaño

Clases	Rangos (m)	No cosechadas (%)	Cosechadas (%)
1	0-0.5	1-3	1
2	0.51-1.0	3-6	2-4
3	1.01-2.0	4-8	3-6
4	>2.0	7-14	5-11

Técnicas de recolección

La recolección se realiza por el corte de la corona de tallos. Los recolectores locales cosechan preferentemente tallos que contengan más de 6 hojas que corresponden a individuos por lo general mayores a 2 m.

Cada operación de recolección involucra por lo general aproximadamente 17 clumps de jatata de los que se colecta entre y 8 tallos. Después de la recolección, cada individuo conserva entre 3 y 14 tallos que corresponden principalmente a las clases menores a 2 m. Estos clumps, permanecen no utilizados para favorecer la regeneración de los tallos. Al cabo de un período de 2 años aproximadamente, se ha visto que la parcela cosechada no ha vuelto a ser utilizada por el grupo Chimane. Los clumps controlados presentan en este período un aumento en el número de tallos, pero principalmente se produce el aumento del número de hojas en los individuops que permanecieron sin ser utilizados. para realiozar un cálculo de la regenación en parcelas recientemente cortadas, se requiere de un control a mediano plazo en un período superior a los cuatro años.

Importancia económica

Cerca de 405 hojas de ***Geonoma deversa*** son utilizadas para la construcción de cada pieza, localmente denominada paño, de 3 m de longitud. Cada paño se vende a Bs 5 (= 1 us$).

Inventory subproject:

In the inventory subproject, Moraes and Henderson have completed a floristic inventory of all Bolivian palms. A database of all palm holdings in the National Herbarium in La Paz, using the Fox-Pro program, has been completed. A student, Eduardo Oviedo, from the National Herbarium in La Paz, entered all data. Seven hundred records from specimens from LPB have been entered into the database (see Appendices II and III).

Collecting of herbarium specimens was carried out in the following areas: in October 1993 Moraes, Sarmiento and Oviedo collected for 10 days to the central and southern region of the Department of Beni; between October and November 1993 Moraes collected for two weeks in the eastern and northern regions of Beni; in September 1994 Moraes collected in Guayaramerín (Beni); in October 1994 Henderson and Moraes collected in the Chapare region of Bolivia (Santa Cruz to Cochabamba); in September 1994 Moraes traveled to the northeastern region of the Department of Beni for 5 days of palm collecting. As a result of this collecting, specimens of Palmae in the National Herbarium in La Paz have increased from 140 to 700 specimens over the life of the project. Two new species of Bolivian palms were discovered as a result of this work, and were published by Moraes (1996a; see Appendix IV). A summary of the diversity of Bolivian palms was published by Moraes (1996b, see Appendix

V). Moraes has used these collections to prepare an inventory of Bolivian palms, and this will be published as a Manual of the Palms of Bolivia, summarizing all taxonomic, conservation, and economic potential data.

Conservation subproject:

All extant palm collections at the Bolivian National Herbarium (LPB) have been entered into a database. For the conservation status of Bolivian palms, information has been added to the database. Conservation status for all Bolivian species has been summarized by Moraes in a Manual of the Palms of Bolivia. An overview of the diversity and conservation status of all Andean palms was published by Moraes et al. (1995a, see Appendix VI).

Economic subproject:

All extant palm collections at the Bolivian National Herbarium (LPB) have been entered into a database. For the economic potential of Bolivian palms, information was added to the database. Summaries of the economic potential were published by Moraes et al. (1995b, see Appendix VII). Furthermore, all known economic uses of Bolivian palms were recorded in the inventory, under the appropriate species, and will be published by Moraes in a Manual of the Palms of Bolivia. Detailed studies on economic uses of two Bolivian

palms were carried out and the results have now been published: Moraes and collaborators studied the uses of the motacú palm (Attalea phalerata)(Moraes et al., in press), and Vargas studied uses of Parajubaea torallyi (Vargas, 1994).

IMPACT, RELEVANCE AND TECHNOLOGY TRANSFER

The results of this project will, we hope, act as a catalyst for further work in Bolivia on sustainable use of natural resources. The project has been run through the National Herbarium in La Paz, and the project has had a large impact on the Herbarium. There now exists a body of expertise that is capable of attracting international funding from other agencies to continue the work of documenting and conservation Bolivia's rich flora. The three students involved in the project have all received valuable training in various techniques. Moraes has been working on her Ph.D. during the life of the project, and her thesis work and the project goals have largely overlapped. Her capability for carrying out further significant botanical work in Bolivia is thus greatly enhanced. The National Herbarium of Bolivia has been greatly strengthened during the life of this project. The activity generated by the project, together with other projects, has made the National Herbarium an extremely active center of botanical research in Bolivia, attracting national and international visitors.

While somewhat intangible, projects such as this greatly increase the level of training of all participants.

PROJECT ACTIVITIES/OUTPUTS

Moraes attended the following: Symposium on Neotropical Montane Forest Biodiversity and Conservation (New York, 21-26 June, 1993).

Moraes and Henderson taught a course in Santa Cruz in January 1996 entitled: Diversity, Distribution, Conservation, and Economic Uses of Bolivian Palms.

Dr. Miguel Pinedo, Columbia University, New York, taught a course in Santa Cruz in January 1996 entitled: Methods for sustainable use of natural resources.

Moraes continued her fellowship at Aarhus University in Denmark in order to complete a Ph.D. degree in Botany. The subject of Moraes's thesis is the floristic survey of Bolivian palms, and thus the requirements of her thesis will be the same as the objectives of the project.

The following publications have resulted from the project:

Moraes, M., G. Galeano, R. Bernal, H. Balslev & A. Henderson. 1995a. Tropical Andean Palms (Arecaceae). Pages 473-487 in: S. Churchill, H. Balslev, E. Forero & J. Luteyn (editors). Biodiversity and Conservation of Neotropical Montane Forests. New York Botanical Garden.

Moraes, M., J. Sarmiento & E. Oviedo. 1995b. Richness and

uses in a diverse palm site in Bolivia. Biodiversity and Conservation 4: 719-727.

Moraes, M. 1996a. Novelties of the genera Parajubaea and Syagrus (Palmae) from interandean valleys of Bolivia. Novon 6: 85-92.

Moraes, M. 1996b. Diversity and distribution of palms in Bolivia. Principes 40: 75-85.

Moraes, M. In press. The genus Allagoptera (Palmae). Flora Neotropica Monograph.

Moraes, M. & I. Vargas. 1994. Los valles interandinos de Bolivia: sitio especial para algunas Palmae. Noticiero Sociedad Boliviana de Estudios Botánicas (Santa Cruz) 1: 1-3.

Moraes, M., F. Borchsenius & U. Blicher-Mathiesen. In press. Notes on the biology and uses of the motacú palm (Attalea phalerata, Arecaceae) from Bolivia. Economic Botany.

Vargas, I. 1994. Ecology and uses of Parajubaea torallyi in Bolivia. Principes 38: 146-152.

PROJECT PRODUCTIVITY

The project accomplished all of its goals. The Manual of Bolivian Palms is not yet published, but is in an advanced stage of publication, and we expect it will appear this year. The results of the Geonoma and Parajubaea subproject

are not yet published, but again we expect that they will be published this year.

FUTURE WORK

The project will no doubt lead to future work on Bolivian palms. Moraes will continue her studies on the flora of Bolivia, and in her position at the National Herbarium will continue to carry out work on sustainable uses and conservation of Bolivian palms.

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Appendix 1

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Los Valles Interandinos de Bolivia: Sitio Especial para algunas Palmas

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Los Valles interandinos de la Cordillera Oriental en Bolivia registran varias sorpresas en cuanto a la diversidad de plantas. Un ejemplo destacable son las palmeras y particularmente el "janchi coco" y la "palma zunkha", que pertenecen al género *Parajubaea*.

Hasta hace poco estaba clara la identidad de la "palma de Pasopaya" (Depto. Chuquisaca), descrita por Martius en 1845 como *Parajubaea torallyi* . Su descripción se basó en las memorias de campo y colección botánica que Alcides d'Orbigny realizó en Bolivia entre 1831-33, durante su expedición a varios países de Sudamérica. Hasta 1991 gracias a las colecciones botánicas de Vargas, Nee, Henderson y Moraes se adicionó otra importante localidad para esta palma: Vallegrande en Santa Cruz.

Moraes y Henderson aportaron con una reseña del género, en la que se reconocían dos especies diferentes: una endémica a Bolivia con una población natural amplia y *P. cocoides* únicamente en estado cultivado distribuida en Colombia y Ecuador. En principio esta reseña argumenta la posibilidad que *P. cocoides* pueda ser un cultígeno de la *Parajubaea* de Bolivia, sin embargo considerando los caracteres que las diferencian se las debería mantener como dos especies distintas.

Hasta ese momento también se contaba con ciertas referencias respecto a una población de *Parajubaea torallyi* con individuos altos que llegaban hasta 24 m de altura. Cárdenas por ejemplo se refiere a los "grandes palmares" del valle de Pasopaya y del envío ejemplares de semillas al Bailey Hortorium, considerablemente mayores a las tipificadas bajo *P. torallyi* de Vallegrande. Si bien el espécimen tipo de esta especie obtenido por d'Orbigny solo consta de frutos, se puede apreciar claramente que tienen una dimensión similar a los frutos procedentes de Vallegrande.

Mediante fotografías obtenidas por el Ing. Oscar Murgía del SE de la ciudad de Sucre, cuando trabajaba en CORDECH y se trabajó bajo un convenio con el Herbario Nacional de Bolivia - se tuvo el primer registro gráfico del palmas totalmente diferentes a

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la palma de Vallegrande. Esto fue complementado también a través del proyecto "Manual de plantas útiles de Potosí" que realizó trabajo de campo en el NE del departamento de Potosí y se estudió material botánico y fotográfico que evidentemente diferia en habito de la palma de Vallegrande.

El viaje a Presto

A través del proyecto "Uso Sostenible, Diversidad, Potencial Económico y Estado de Conservación de las Palmas Bolivianas" - financiado por USAID al Herbario Nacional de Bolivia y al New York Botanical Garden - se ha logrado un conocimiento más profundo de la *Parajubaea* - "palma zunkha" de Vallegrande, componente ejecutado por Israel Vargas desde enero de 1993 al presente. Por lo que se planificó la realización de un viaje prospectivo hacia el NE del departamento de Chuquisaca, con un solo objetivo encontrar los "grandes palmares" de *Parajubaea*.

Para seguir el rastro no documentado de localidades mencionadas en viejas publicaciones se necesita sobretodo un enorme caudal de paciencia y perseverancia. Las palabras claves para la realización de este viaje eran: Presto, valle de Pasopaya y el nombre vernacular " janchi coco" -alusivo a que la semillas es aprovechada y masticada por los lugarenos.

Durante la época seca - en que fue realizado este viaje - el paisaje desde Vallegrande hacia Zudanez y luego Presto hay pocas esperanzas de encontrar hábitats adecuados para el desarrollo de palmas. La mayor parte de los valles son amplios y carecen de quebradas cerradas que les permita retener condiciones de humedad. Dependiendo de la altitud se presentan vastos matorrales espinosos hasta praderas de herbáceas.

A partir de Presto, las condiciones logísticas fueron haciéndose más difíciles porque la carretera utilizada no esta mantenida y por naturaleza se encuentra muy accidentada y erosionada, por lo que el trayecto hasta cerca de Mulani de solo 40 Km fue realizado en 6 horas! Desde el momento en que divisamos unas cuantas palmas en pleno borde de la montaña - casi entre visiones y el afán de encontrar el palmar - las perspectivas de nuestro viaje fueron más promisorias, ya que cada vez más personas nos daban mayores referencias del gran palmar cerca de Mulani.

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M. Moraes R. & I. Vargas C. - Palmas Interandinas de Bolivia

El mejor premio a tremendo viaje fue lograr ver apenas llegamos al famoso palmar y confirmar que se trata de una población diferente a la de Vallegrande. Fue intensa la recolección de los frutos y flores porque confirmamos que evidentemente hay diferencias en las tendencias del número de semillas por fruto y en el número de estambres. Las fotografías revelan que no fue ilusoria la comparación de una persona con el tronco de estas increíbles palmeras con casi 50 cm de diámetro y que aventuran a trepar hasta el borde de esos valles cerrados logrando llegar hasta los 3.000 m de altitud.

En realidad, son muchos los caracteres que difieren de los estudiados en la *Parajubaea* de Vallegrande y en definitiva la descripción original de *P. torallyi* adolece de una mezcla fortuita entre ambas poblaciones. Por lo que contamos con suficientes criterios para ubicar definitivamente a las dos especies endémicas de *Parajubaea* en Bolivia.

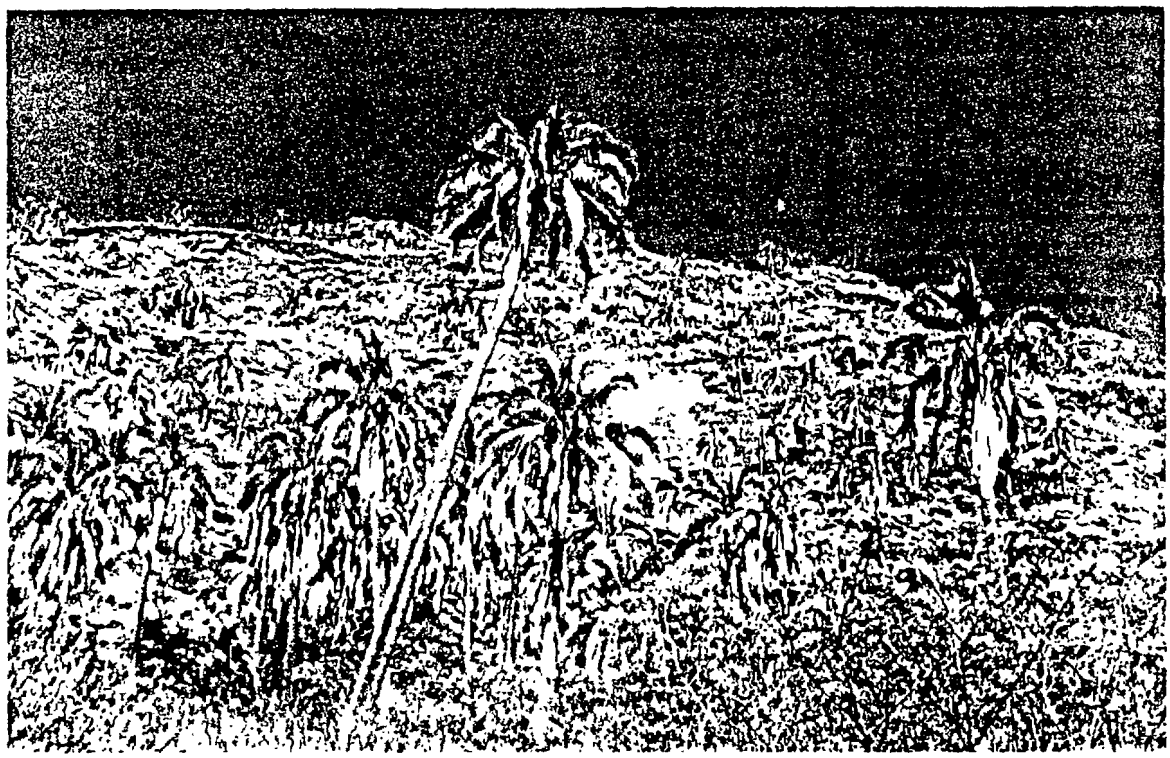

Foto. 1. Los palmares de Pasopaya Fotog. Israel Vargas

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Las Palmeras de d'Orbigny. En la reunión del mes de septiembre de la Sociedad de Estudios Botánicos el Dr. Luis René Moreno dio una interesante disertación sobre el estudio de las palmeras de Bolivia realizado por el naturalista francés Alcides Dessalines d'Orbigny durante su travesía por este territorio entre los años 1830 a 1833.

El interés científico de d'Orbigny fue bien amplio abarcando tanto la antropología y etnografía como la zoología y la botánica. Pero tuvo una manifiesta preferencia por las palmeras inclinación esta que se refleja en las múltiples menciones que hace de estas plantas en su celebre libro Viajes por la América meridional. Por ejemplo encontramos esta cita fechada el 17 de marzo de 1832 cuando visitaba la Misión de San Juaquín " En los bosques de árboles inmensos y del más variado follaje se destacaba, en medio de los motacús una magnífica palmera, llamada palma de rosario - asaí - (*Euterpe precatoria*), porque sus cocos se utilizan para tornear las cuentas de los rosarios. Su tronco recto y liso esta coronado con hojas agradablemente arqueadas. Es sin disputa una de las palmeras más elegantes que haya encontrado." Luego continua.. "En el linde de esos bosques admiré otras dos especies de palmeras, nuevas para mi. Una muy esbelta, lleva sus hojas en una sola linea alterna de cada lado, de manera que forma un abanico del más hermoso color verde (*Oenocarpus distichus)*; la otra es espinosa (*Mauritiella armata)*.... Me ocupe en dibujarlas, en hacerlas derribar y en llevar triunfalmente a la misión todos los materiales para poder pintar y describir bien a esos tres bellos vegetales."

D'Orbigny descubrió cerca de 40 especies de palmeras en Bolivia que fueron descritas por Carl von Martius en su obra "PALMETUM ORBIGNIANUM".

Foto 1. Una de las ilustaciones de d'Orbigny en "Palmarum Orbignianum"

Sociedad de Estudios Botánicos
Casilla 4039 - Santa Cruz - Bolivia

Foto Nº 1. Emplaquetado de imflorescencias para contral de floración y maduración de los frutos; paralelamente se procede a la captura y observación de insectos que visitan las flores. (Loc. Huasacañada).

Foto Nº 2. Cosecha de la fibra (Zunkha), cortando las hojas externas hasta un límite en que no son afectadas las infrutescencias en desarrollo. (Loc. Huasacañada).

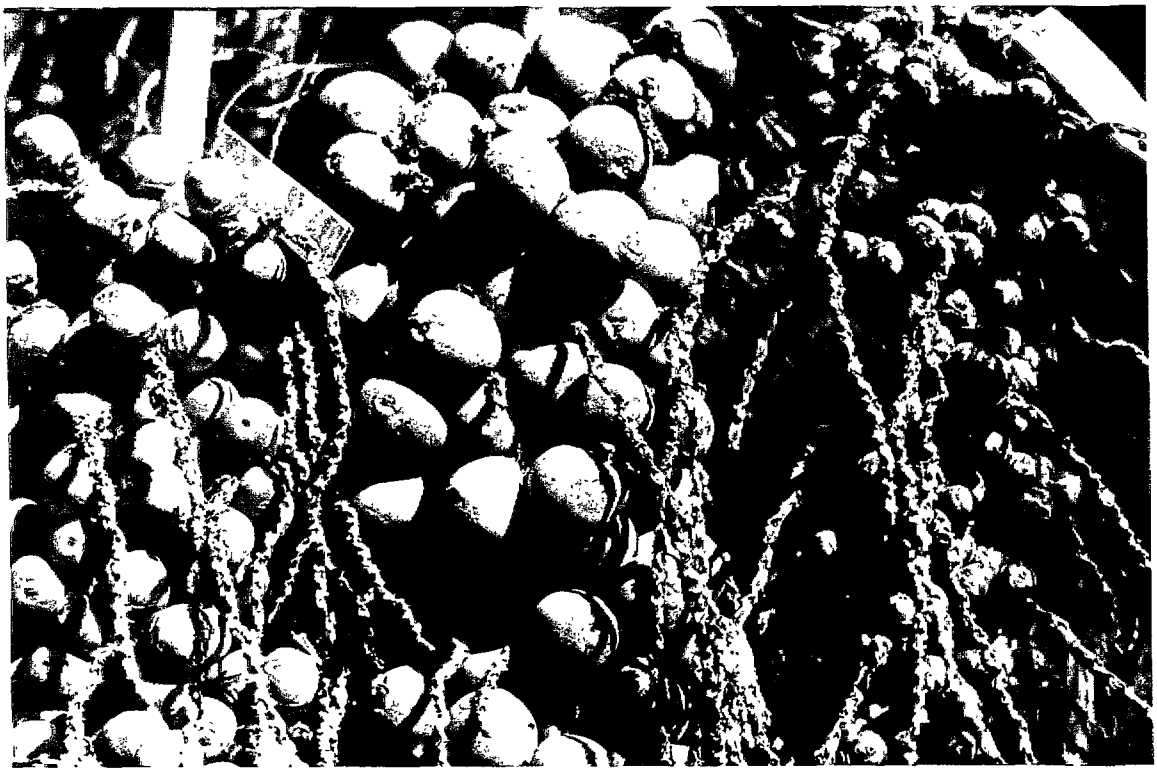

Foto Nº 3. Detalle que muestra frutos de diferentes edades en un minma planta, Palmera en la Localidad de Huasacañada.

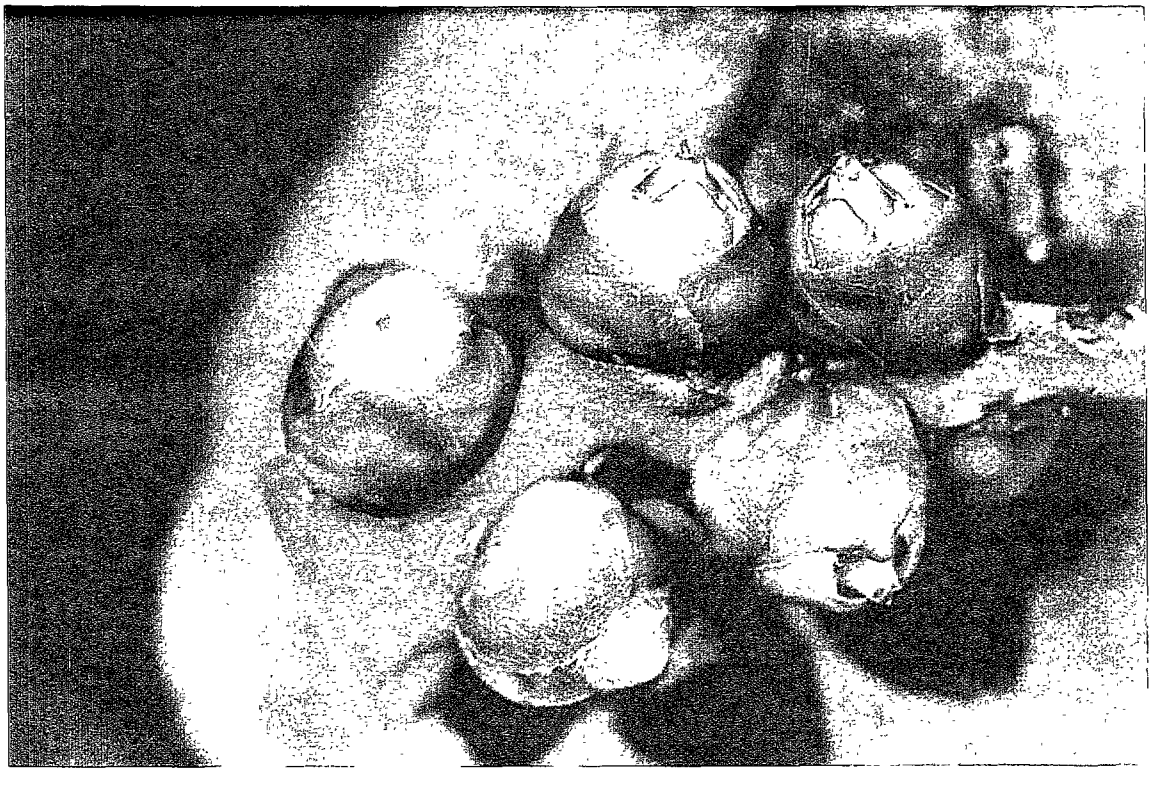

Foto Nº 4. Parte de una raquilla con flores femeninas, serradas en la base y habiertas en el extremo; las masculinas del ápice han caido todas. (Loc. Huasacañada).

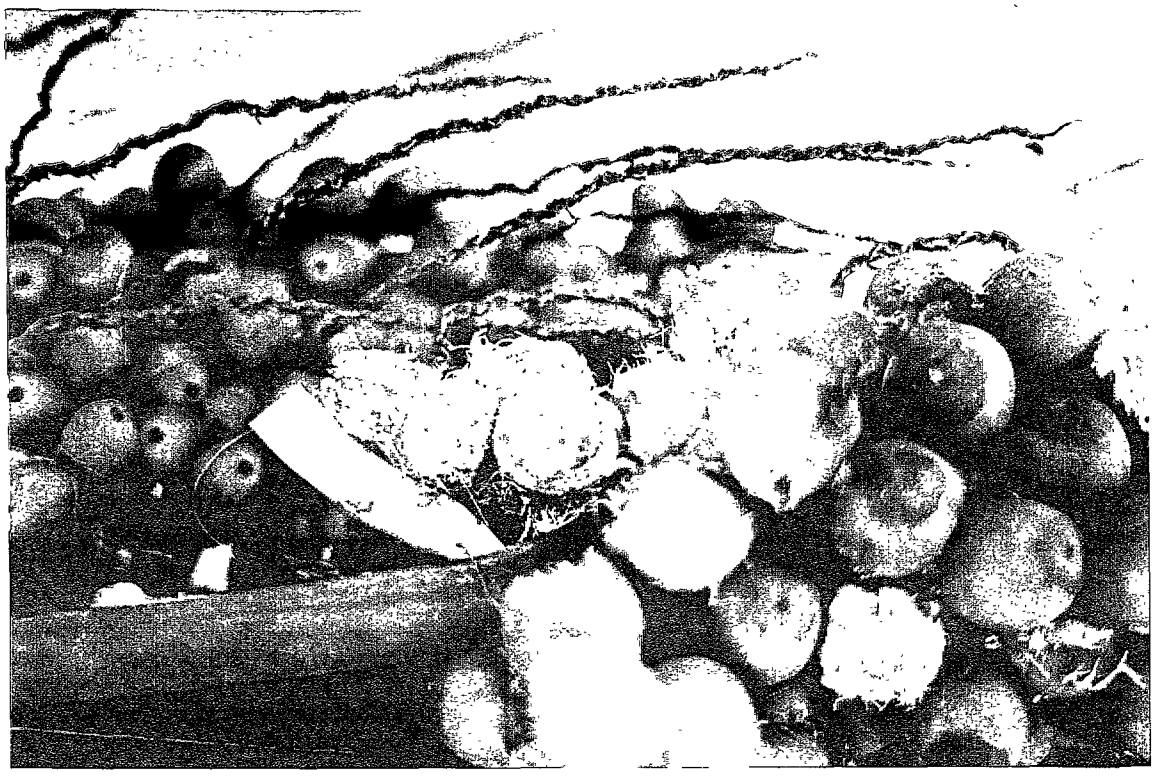

Foto Nº 5. Frutos maduros con mesocarpio dañado por ratenes que llevan algunas semillas, no son perjudicadas las semillas tiernas. (Loc. Huasacañada).

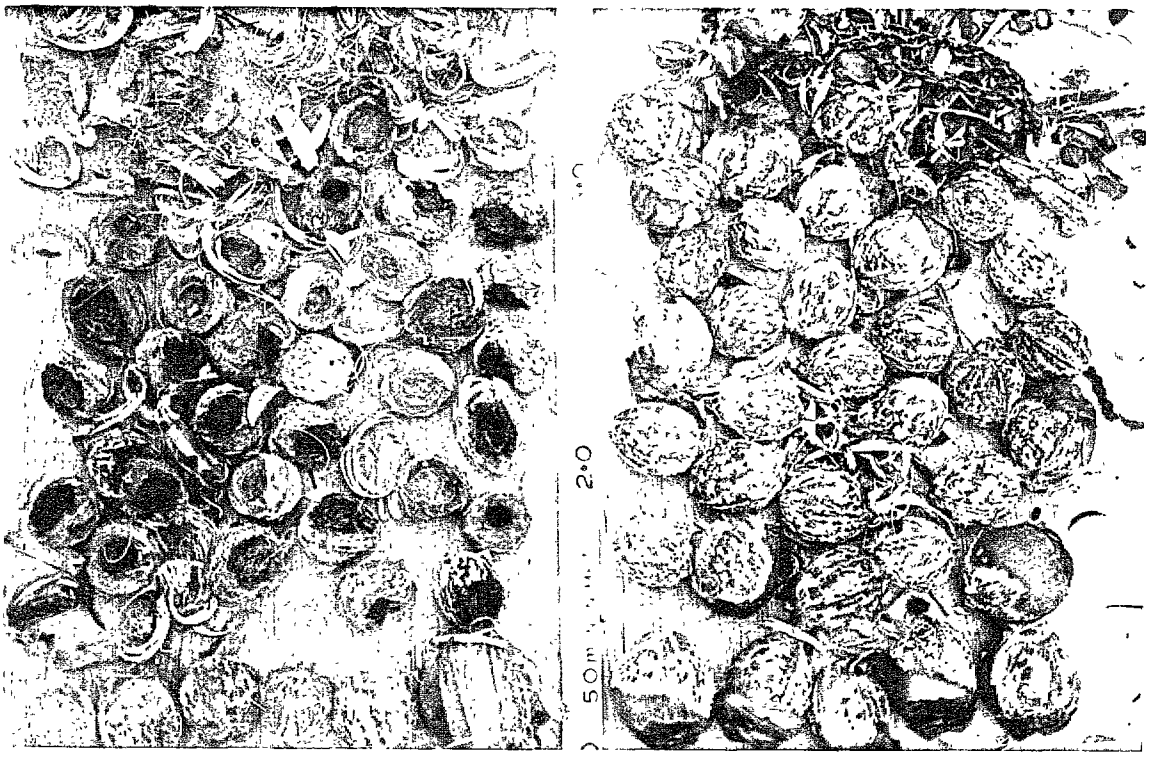

Foto Nº 6. Dos formas de consumo de frutos por roedores. Isquierda, Consumo por Ardillas que rompen el endocarpio para consumir la semilla. Derecha, Consumo por Ratones que solamente consumen el Mesocarpio.

PALMERAS DE BOLIVIA

BASE DE DATOS-COLECCION

GENERO	ESPECIE	DEPARTAMENTO	PROVINCIA	ALTITUD
Acrocomia	aculeata	Beni	Cercado	150 m
Acrocomia	aculeata	Beni	Marbán	230 m
Acrocomia	aculeata	Beni	Marbán	220 m
Acrocomia	aculeata	Santa Cruz	Andrés Ibañez	400 m
Acrocomia	aculeata	Santa Cruz	Andrés Ibañez	400 m
Acrocomia	aculeata	Santa Cruz	Andrés Ibañez	420 m
Acrocomia	aculeata	Santa Cruz	Andrés Ibañez	450 m
Acrocomia	aculeata	Santa Cruz	Andrés Ibañez	375 m
Acrocomia	aculeata	Santa Cruz	Andrés Ibañez	500 m
Acrocomia	aculeata	Santa Cruz	Ichilo	315 m
Acrocomia	aculeata	Santa Cruz	Ichilo	355 m
Acrocomia	aculeata	Santa Cruz	Valle Grande	550 m
Acrocomia	aculeata	Santa Cruz	Velasco	190 m
Acrocomia	aculeata	Santa Cruz	Ñuflo de Chavez	+/-500 m
Acrocomia	aculeata	Santa Cruz	Ñuflo de Chavez	500 m
No.DE REGISTROS			15	
Aiphanes	aculeata	La Paz	Bautista Saavedra	1200 m
Aiphanes	aculeata	La Paz	Franz Tamayo	1550 m
Aiphanes	aculeata	La Paz	Inquisivi	1340 m
Aiphanes	aculeata	La Paz	Inquisivi	1420 m
Aiphanes	aculeata	La Paz	Iturralde	370-380 m
Aiphanes	aculeata	La Paz	Iturralde	+/-300 m
Aiphanes	aculeata	La Paz	Iturralde	350 m
Aiphanes	aculeata	La Paz	Murillo	1200 m
Aiphanes	aculeata	La Paz	Nor Yungas	750 m
Aiphanes	aculeata	La Paz	Nor Yungas	1400-1500 m
Aiphanes	aculeata	La Paz	Nor Yungas	+/-900 m
Aiphanes	aculeata	La Paz	Nor Yungas	1700 m
Aiphanes	aculeata	La Paz	Nor Yungas	870 m
Aiphanes	aculeata	La Paz	Nor Yungas	1330 m
Aiphanes	aculeata	La Paz	Nor Yungas	800 m
Aiphanes	aculeata	La Paz	Nor Yungas	600 m
Aiphanes	aculeata	La Paz	Sud Yungas	1700 m
Aiphanes	aculeata	Pando	Nicolás Suarez	240 m
Aiphanes	aculeata	Santa Cruz	Florida	1090 m
Aiphanes	aculeata	Santa Cruz	Ichilo	600-650 m
Aiphanes	aculeata	Santa Cruz	Ichilo	300 m
No.DE REGISTROS			21	
Allagoptera	leucocalyx	Beni	Ballivián	250 m
Allagoptera	leucocalyx	Beni	Ballivián	240 m
Allagoptera	leucocalyx	Beni	Ballivián	+/-200 m
Allagoptera	leucocalyx	Beni	Cercado	+/-150 m
Allagoptera	leucocalyx	Beni	Vaca Diez	230 m
Allagoptera	leucocalyx	Beni	Yacuma	250 m
Allagoptera	leucocalyx	Beni	Yacuma	+/-200 m
Allagoptera	leucocalyx	Beni	Yacuma	200 m
Allagoptera	leucocalyx	Beni	Yacuma	160 m
Allagoptera	leucocalyx	La Paz	Iturralde	+/-250 m
Allagoptera	leucocalyx	La Paz	Iturralde	460 m
Allagoptera	leucocalyx	Santa Cruz	Andrés Ibañez	400 m

BASE DE DATOS-COLECCION

GENERO	ESPECIE	DEPARTAMENTO	PROVINCIA	ALTITUD
Allagoptera	leucocalyx	Santa Cruz	Chiquitos	400 m
Allagoptera	leucocalyx	Santa Cruz	Chiquitos	900 m
Allagoptera	leucocalyx	Santa Cruz	Chiquitos	700 m
Allagoptera	leucocalyx	Santa Cruz	Guarayos	250 m
Allagoptera	leucocalyx	Santa Cruz	Ichilo	315 m
Allagoptera	leucocalyx	Santa Cruz	Velasco	750-800 m
Allagoptera	leucocalyx	Santa Cruz	Warnes	400 m
Allagoptera	leucocalyx	Santa Cruz	Ñuflo de Chavez	+/-500 m
No.DE REGISTROS			20	
Astrocaryum		La Paz	Iturralde	250 m
Astrocaryum	aculeatum	Beni	Vaca Diez	+/-150 m
Astrocaryum	aculeatum	Pando	Abuna	100 m
Astrocaryum	aculeatum	Pando	Madre de Dios	125 m
Astrocaryum	aculeatum	Pando	Nicolás Suarez	280 m
Astrocaryum	aculeatum	Santa Cruz	Ñuflo de Chavez	100 m
Astrocaryum	campestre	Santa Cruz	Velasco	800 m
Astrocaryum	campestre	Santa cruz	Velasco	800 m
Astrocaryum	gynacanthum	Pando	Abuna	160 m
Astrocaryum	gynacanthum	Pando	Abuná	150 m
Astrocaryum	gynacanthum	Pando	Federico Román	110 m
Astrocaryum	huaimi	La Paz	Iturralde	190 m
Astrocaryum	huaimi	La Paz	Iturralde	180 m
Astrocaryum	huaimi	Santa Cruz	Ñuflo de Chavez	+/-500 m
Astrocaryum	murumuru	Beni	Ballivián	230 m
Astrocaryum	murumuru	Beni	Yacuma	+/- 250 m
Astrocaryum	murumuru	Beni	Yacuma	250 m
Astrocaryum	murumuru	Beni	Yacuma	250 m
Astrocaryum	murumuru	Beni	Yacuma	250 m
Astrocaryum	murumuru	La Paz	Iturralde	+/-500 m
Astrocaryum	murumuru	La Paz	Iturralde	200 m
Astrocaryum	murumuru	La Paz	Iturralde	180 m
Astrocaryum	murumuru	La Paz	Nor Yungas	800 m
Astrocaryum	murumuru	La paz	Iturralde	+/-500 m
Astrocaryum	murumuru	Pando	Cobija	250 m
Astrocaryum	murumuru	Pando	Nicolás Suarez	280 m
Astrocaryum	murumuru	Pando	Nicolás Suarez	280 m
Astrocaryum	murumuru	Pando	Nicolás Suarez	260 m
Astrocaryum	murumuru	Pando	Nicolás Suarez	240 m
Astrocaryum	murumuru	Santa Cruz	Ichilo	400 m
No.DE REGISTROS			30	
Attalea	butyracea	Beni	Vaca Diez	+/-150 m
Attalea	butyracea	Cochabamba	Carrasco	+/- 400 m
Attalea	butyracea	La Paz	Iturralde	190 m
Attalea	butyracea	La Paz	Iturralde	180 m
Attalea	butyracea	Pando	Federico Román	150 m
Attalea	butyracea	Pando	Nicolás Suarez	240 m
Attalea	maripa	Beni	Vaca Diez	+/-150 m
Attalea	maripa	La Paz	Iturralde	190 m
Attalea	maripa	Santa Cruz	Ñuflo de Chavez	275 m
Attalea	phalerata	Beni	Ballivián	250 m

BASE DE DATOS-COLECCION

GENERO	ESPECIE	DEPARTAMENTO	PROVINCIA	ALTITUD
Attalea	phalerata	Beni	Ballivián	200 m
Attalea	phalerata	Beni	Cercado	+/-150 m
Attalea	phalerata	Beni	Cercado-Marbán	230 m
Attalea	phalerata	Beni	Vaca Diez	125 m
Attalea	phalerata	Beni	Vaca Diez	125 m
Attalea	phalerata	Beni	Vaca Diez	+/-150 m
Attalea	phalerata	Beni	Yacuma	250 m
Attalea	phalerata	Beni	Yacuma	160 m
Attalea	phalerata	Beni	Yacuma	250 m
Attalea	phalerata	Beni	Yacuma	+/-200 m
Attalea	phalerata	La Paz	Franz Tamayo	900 m
Attalea	phalerata	La Paz	Iturralde	+/-500 m
Attalea	phalerata	La Paz	Iturralde	+/-300m
Attalea	phalerata	La Paz	Iturralde	140 m
Attalea	phalerata	La Paz	Iturralde	250 m
Attalea	phalerata	La Paz	Iturralde	200 m
Attalea	phalerata	La Paz	Nor Yungas	+/-800 m
Attalea	phalerata	Pando	Nicolás Suarez	280 m
Attalea	phalerata	Pando	Nicolás Suarez	275 m
Attalea	phalerata	Santa Cruz	Andrés Ibañez	350 m
Attalea	phalerata	Santa Cruz	Ñuflo de chavez	+/-500 m
Attalea	phaleratha	Beni	Vaca Diez	+/-200 m
Attalea	speciosa	Beni	Mamoré	200 m
Attalea	speciosa	Beni	Marbán	230 m
Attalea	speciosa	Beni	Vaca Diez	125 m
Attalea	speciosa	Pando	Manuripi	+/-150 m
Attalea	speciosa	Santa Cruz	Velasco	320 m
Attalea	speciosa	Santa Cruz	Ñuflo de Chavez	+/-500 m
No.DE REGISTROS			38	
Bactris		Beni	Vaca Diez	140 m
Bactris		Santa Cruz	Ichilo	415 m
Bactris	acanthocarpa	Pando	Abuna	160 m
Bactris	acanthocarpa	Pando	Federico Román	150 m
Bactris	acanthocarpa	Pando	Federico Román	150 m
Bactris	acanthocarpa	Pando	Nicolás Suarez	260 m
Bactris	acanthocarpa	Pando	Nicolás Suarez	280 m
Bactris	acanthocarpa	Pando	Nicolás Suarez	+/-260 m
Bactris	brongniartii	La Paz	Iturralde	180 m
Bactris	brongniartii	Pando	Federico Román	110 m
Bactris	brongniartii	Pando	Nicolás Suarez	260 m
Bactris	brongniartii	Santa Cruz	Velasco	200-300 m
Bactris	concinna	La Paz	Iturralde	+/-230 m
Bactris	concinna	La Paz	Iturralde	200 m
Bactris	concinna	La Paz	Iturralde	200 m
Bactris	concinna	Pando	Federico Román	110 m
Bactris	concinna	Pando	Federico Román	150 m
Bactris	concinna	Pando	Nicolás Suarez	275 m
Bactris	concinna	Pando	Nicolás Suarez	280 m
Bactris	concinna	Pando	Nicolás Suarez	240 m
Bactris	concinna	Pando	Nicolás Suarez	260 m
Bactris	concinna	Pando	Nicolás Suarez	260 m
Bactris	elegans	Pando	Federico Román	150 m

BASE DE DATOS-COLECCION

GENERO	ESPECIE	DEPARTAMENTO	PROVINCIA	ALTITUD
Bactris	faucium	Beni	Ballivián	300-500 m
Bactris	faucium	Cochabamba	Chapare	485 m
Bactris	faucium	Cochabamba	Chapare	365 m
Bactris	faucium	Cochabamba	Chapare	400 m
Bactris	faucium	Cochabamba	Chapare	450 m
Bactris	faucium	La Paz	Iturralde	430 m
Bactris	faucium	Santa Cruz	Ichilo	415 m
Bactris	gasipaes	Beni	Ballivián	320 m
Bactris	gasipaes	Cochabamba	Carrasco	280 m
Bactris	gasipaes	Cochabamba	Chapare	500 m
Bactris	gasipaes	La Paz	Iturralde	250 m
Bactris	gasipaes	La Paz	Nor Yungas	1120 m
Bactris	gasipaes	Santa Cruz	Ichilo	340 m
Bactris	glaucescens	Beni	Ballivián	+/-250 m
Bactris	glaucescens	Beni	Ballivián	200 m
Bactris	glaucescens	Beni	Cercado	200 m
Bactris	glaucescens	Beni	Yacuma	160 m
Bactris	glaucescens	Beni	Yacuma	160 m
Bactris	glaucescens	La Paz	Iturralde	180 m
Bactris	glaucescens	Santa Cruz	Guarayos	275 m
Bactris	hirta	La Paz	Iturralde	190 m
Bactris	hirta	Pando	Federico Román	150 m
Bactris	juruensis	La Paz	Nor Yungas	800 m
Bactris	juruensis	La Paz	Sud Yungas	650 m
Bactris	juruensis	Pando	Nicolás Suarez	260 m
Bactris	major	Beni	Ballivián	230 m
Bactris	major	Beni	Ballivián	210 m
Bactris	major	Beni	Cercado	200 m
Bactris	major	Beni	Cercado	200 m
Bactris	major	Beni	Itenez	+/-200 m
Bactris	major	Beni	Marbán	+/-250 m
Bactris	major	Beni	Vaca Diez	230 m
Bactris	major	Beni	Vaca Diez	140 m
Bactris	major	Beni	Yacuma	250 m
Bactris	major	Cochabamba	Carrasco	360 m
Bactris	major	Cochabamba	Carrasco	230 m
Bactris	major	La Paz	Iturralde	+/-500 m
Bactris	major	La Paz	Iturralde	+/-250 m
Bactris	major	La Paz	Iturralde	+/-250 m
Bactris	major	La Paz	Iturralde	190 m
Bactris	major	La Paz	Iturralde	250 m
Bactris	major	Pando	Madre de Dios	125 m
Bactris	major	Pando	Manuripi	140 m
Bactris	major	Santa Cruz	Andrés Ibañez	400 m
Bactris	major	Santa Cruz	Andrés Ibañez	400 m
Bactris	major	Santa Cruz	Ichilo	180 m
Bactris	major	Santa Cruz	Ichilo	400 m
Bactris	major	Santa Cruz	Ñuflo de Chavez	+/-500 m
Bactris	major	Santa Cruz	Ñuflo de Chavez	+/-500 m
Bactris	major	Santa Cruz	Ñuflo de Chavez	500 m
Bactris	maraja	Beni	Ballivián	300-500 m
Bactris	maraja	Beni	Ballivián	240 m
Bactris	maraja	Beni	Ballivián	250 m
Bactris	maraja	La Paz	Iturralde	+/- 250 m

BASE DE DATOS-COLECCION

GENERO	ESPECIE	DEPARTAMENTO	PROVINCIA	ALTITUD
Bactris	maraja	La Paz	Iturralde	340 m
Bactris	maraja	La Paz	Iturralde	500 m
Bactris	maraja	Pando	Abuna	160 m
Bactris	maraja	Pando	Abuna	160 m
Bactris	maraja	Pando	Federico Román	110 m
Bactris	maraja	Pando	Madre de Dios	165 m
Bactris	maraja	Pando	Nicolás Suarez	260 m
Bactris	maraja	Pando	Nicolás Suarez	280 m
Bactris	maraja	Pando	Nicolás Suarez	240 m
Bactris	maraja	Pando	Nicolás Suarez	275 m
Bactris	maraja	Pando	Nicolás Suarez	260 m
Bactris	monticola	La Paz	Iturralde	190 m
Bactris	riparia	Beni	Ballivián	200 m
Bactris	riparia	Beni	Cercado	+/-150 m
Bactris	riparia	Beni	Marbán	230 m
Bactris	riparia	Beni	Marbán	200 m
Bactris	riparia	Beni	Vaca Diez	125 m
Bactris	riparia	Beni	Yacuma	200 m
Bactris	riparia	La Paz	Iturralde	180 m
Bactris	riparia	Santa Cruz	Obispo Santiestevan	200 m
Bactris	riparia	Santa Cruz	Velasco	230 m
Bactris	riparia	Santa Cruz	Ñuflo de Chavez	275 m
Bactris	simplicifrons	Beni	Vaca Diez	+/-200 m
Bactris	simplicifrons	Beni	Vaca Diez	+/-200 m
Bactris	simplicifrons	La Paz	Iturralde	190 m
Bactris	simplicifrons	Pando	Federico Román	110 m
Bactris	simplicifrons	Pando	Federico Román	150 m
Bactris	trailiana	Beni	Vaca Diez	+/-150 m
Bactris	trailiana	Pando	Abuná	170 m
No.DE REGISTROS			106	
Ceroxylon	parvifrons	La Paz	Nor Yungas	2800 m
Ceroxylon	parvifrons	La Paz	Nor Yungas	2720 m
Ceroxylon	parvum	Cochabamba	Carrasco	2350 m
Ceroxylon	parvum	La Paz	Nor Yungas	1500 m
Ceroxylon	parvum	La Paz	Nor Yungas	1400 m
Ceroxylon	parvum	Santa Cruz	Florida	1600 m
Ceroxylon	parvum	Santa Cruz	Vallegrande	1750 m
Ceroxylon	vogelianum	La Paz	Inquisivi	3000 m
Ceroxylon	vogelianum	La Paz	Sud Yungas	2150 m
Ceroxylon	vogelianum	Santa Cruz	Florida	2500-2600 m
Ceroxylon	vogelianum	Santa Cruz	Valle Grande	2000 m
Ceroxylon	vogelianum	Santa Cruz	Vallegrande	1900 m
No.DE REGISTROS			12	
Chamaedorea	angustisecta	Beni	Ballivián	900-850 m
Chamaedorea	angustisecta	Beni	Ballivián	220 m
Chamaedorea	angustisecta	Beni	Ballivián	220-235 m
Chamaedorea	angustisecta	Beni	Ballivián	+/-160 m
Chamaedorea	angustisecta	Beni	Ballivián	250 m
Chamaedorea	angustisecta	Beni	Ballivián	250 m
Chamaedorea	angustisecta	Beni	Yacuma	250 m

BASE DE DATOS-COLECCION

GENERO	ESPECIE	DEPARTAMENTO	PROVINCIA	ALTITUD
Chamaedorea	angustisecta	Beni	Yacuma	250 m
Chamaedorea	angustisecta	Beni	Yacuma	250 m
Chamaedorea	angustisecta	Beni	Yacuma	250 m
Chamaedorea	angustisecta	La Paz	Franz Tamayo	250 m
Chamaedorea	angustisecta	La Paz	Franz Tamayo	1000 m
Chamaedorea	angustisecta	La Paz	Franz Tamayo	700 m
Chamaedorea	angustisecta	La Paz	Franz Tamayo	900 m
Chamaedorea	angustisecta	La Paz	Franz Tamayo	1350 m
Chamaedorea	angustisecta	La Paz	Iturralde	360 m
Chamaedorea	angustisecta	La Paz	Iturralde	+/-250 m
Chamaedorea	angustisecta	La Paz	Iturralde	+/-250 m
Chamaedorea	angustisecta	La Paz	Iturralde	+/-250 m
Chamaedorea	angustisecta	La Paz	Iturralde	+/-250 m
Chamaedorea	angustisecta	La Paz	Iturralde	350 m
Chamaedorea	angustisecta	La Paz	Iturralde	430 m
Chamaedorea	angustisecta	La Paz	Iturralde	190 m
Chamaedorea	angustisecta	La Paz	Iturralde	250 m
Chamaedorea	angustisecta	La Paz	Iturralde	275 m
Chamaedorea	angustisecta	La Paz	Nor Yungas	1500 m
Chamaedorea	angustisecta	La Paz	Nor Yungas	550 m
Chamaedorea	angustisecta	La Paz	Sud Yungas	800 m
Chamaedorea	angustisecta	La Paz	Sud Yungas	620 m
Chamaedorea	angustisecta	La Paz	Sud Yungas	830 m
Chamaedorea	angustisecta	La Paz	Sud Yungas	+/-400 m
Chamaedorea	angustisecta	Pando	Nicolás Suarez	280 m
Chamaedorea	angustisecta	Pando	Nicolás Suarez	240 m
Chamaedorea	linearis	Cochabamba	Carrasco	1300 m
Chamaedorea	pauciflora	La Paz	Iturralde	190 m
Chamaedorea	pauciflora	Pando	Abuná	170 m
Chamaedorea	pinnatifrons	Beni	Ballivián	235 m
Chamaedorea	pinnatifrons	Beni	Ballivián	220 m
Chamaedorea	pinnatifrons	Beni	Ballivián	900 m
Chamaedorea	pinnatifrons	Beni	Ballivián	220 m
Chamaedorea	pinnatifrons	Beni	Ballivián	220 m
Chamaedorea	pinnatifrons	Beni	Ballivián	160 m
Chamaedorea	pinnatifrons	Beni	Ballivián	1000 m
Chamaedorea	pinnatifrons	La Paz	Franz Tamayo	1500-1550 m
Chamaedorea	pinnatifrons	La Paz	Franz Tamayo	1600 m
Chamaedorea	pinnatifrons	La Paz	Inquisivi	1340 m
Chamaedorea	pinnatifrons	La Paz	Inquisivi	1350 m
Chamaedorea	pinnatifrons	La Paz	Iturralde	300 m
Chamaedorea	pinnatifrons	La Paz	Iturralde	+/-250 m
Chamaedorea	pinnatifrons	La Paz	Iturralde	+/-250 m
Chamaedorea	pinnatifrons	La Paz	Iturralde	+/-250 m
Chamaedorea	pinnatifrons	La Paz	Iturralde	+/-250 m
Chamaedorea	pinnatifrons	La Paz	Iturralde	+/-300 m
Chamaedorea	pinnatifrons	La Paz	Iturralde	+/-300 m
Chamaedorea	pinnatifrons	La Paz	Iturralde	300 m
Chamaedorea	pinnatifrons	La Paz	Larecaja	800 m
Chamaedorea	pinnatifrons	La Paz	Nor Yungas	1500 m
Chamaedorea	pinnatifrons	La Paz	Nor Yungas	1250 m
Chamaedorea	pinnatifrons	La Paz	Sud Yungas	750-900 m
Chamaedorea	pinnatifrons	La Paz	Sud Yungas	2150 m
Chamaedorea	pinnatifrons	La Paz	Sud Yungas	680 m

BASE DE DATOS-COLECCION

GENERO	ESPECIE	DEPARTAMENTO	PROVINCIA	ALTITUD
Chamaedorea	pinnatifrons	La Paz	Sud Yungas	1000 m
Chamaedorea	pinnatifrons	La Paz	Sud Yungas	900 m
Chamaedorea	pinnatifrons	Pando	Nicolás Suarez	275 m
Chamaedorea	pinnatifrons	Pando	Nicolás Suarez	280 m
Chamaedorea	pinnatifrons	Pando	Nicolás Suarez	260 m
Chamaedorea	pinnatifrons	Pando	Nicolás Suarez	260 m
Chamaedorea	pinnatifrons	Pando	Nicolás Suarez	260 m
Chamaedorea	pinnatifrons	Santa Cruz	Ichilo	360 m
Chamaedorea	pinnatifrons	Santa Cruz	Ichilo	400 m
Chamaedorea	pinnatifrons	Santa Cruz	Ichilo	700 m
Chamaedorea	pinnatifrons	Santa Cruz	Ichilo	350 m
Chamaedorea	pinnatifrons	Santa Cruz	Ichilo	600-750 m
Chamaedorea	pinnatifrons	Santa Cruz	Ichilo	315 m
Chamaedorea	pinnatifrons	Santa Cruz	Ichilo	350 m
Chamaedorea	pinnatifrons	Santa Cruz	Ichilo	350 m
Chamaedorea	pinnatifrons	Santa Cruz	Ichilo	940 m
Chamaedorea	pinnatifrons	Santa Cruz	Ichilo	450 m
No.DE REGISTROS			78	
Chamaerops	humilis	Cochabamba	Cercado	2600 m
No.DE REGISTROS			1	
Chelyocarpus	chuco	Beni	Vaca Diez	+/-150 m
Chelyocarpus	chuco	Beni	Vaca Diez	100 m
Chelyocarpus	chuco	Beni	Vaca Diez	140 m
Chelyocarpus	chuco	Pando	Madre de Dios	135 m
Chelyocarpus	chuco	Pando	Madre de Dios	165 m
Chelyocarpus	chuco	Pando	Manuripi	+/-150 m
Chelyocarpus	chuco	Pando	Nicolás Suarez	260 m
No.DE REGISTROS			7	
Cocos	nucifera	Beni	Yacuma	250 m
No.DE REGISTROS			1	
Copernicia	alba	Beni	Ballivián	200 m
Copernicia	alba	Beni	Cercado	230 m
Copernicia	alba	Beni	Cercado	150 m
Copernicia	alba	Beni	Trinidad	250 m
Copernicia	alba	Beni	Yacuma	160 m
Copernicia	alba	Beni	Yacuma	+/-200 m
Copernicia	alba	Beni	Yacuma	160 m
Copernicia	alba	Santa Cruz	Andrés Ibañez	+/-500 m
Copernicia	alba	Santa Cruz	Andrés Ibañez	325 m
Copernicia	alba	Santa Cruz	Cordillera	400 m
Copernicia	alba	Santa Cruz	Cordillera	1200 m
Copernicia	alba	Santa Cruz	Cordillera	700 m
Copernicia	alba	Santa Cruz	Velasco	300 m
Copernicia	alba	Tarija	Gran Chaco	460 m
No.DE REGISTROS			14	

BASE DE DATOS-COLECCION

GENERO	ESPECIE	DEPARTAMENTO	PROVINCIA	ALTITUD
Demoncus	mitis	Beni	Ballivián	200 m
No.DE REGISTROS			1	
Desmoncus	leptospadix	Pando	Federico Román	150 m
Desmoncus	mitis	Beni	Ballivián	300-500 m
Desmoncus	mitis	La Paz	Franz Tamayo	900 m
Desmoncus	mitis	La Paz	Iturralde	180 m
Desmoncus	mitis	La Paz	Iturralde	+/-300 m
Desmoncus	mitis	La Paz	Iturralde	285 m
Desmoncus	mitis	La Paz	Sud Yungas	520 m
Desmoncus	orthacanthos	La Paz	Iturralde	300 m
Desmoncus	orthacanthos	Pando	Federico Román	120 m
Desmoncus	polyacanthos	Beni	Ballivián	255 m
Desmoncus	polyacanthos	Beni	Ballivián	250 m
Desmoncus	polyacanthos	Beni	Ballivián	+/-250 m
Desmoncus	polyacanthos	Beni	Cercado	+/-150 m
Desmoncus	polyacanthos	Beni	Mamoré	+/-200 m
Desmoncus	polyacanthos	Beni	Marbán	230 m
Desmoncus	polyacanthos	Beni	Yacuma	250 m
Desmoncus	polyacanthos	Beni	Yacuma	250 m
Desmoncus	polyacanthos	Beni	Yacuma	250 m
Desmoncus	polyacanthos	La Paz	Iturralde	180 m
Desmoncus	polyacanthos	La Paz	Sud Yungas	550 m
Desmoncus	polyacanthos	La Paz	Sud Yungas	530 m
Desmoncus	polyacanthos	Pando	Federico Román	150 m
Desmoncus	polyacanthos	Santa Cruz	Ichilo	180 m
Desmoncus	polyacanthos	Santa Cruz	Ichilo	300 m
No.DE REGISTROS			24	
Dictyocaryum	lamarchianum	La Paz	Nor Yungas	+/-1500 m
Dictyocaryum	lamarckianum	La Paz	Franz Tamayo	1550 m
Dictyocaryum	lamarckianum	La Paz	Nor Yungas	1600 m
Dictyocaryum	lamarckianum	La Paz	Nor Yungas	1500 m
Dictyocaryum	lamarckianum	La Paz	Nor Yungas	1530 m
Dictyocaryum	lamarckianum	La Paz	Nor Yungas	1760 m
No.DE REGISTROS			6	
Elaeis	guineensis	Beni	Vaca Diez	125 m
No.DE REGISTROS			1	
Euterpe	precatoria	Beni	Ballivián	220 m
Euterpe	precatoria	Beni	Vaca Diez	+/-200 m
Euterpe	precatoria	Beni	Yacuma	250 m
Euterpe	precatoria	La Paz	Iturralde	280 m
Euterpe	precatoria	La Paz	Iturralde	+/-500 m
Euterpe	precatoria	La Paz	Iturralde	190 m
Euterpe	precatoria	La Paz	Iturralde	250 m
Euterpe	precatoria	La Paz	Iturralde	200 m
Euterpe	precatoria	La Paz	Nor Yungas	1500 m
Euterpe	precatoria	La Paz	Nor Yungas	1500 m

BASE DE DATOS-COLECCION

GENERO	ESPECIE	DEPARTAMENTO	PROVINCIA	ALTITUD
Euterpe	precatoria	La Paz	Nor Yungas	1300 m
Euterpe	precatoria	La Paz	Nor Yungas	1740 m
Euterpe	precatoria	La Paz	Sud Yungas	850 m
Euterpe	precatoria	Pando	Abuna	160 m
Euterpe	precatoria	Pando	Federico Román	110 m
Euterpe	precatoria	Pando	Madre de Dios	165 m
Euterpe	precatoria	Pando	Manuripi	150 m
Euterpe	precatoria	Pando	Manuripi	+/-150 m
Euterpe	precatoria	Pando	NIcolás Suarez	260 m
Euterpe	precatoria	Pando	Nicolás Suarez	240 m
Euterpe	precatoria	Pando	Nicolás Suarez	275 m
Euterpe	precatoria	Santa Cruz	Guarayos	275 m
No.DE REGISTROS			22	
Geonoma		La Paz	Bautista Saavedra	1200 m
Geonoma		La Paz	Bautista Saavedra	1200 m
Geonoma	bongniartii	Cochabamba	Carrasco	250 m
Geonoma	brevispatha	Beni	Ballivián	240 m
Geonoma	brevispatha	Beni	Moxos	300 m
Geonoma	brevispatha	Cochabamba	Carrasco	250 m
Geonoma	brevispatha	Cochabamba	Carrasco	220 m
Geonoma	brevispatha	La Paz	Iturralde	290 m
Geonoma	brevispatha	La Paz	Iturralde	+/-250 m
Geonoma	brevispatha	La Paz	Iturralde	430 m
Geonoma	brevispatha	La Paz	Iturralde	190 m
Geonoma	brevispatha	Pando	Manuripi	150 m
Geonoma	brevispatha	Pando	Manuripi	+/-150 m
Geonoma	brevispatha	Pando	Nicolás Suarez	280 m
Geonoma	brevispatha	Pando	Nicolás Suarez	260 m
Geonoma	brevispatha	Pando	Nicolás Suarez	280 m
Geonoma	brevispatha	Santa Cruz	Velasco	800 m
Geonoma	brongniartii	Beni	Ballivián	220 m
Geonoma	brongniartii	Beni	Ballivián	965 m
Geonoma	brongniartii	Beni	Ballivián	1100 m
Geonoma	brongniartii	Beni	Ballivián	1000 m
Geonoma	brongniartii	Beni	Ballivián	700 m
Geonoma	brongniartii	Beni	Ballivián	300-500 m
Geonoma	brongniartii	Beni	Moxos	260 m
Geonoma	brongniartii	Beni	Yacuma	350 m
Geonoma	brongniartii	Cochabamba	Carrasco	235 m
Geonoma	brongniartii	Cochabamba	Carrasco	212 m
Geonoma	brongniartii	Cochabamba	Carrasco	320 m
Geonoma	brongniartii	Cochabamba	Carrasco	220 m
Geonoma	brongniartii	La Paz	Franz Tamayo	900 m
Geonoma	brongniartii	La Paz	Iturralde	290 m
Geonoma	brongniartii	La Paz	Iturralde	+/- 500 m
Geonoma	brongniartii	La Paz	Iturralde	+/-350 m
Geonoma	brongniartii	La Paz	Iturralde	300 m
Geonoma	brongniartii	La Paz	Nor Yungas	865 m
Geonoma	brongniartii	Santa Cruz	Ichilo	180 m
Geonoma	densa	La Paz	Nor Yungas	2400 m
Geonoma	densa	La Paz	Nor Yungas	1500 m
Geonoma	densa	La Paz	Nor Yungas	2800 m

BASE DE DATOS-COLECCION

GENERO	ESPECIE	DEPARTAMENTO	PROVINCIA	ALTITUD
Geonoma	deversa	Beni	Ballivián	255 m
Geonoma	deversa	Beni	Ballivián	240 m
Geonoma	deversa	Beni	Moxos	250 m
Geonoma	deversa	Beni	Moxos	250 m
Geonoma	deversa	Cochabamba	Carrasco	290 m
Geonoma	deversa	Cochabamba	Carrasco	235 m
Geonoma	deversa	Cochabamba	Carrasco	250 m
Geonoma	deversa	Cochabamba	Carrasco	220 m
Geonoma	deversa	La Paz	Iturralde	+/-500 m
Geonoma	deversa	La Paz	Iturralde	250 m
Geonoma	deversa	La Paz	Iturralde	+/-250 m
Geonoma	deversa	La Paz	Iturralde	+/-250 m
Geonoma	deversa	La Paz	Iturralde	+/-250 m
Geonoma	deversa	La Paz	Iturralde	+/-250 m
Geonoma	deversa	La Paz	Iturralde	+/-250 m
Geonoma	deversa	La Paz	Iturralde	340 m
Geonoma	deversa	La Paz	Iturralde	190 m
Geonoma	deversa	La Paz	Iturralde	280 m
Geonoma	deversa	La Paz	Iturralde	350 m
Geonoma	deversa	La Paz	Larecaja	490-750 m
Geonoma	deversa	La Paz	Sud Yungas	850 m
Geonoma	deversa	La Paz	Sud Yungas	800 m
Geonoma	deversa	La Paz	Sud Yungas	320 m
Geonoma	deversa	Pando	Madre de Dios	+/-130 m
Geonoma	deversa	Pando	Madre de Dios	+/-130 m
Geonoma	deversa	Pando	Madre de Dios	165 m
Geonoma	deversa	Pando	Nicolás Suarez	260 m
Geonoma	deversa	Pando	Nicolás Suarez	280 m
Geonoma	deversa	Pando	Nicolás Suarez	275 m
Geonoma	deversa	Pando	Nicolás Suarez	280 m
Geonoma	deversa	Pando	Nicolás Suarez	250 m
Geonoma	deversa	Pando	Nicolás Suarez	+/-250 m
Geonoma	deversa	Pando	Nicolás Suarez	280 m
Geonoma	deversa	Pando	Nicolás Suarez	+/-250 m
Geonoma	interrupta	Beni	Ballivián	220 m
Geonoma	interrupta	Beni	Ballivián	220 m
Geonoma	interrupta	La Paz	Iturralde	+/-250 m
Geonoma	interrupta	La Paz	Iturralde	+/-250 m
Geonoma	interrupta	La Paz	Iturralde	+/- 250 m
Geonoma	interrupta	La Paz	Iturralde	250 m
Geonoma	interrupta	La Paz	Larecaja	490-750 m
Geonoma	jussieuana	Beni	Ballivián	200 m
Geonoma	jussieuana	Beni	Ballivián	730 m
Geonoma	jussieuana	La Paz	Nor Yungas	1500 m
Geonoma	jussieuana	La Paz	Nor Yungas	1300 m
Geonoma	jussieuana	La Paz	Nor Yungas	1400-1500 m
Geonoma	jussieuana	La Paz	Nor Yungas	1530-1560 m
Geonoma	jussieuana	La Paz	Nor Yungas	1500 m
Geonoma	jussieuana	La Paz	Sud Yungas	900 m
Geonoma	laxiflora	Pando	Federico Román	120 m
Geonoma	laxiflora	Pando	Federico Román	110 m
Geonoma	laxiflora	Pando	Federico Román	110 m
Geonoma	laxiflora	Pando	Nicolás Suarez	260 m
Geonoma	leptospadix	Beni	Vaca Diez	230 m

BASE DE DATOS-COLECCION

GENERO	ESPECIE	DEPARTAMENTO	PROVINCIA	ALTITUD
Geonoma	leptospadix	Beni	Vaca Diez	+/-200 m
Geonoma	macrostachys	Cochabamba	Carrasco	235 m
Geonoma	macrostachys	Cochabamba	Carrasco	250 m
Geonoma	macrostachys	Cochabamba	Carrasco	250 m
Geonoma	macrostachys	Cochabamba	Carrasco	220 m
Geonoma	macrostachys	Cochabamba	Chapare	400
Geonoma	macrostachys	Pando	Manuripi	+/-150 m
Geonoma	macrostachys	Pando	Manuripi	+/-150 m
Geonoma	macrostachys	Pando	Nicolás Suarez	240 m
Geonoma	macrostachys	Pando	Nicolás Suarez	240 m
Geonoma	macrostachys	Pando	Nicolás Suarez	280 m
Geonoma	macrostachys	Pando	Nicolás Suarez	275 m
Geonoma	macrostachys	Pando	Nicolás Suarez	250 m
Geonoma	macrostachys	Santa Cruz	Ichilo	700 m
Geonoma	maxima	Beni	Vaca Diez	+/-150 m
Geonoma	maxima	Beni	Vaca Diez	230 m
Geonoma	maxima	Pando	Madre de Dios	240 m
Geonoma	maxima	Pando	Manuripi	+/-150 m
Geonoma	maxima	Pando	Nicolás Suares	280 m
Geonoma	maxima	Pando	Nicolás Suarez	275 m
Geonoma	maxima	Pando	Nicolás Suarez	260 m
Geonoma	megalospatha	La Paz	Nor Yungas	2800 m
Geonoma	orbignyana	La Paz	Franz Tamayo	1550 m
Geonoma	orbignyana	La Paz	Nor Yungas	1600 m
Geonoma	orbignyana	La Paz	Nor Yungas	1530 m
Geonoma	orbignyana	La Paz	Nor Yungas	1400-1450 m
Geonoma	orbignyana	La Paz	Nor Yungas	1400 m
Geonoma	orbignyana	La Paz	Nor Yungas	1500 m
Geonoma	orbignyana	La Paz	Nor Yungas	1850 m
Geonoma	orbignyana	La Paz	Nor Yungas	1300 m
Geonoma	orbignyana	La Paz	Nor Yungas	1720 m
Geonoma	orbignyana	La Paz	Sud Yungas	2300 m
Geonoma	orbignyana	La Paz	Sud Yungas	2250 m
Geonoma	orbignyana	La Paz	Sud Yungas	2250 m
Geonoma	stricta	Cochabamba	Carrasco	235 m
Geonoma	stricta	Cochabamba	Carrasco	250 m
Geonoma	stricta	Cochabamba	Carrasco	220 m
Geonoma	stricta	La Paz	Iturralde	190 m
Geonoma	stricta	Pando	Federico Román	150 m
Geonoma	stricta	Pando	Nicolás Suarez	280 m
Geonoma	stricta	Pando	Nicolás Suarez	260 m
Geonoma	stricta	Pando	Nicolás Suarez	275 m
Geonoma	stricta	Pando	Nicolás Suarez	250 m
Geonoma	stricta	Pando	Nicolás Suarez	260 m
Geonoma	undata	Cochabamba	Carrasco	1500 m
Geonoma	undata	La Paz	Franz Tamayo	1500-1550 m
Geonoma	undata	La Paz	Nor Yungas	1600 m
Geonoma	weberbaueri	La Paz	Nor Yungas	2350 m
Geonoma	weberbaueri	La Paz	Nor Yungas	2000 m
Geonoma	weberbaueri	La Paz	Nor Yungas	2600 m
Geonoma	weberbaueri	La Paz	Nor Yungas	2310 m

No.DE REGISTROS 144

GENERO	ESPECIE	DEPARTAMENTO	PROVINCIA	ALTITUD
Hyospathe	elegans	Beni	Ballivián	200 m
Hyospathe	elegans	Beni	Ballivián	200 m
Hyospathe	elegans	Beni	Moxos	260 m
Hyospathe	elegans	Beni	Moxos	250 m
Hyospathe	elegans	Cochabamba	Carrasco	290 m
Hyospathe	elegans	Cochabamba	Carrasco	235 m
Hyospathe	elegans	Cochabamba	Carrasco	235 m
Hyospathe	elegans	Cochabamba	Carrasco	250 m
Hyospathe	elegans	Cochabamba	Carrasco	400 m
Hyospathe	elegans	Cochabamba	Carrasco	400 m
Hyospathe	elegans	Cochabamba	Chapare	650 m
Hyospathe	elegans	Cochabamba	Chapare	400 m
Hyospathe	elegans	La Paz	Iturralde	400 m
Hyospathe	elegans	La Paz	Larecaja	610 m
Hyospathe	elegans	Pando	Nicolás Suarez	260 m
Hyospathe	elegans	Pando	Nicolás Suarez	260 m
No.DE REGISTROS			16	
Iriartea	deltoidea	Beni	Ballivián	220 m
Iriartea	deltoidea	Beni	Ballivián	435-585 m
Iriartea	deltoidea	Cochabamba	Carrasco	320 m
Iriartea	deltoidea	Cochabamba	Carrasco	400 m
Iriartea	deltoidea	Cochabamba	Chapare	+/-450 m
Iriartea	deltoidea	La Paz	Iturralde	280 m
Iriartea	deltoidea	La Paz	Iturralde	+/-500 m
Iriartea	deltoidea	La Paz	Iturralde	250 m
Iriartea	deltoidea	La Paz	Iturralde	200 m
Iriartea	deltoidea	La Paz	Nor Yungas	1400 m
Iriartea	deltoidea	Pando	Manuripi	150 m
Iriartea	deltoidea	Pando	Nicolás Suarez	275 m
Iriartea	deltoidea	Pando	Nicolás Suarez	250 m
Iriartea	deltoidea	Santa Cruz	Ichilo	700 m
Iriartea	deltoidea	Santa Cruz	Ichilo	400 m
Iriartea	deltoidea	Santa Cruz	Ichilo	250 m
No.DE REGISTROS			16	
Mauritia	flexuosa	Beni	Vaca Diez	+/-125 m
Mauritia	flexuosa	Beni	Vaca Diez	140 m
Mauritia	flexuosa	La Paz	Franz Tamayo	336 m
Mauritia	flexuosa	La Paz	Iturralde	+/-500 m
Mauritia	flexuosa	La Paz	Iturralde	180 m
Mauritia	flexuosa	La Paz	Sud Yungas	320 m
Mauritia	flexuosa	Pando	Nicolás Suarez	+/-250
Mauritia	flexuosa	Santa Cruz	Ñuflo de Chavez	+/-500 m
Mauritia	flexuosa	Santa Cruz	Ñuflo de Chavez	500 m
No.DE REGISTROS			9	
Mauritiella	martiana	Beni	Vaca Diez	140 m
Mauritiella	martiana	La Paz	Iturralde	190 m
Mauritiella	martiana	La Paz	Iturralde	180 m
Mauritiella	martiana	Santa Cruz	Velasco	190 m

GENERO	ESPECIE	DEPARTAMENTO	PROVINCIA	ALTITUD
Mauritiella	martiana	Santa Cruz	Velasco	750-800 m
No.DE REGISTROS			5	
Oenocarpus	balickii	Pando	Nicolás Suarez	280 m
Oenocarpus	bataua	Beni	Ballivián	220 m
Oenocarpus	bataua	Beni	Vaca Diez	170 m
Oenocarpus	bataua	Cochabamba	Carrasco	400 m
Oenocarpus	bataua	La Paz	Bautista Saavedra	1000 m
Oenocarpus	bataua	La Paz	Iturralde	+/- 500 m
Oenocarpus	bataua	La Paz	Iturralde	180 m
Oenocarpus	bataua	La Paz	Iturralde	190 m
Oenocarpus	bataua	La Paz	Iturralde	200 m
Oenocarpus	bataua	La Paz	Muñecas	1150 m
Oenocarpus	bataua	Pando	Madre de Dios	165 m
Oenocarpus	bataua	Pando	Manuripi	+/-150 m
Oenocarpus	bataua	Pando	Nicolás Suarez	260 m
Oenocarpus	bataua	Pando	Nicolás Suarez	275 m
Oenocarpus	bataua	Pando	Nicolás Suarez	250 m
Oenocarpus	bataua	Santa Cruz	Ichilo	400 m
Oenocarpus	distichus	Beni	Vaca Diez	+/-150 m
Oenocarpus	distichus	Beni	Vaca Diez	+/- 150 m
Oenocarpus	distichus	Pando	Manuripi	150 m
Oenocarpus	distichus	Pando	Manuripi	+/-150 m
Oenocarpus	distichus	Santa Cruz	Ñuflo de Chavez	275 m
Oenocarpus	mapora	Beni	Vaca Diez	230 m
Oenocarpus	mapora	La Paz	Ballivián	250 m
Oenocarpus	mapora	La Paz	Franz Tamayo	700 m
Oenocarpus	mapora	La Paz	Iturralde	+/-500 m
Oenocarpus	mapora	La Paz	Iturralde	+/-500 m
Oenocarpus	mapora	La Paz	Iturralde	+/-250 m
Oenocarpus	mapora	La Paz	Iturralde	190 m
Oenocarpus	mapora	La Paz	Iturralde	250 m
Oenocarpus	mapora	Pando	Manuripi	+/-150 m
Oenocarpus	mapora	Pando	Nicolás Suarez	260 m
Oenocarpus	mapora	Pando	Nicolás Suarez	275 m
No.DE REGISTROS			32	
Parajubaea	sunkha	Santa Cruz	Vallegrande	2400 m
Parajubaea	torallyi	Chuquisaca	Zudañez	2500 m
Parajubaea	torallyi	Chuquisaca	Zudañez	2673 m
Parajubaea	torallyi	Potosí	Linares	2750 m
Parajubaea	torallyi	Santa Cruz	Vallegrande	1900 m
Parajubaea	torallyi	Santa Cruz	Vallegrande	2810 m
Parajubaea	torallyi	Santa Cruz	Vallegrande	1900 m
Parajubaea	torallyi	Santa Cruz	Vallegrande	1800 m
Parajubaea	torallyi	Santa Cruz	Vallegrande	2000 m
No.DE REGISTROS			9	
Phoenix	canariensis	La Paz	Murillo	3300 m
Phoenix	canariensis	Santa Cruz	Vallegrande	2040 m
Phoenix	dactylifera	Santa Cruz	Andrés Ibañez	420 m
No.DE REGISTROS			3	

BASE DE DATOS-COLECCION

GENERO	ESPECIE	DEPARTAMENTO	PROVINCIA	ALTITUD
Phytelephas	macrocarpa	La Paz	Iturralde	290 m
Phytelephas	macrocarpa	La Paz	Iturralde	+/-500 m
Phytelephas	macrocarpa	La Paz	Iturralde	340 m
Phytelephas	macrocarpa	La Paz	Iturralde	200 m
Phytelephas	macrocarpa	La Paz/Beni	Sud Yungas/Ballivián	+/-330 m
Phytelephas	macrocarpa	Pando	Nicolás Suarez	275 m
Phytelephas	macrocarpa	Pando	Nicolás Suarez	260 m
Phytelephas	macrocarpa	Pando	Nicolás Suarez	260 m
No.DE REGISTROS			8	
Prestoea	acuminata	Cochabamba	Carrasco	1480 m
Prestoea	acuminata	La Paz	Franz Tamayo	1650 m
Prestoea	acuminata	La Paz	Inquisivi	1900 m
Prestoea	acuminata	La Paz	Sud Yungas	1100 m
Prestoea	globosa	Beni	Ballivián	850-900 m
Prestoea	globosa	La Paz	Nor Yungas	1400-1500 m
No.DE REGISTROS			6	
Socratea	exorrhiza	Beni	Ballivián	220 m
Socratea	exorrhiza	Beni	Vaca Diez	230 m
Socratea	exorrhiza	Beni	Vaca Diez	230 m
Socratea	exorrhiza	Beni	Vaca Diez	+/-200 m
Socratea	exorrhiza	Beni	Vaca Diez	+/-200 m
Socratea	exorrhiza	Beni	Yacuma	250 m
Socratea	exorrhiza	Beni	Yacuma	250 m
Socratea	exorrhiza	La Paz	Franz Tamayo	1500-1550 m
Socratea	exorrhiza	La Paz	Iturralde	280 m
Socratea	exorrhiza	La Paz	Iturralde	+/-500 m
Socratea	exorrhiza	La Paz	Iturralde	190 m
Socratea	exorrhiza	La Paz	Iturralde	250 m
Socratea	exorrhiza	La Paz	Iturralde	200 m
Socratea	exorrhiza	Pando	Madre de Dios	165 m
Socratea	exorrhiza	Pando	Nicolás Suarez	280 m
Socratea	exorrhiza	Pando	Nicolás Suarez	250 m
Socratea	exorrhiza	Santa Cruz	Guarayos	275 m
Socratea	exorrhiza	Santa Cruz	Ichilo	+/-150 m
Socratea	exorrhiza	Santa Cruz	Velasco	600 m
Socratea	salazarii	La Paz	Iturralde	360 m
No.DE REGISTROS			20	
Syagrus	cardenasii	Chuquisaca	Hernando Siles	1300 m
Syagrus	cardenasii	Chuquisaca	Hernando Siles	1200 m
Syagrus	cardenasii	Santa Cruz	Andrés Ibañez	+/-450 m
Syagrus	cardenasii	Santa Cruz	Cordillera	1200 m
Syagrus	cardenasii	Santa Cruz	Valle Grande	550 m
Syagrus	cardenasii	Santa Cruz	Vallegrande	1400 m
Syagrus	cardenasii	Santa Cruz	Warnes	400 m
Syagrus	petraea	Santa Cruz	Velasco	230-800 m
Syagrus	petraea	Santa Cruz	Velasco	190 m
Syagrus	sancona	Beni	Ballivián	235 m
Syagrus	sancona	Beni	Ballivián	200 m

BASE DE DATOS-COLECCION

GENERO	ESPECIE	DEPARTAMENTO	PROVINCIA	ALTITUD
Syagrus	sancona	Beni	Vaca Diez	125 m
Syagrus	sancona	Beni	Yacuma	250 m
Syagrus	sancona	Beni	Yacuma	250 m
Syagrus	sancona	Beni	Yacuma	250 m
Syagrus	sancona	Beni	Yacuma	+/-200 m
Syagrus	sancona	La Paz	Iturralde	190 m
Syagrus	sancona	La Paz	Sud Yungas	990 m
Syagrus	sancona	Pando	Nicolás Suarez	240 m
Syagrus	sancona	Pando	Nicolás Suarez	280 m
Syagrus	sancona	Santa Cruz	Ñuflo de Chavez	+/-500 m
Syagrus	sancona	Santa cruz	Andrés Ibañez	460 m
Syagrus	yungasensis	La Paz	Sud Yungas	900 m
Syagrus	yungasensis	La Paz	Sud Yungas	700-1000 m
Syagrus	yungasensis	La Paz	Sud Yungas	700 m
No.DE REGISTROS			25	
Trachycarpus	fortunei	La Paz	Murillo	3300 m
No.DE REGISTROS			1	
Trithrinax	campestris	Santa Cruz	Andrés Ibañez	320 m
Trithrinax	campestris	Tarija	Gran Chaco-O'Connor	450 m
Trithrinax	campestris	Tarija	O'Connor	+/-800 m
Trithrinax	campestris	Tarija	O'Connor	1200 m
No.DE REGISTROS			4	
Washingtonia	filifera	La Paz	Murillo	3300 m
No.DE REGISTROS			1	
Wendlandiella	simplicifrons	La Paz	Iturralde	300 m
Wendlandiella	simplicifrons	La Paz	Iturralde	450 m
No.DE REGISTROS			2	
Wettinia	augusta	La Paz	Alto Madidi	290 m
No.DE REGISTROS			1	
TOTAL REGISTROS			699	

Record#	GENERO	ESPECIE	PROVINCIA	ALTITUD
1	Acrocomia	aculeata	Cercado	150 m
2	Acrocomia	aculeata	Marbán	220 m
3	Acrocomia	aculeata	Marbán	230 m
4	Acrocomia	aculeata	Andrés Ibañez	375 m
5	Acrocomia	aculeata	Andrés Ibañez	400 m
6	Acrocomia	aculeata	Andrés Ibañez	400 m
7	Acrocomia	aculeata	Andrés Ibañez	420 m
8	Acrocomia	aculeata	Andrés Ibañez	450 m
9	Acrocomia	aculeata	Andrés Ibañez	500 m
10	Acrocomia	aculeata	Ichilo	315 m
11	Acrocomia	aculeata	Ichilo	355 m
12	Acrocomia	aculeata	Valle Grande	550 m
13	Acrocomia	aculeata	Velasco	190 m
14	Acrocomia	aculeata	Ñuflo de Chavez	+/-500 m
15	Acrocomia	aculeata	Ñuflo de Chavez	500 m
16	Aiphanes	aculeata	Bautista Saavedra	1200 m
17	Aiphanes	aculeata	Franz Tamayo	1550 m
18	Aiphanes	aculeata	Inquisivi	1340 m
19	Aiphanes	aculeata	Inquisivi	1420 m
20	Aiphanes	aculeata	Iturralde	+/-300 m
21	Aiphanes	aculeata	Iturralde	350 m
22	Aiphanes	aculeata	Iturralde	370-380 m
23	Aiphanes	aculeata	Murillo	1200 m
24	Aiphanes	aculeata	Nor Yungas	+/-900 m
25	Aiphanes	aculeata	Nor Yungas	1330 m
26	Aiphanes	aculeata	Nor Yungas	1400-1500 m
27	Aiphanes	aculeata	Nor Yungas	1700 m
28	Aiphanes	aculeata	Nor Yungas	600 m
29	Aiphanes	aculeata	Nor Yungas	750 m
30	Aiphanes	aculeata	Nor Yungas	800 m
31	Aiphanes	aculeata	Nor Yungas	870 m
32	Aiphanes	aculeata	Sud Yungas	1700 m
33	Aiphanes	aculeata	Nicolás Suarez	240 m
34	Aiphanes	aculeata	Florida	1090 m
35	Aiphanes	aculeata	Ichilo	300 m
36	Aiphanes	aculeata	Ichilo	600-650 m
37	Allagoptera	leucocalyx	Ballivián	+/-200 m
38	Allagoptera	leucocalyx	Ballivián	240 m
39	Allagoptera	leucocalyx	Ballivián	250 m
40	Allagoptera	leucocalyx	Cercado	+/-150 m
41	Allagoptera	leucocalyx	Vaca Diez	230 m
42	Allagoptera	leucocalyx	Yacuma	+/-200 m
43	Allagoptera	leucocalyx	Yacuma	160 m
44	Allagoptera	leucocalyx	Yacuma	200 m
45	Allagoptera	leucocalyx	Yacuma	250 m
46	Allagoptera	leucocalyx	Iturralde	+/-250 m
47	Allagoptera	leucocalyx	Iturralde	460 m
48	Allagoptera	leucocalyx	Andrés Ibañez	400 m
49	Allagoptera	leucocalyx	Chiquitos	400 m
50	Allagoptera	leucocalyx	Chiquitos	700 m
51	Allagoptera	leucocalyx	Chiquitos	900 m
52	Allagoptera	leucocalyx	Guarayos	250 m
53	Allagoptera	leucocalyx	Ichilo	315 m
54	Allagoptera	leucocalyx	Velasco	750-800 m
55	Allagoptera	leucocalyx	Warnes	400 m
56	Allagoptera	leucocalyx	Ñuflo de Chavez	+/-500 m
57	Astrocaryum		Iturralde	250 m
58	Astrocaryum	aculeatum	Vaca Diez	+/-150 m
59	Astrocaryum	aculeatum	Abuna	100 m
60	Astrocaryum	aculeatum	Madre de Dios	125 m

61	Astrocaryum	aculeatum	Nicolás Suarez	280 m
62	Astrocaryum	aculeatum	Ñuflo de Chavez	100 m
63	Astrocaryum	campestre	Velasco	800 m
64	Astrocaryum	campestre	Velasco	800 m
65	Astrocaryum	gynacanthum	Abuna	160 m
66	Astrocaryum	gynacanthum	Abuná	150 m
67	Astrocaryum	gynacanthum	Federico Román	110 m
68	Astrocaryum	huaimi	Iturralde	180 m
69	Astrocaryum	huaimi	Iturralde	190 m
70	Astrocaryum	huaimi	Ñuflo de Chavez	+/-500 m
71	Astrocaryum	murumuru	Ballivián	230 m
72	Astrocaryum	murumuru	Yacuma	+/- 250 m
73	Astrocaryum	murumuru	Yacuma	250 m
74	Astrocaryum	murumuru	Yacuma	250 m
75	Astrocaryum	murumuru	Yacuma	250 m
76	Astrocaryum	murumuru	Iturralde	+/-500 m
77	Astrocaryum	murumuru	Iturralde	180 m
78	Astrocaryum	murumuru	Iturralde	200 m
79	Astrocaryum	murumuru	Nor Yungas	800 m
80	Astrocaryum	murumuru	Iturralde	+/-500 m
81	Astrocaryum	murumuru	Cobija	250 m
82	Astrocaryum	murumuru	Nicolás Suarez	240 m
83	Astrocaryum	murumuru	Nicolás Suarez	260 m
84	Astrocaryum	murumuru	Nicolás Suarez	280 m
85	Astrocaryum	murumuru	Nicolás Suarez	280 m
86	Astrocaryum	murumuru	Ichilo	400 m
87	Attalea	butyracea	Vaca Diez	+/-150 m
88	Attalea	butyracea	Carrasco	+/- 400 m
89	Attalea	butyracea	Iturralde	180 m
90	Attalea	butyracea	Iturralde	190 m
91	Attalea	butyracea	Federico Román	150 m
92	Attalea	butyracea	Nicolás Suarez	240 m
93	Attalea	maripa	Vaca Diez	+/-150 m
94	Attalea	maripa	Iturralde	190 m
95	Attalea	maripa	Ñuflo de Chavez	275 m
96	Attalea	phalerata	Ballivián	200 m
97	Attalea	phalerata	Ballivián	250 m
98	Attalea	phalerata	Cercado	+/-150 m
99	Attalea	phalerata	Cercado-Marbán	230 m
100	Attalea	phalerata	Vaca Diez	+/-150 m
101	Attalea	phalerata	Vaca Diez	125 m
102	Attalea	phalerata	Vaca Diez	125 m
103	Attalea	phalerata	Yacuma	+/-200 m
104	Attalea	phalerata	Yacuma	160 m
105	Attalea	phalerata	Yacuma	250 m
106	Attalea	phalerata	Yacuma	250 m
107	Attalea	phalerata	Franz Tamayo	900 m
108	Attalea	phalerata	Iturralde	+/-300m
109	Attalea	phalerata	Iturralde	+/-500 m
110	Attalea	phalerata	Iturralde	140 m
111	Attalea	phalerata	Iturralde	200 m
112	Attalea	phalerata	Iturralde	250 m
113	Attalea	phalerata	Nor Yungas	+/-800 m
114	Attalea	phalerata	Nicolás Suarez	275 m
115	Attalea	phalerata	Nicolás Suarez	280 m
116	Attalea	phalerata	Andrés Ibañez	350 m
117	Attalea	phalerata	Ñuflo de chavez	+/-500 m
118	Attalea	phaleratha	Vaca Diez	+/-200 m
119	Attalea	speciosa	Mamoré	200 m
120	Attalea	speciosa	Marbán	230 m
121	Attalea	speciosa	Vaca Diez	125 m
122	Attalea	speciosa	Manuripi	+/-150 m

123	Attalea	speciosa	Velasco	320 m
124	Attalea	speciosa	Ñuflo de Chavez	+/-500 m
125	Bactris		Vaca Diez	140 m
126	Bactris		Ichilo	415 m
127	Bactris	acanthocarpa	Abuna	160 m
128	Bactris	acanthocarpa	Federico Román	150 m
129	Bactris	acanthocarpa	Federico Román	150 m
130	Bactris	acanthocarpa	Nicolás Suarez	+/-260 m
131	Bactris	acanthocarpa	Nicolás Suarez	260 m
132	Bactris	acanthocarpa	Nicolás Suarez	280 m
133	Bactris	brongniartii	Iturralde	180 m
134	Bactris	brongniartii	Federico Román	110 m
135	Bactris	brongniartii	Nicolás Suarez	260 m
136	Bactris	brongniartii	Velasco	200-300 m
137	Bactris	concinna	Iturralde	+/-230 m
138	Bactris	concinna	Iturralde	200 m
139	Bactris	concinna	Iturralde	200 m
140	Bactris	concinna	Federico Román	110 m
141	Bactris	concinna	Federico Román	150 m
142	Bactris	concinna	Nicolás Suarez	240 m
143	Bactris	concinna	Nicolás Suarez	260 m
144	Bactris	concinna	Nicolás Suarez	260 m
145	Bactris	concinna	Nicolás Suarez	275 m
146	Bactris	concinna	Nicolás Suarez	280 m
147	Bactris	elegans	Federico Román	150 m
148	Bactris	faucium	Chapare	365 m
149	Bactris	faucium	Chapare	400 m
150	Bactris	faucium	Chapare	450 m
151	Bactris	faucium	Chapare	485 m
152	Bactris	faucium	Iturralde	430 m
153	Bactris	faucium	Ichilo	415 m
154	Bactris	faucium	Ballivián	300-500 m
155	Bactris	gasipaes	Ballivián	320 m
156	Bactris	gasipaes	Carrasco	280 m
157	Bactris	gasipaes	Chapare	500 m
158	Bactris	gasipaes	Iturralde	250 m
159	Bactris	gasipaes	Nor Yungas	1120 m
160	Bactris	gasipaes	Ichilo	340 m
161	Bactris	glaucescens	Ballivián	+/-250 m
162	Bactris	glaucescens	Ballivián	200 m
163	Bactris	glaucescens	Cercado	200 m
164	Bactris	glaucescens	Yacuma	160 m
165	Bactris	glaucescens	Yacuma	160 m
166	Bactris	glaucescens	Iturralde	180 m
167	Bactris	glaucescens	Guarayos	275 m
168	Bactris	hirta	Iturralde	190 m
169	Bactris	hirta	Federico Román	150 m
170	Bactris	juruensis	Nor Yungas	800 m
171	Bactris	juruensis	Sud Yungas	650 m
172	Bactris	juruensis	Nicolás Suarez	260 m
173	Bactris	major	Cercado	200 m
174	Bactris	major	Cercado	200 m
175	Bactris	major	Itenez	+/-200 m
176	Bactris	major	Vaca Diez	140 m
177	Bactris	major	Yacuma	250 m
178	Bactris	major	Carrasco	360 m
179	Bactris	major	Iturralde	+/-250 m
180	Bactris	major	Iturralde	+/-500 m
181	Bactris	major	Iturralde	190 m
182	Bactris	major	Iturralde	250 m
183	Bactris	major	Ballivián	210 m
184	Bactris	major	Ballivián	230 m

185	Bactris	major	Marbán	+/-250 m
186	Bactris	major	Vaca Diez	230 m
187	Bactris	major	Carrasco	230 m
188	Bactris	major	Iturralde	+/-250 m
189	Bactris	major	Madre de Dios	125 m
190	Bactris	major	Manuripi	140 m
191	Bactris	major	Andrés Ibañez	400 m
192	Bactris	major	Andrés Ibañez	400 m
193	Bactris	major	Ichilo	180 m
194	Bactris	major	Ichilo	400 m
195	Bactris	major	Ñuflo de Chavez	+/-500 m
196	Bactris	major	Ñuflo de Chavez	+/-500 m
197	Bactris	major	Ñuflo de Chavez	500 m
198	Bactris	maraja	Ballivián	240 m
199	Bactris	maraja	Ballivián	250 m
200	Bactris	maraja	Ballivián	300-500 m
201	Bactris	maraja	Iturralde	+/- 250 m
202	Bactris	maraja	Iturralde	340 m
203	Bactris	maraja	Iturralde	500 m
204	Bactris	maraja	Abuna	160 m
205	Bactris	maraja	Abuna	160 m
206	Bactris	maraja	Federico Román	110 m
207	Bactris	maraja	Madre de Dios	165 m
208	Bactris	maraja	Nicolás Suarez	240 m
209	Bactris	maraja	Nicolás Suarez	260 m
210	Bactris	maraja	Nicolás Suarez	260 m
211	Bactris	maraja	Nicolás Suarez	275 m
212	Bactris	maraja	Nicolás Suarez	280 m
213	Bactris	monticola	Iturralde	190 m
214	Bactris	riparia	Ballivián	200 m
215	Bactris	riparia	Cercado	+/-150 m
216	Bactris	riparia	Marbán	200 m
217	Bactris	riparia	Marbán	230 m
218	Bactris	riparia	Vaca Diez	125 m
219	Bactris	riparia	Yacuma	200 m
220	Bactris	riparia	Iturralde	180 m
221	Bactris	riparia	Obispo Santiestevan	200 m
222	Bactris	riparia	Velasco	230 m
223	Bactris	riparia	Ñuflo de Chavez	275 m
224	Bactris	simplicifrons	Vaca Diez	+/-200 m
225	Bactris	simplicifrons	Vaca Diez	+/-200 m
226	Bactris	simplicifrons	Iturralde	190 m
227	Bactris	simplicifrons	Federico Román	110 m
228	Bactris	simplicifrons	Federico Román	150 m
229	Bactris	trailiana	Vaca Diez	+/-150 m
230	Bactris	trailiana	Abuná	170 m
231	Ceroxylon	parvifrons	Nor Yungas	2720 m
232	Ceroxylon	parvifrons	Nor Yungas	2800 m
233	Ceroxylon	parvum	Carrasco	2350 m
234	Ceroxylon	parvum	Nor Yungas	1400 m
235	Ceroxylon	parvum	Nor Yungas	1500 m
236	Ceroxylon	parvum	Florida	1600 m
237	Ceroxylon	parvum	Vallegrande	1750 m
238	Ceroxylon	vogelianum	Inquisivi	3000 m
239	Ceroxylon	vogelianum	Sud Yungas	2150 m
240	Ceroxylon	vogelianum	Florida	2500-2600 m
241	Ceroxylon	vogelianum	Valle Grande	2000 m
242	Ceroxylon	vogelianum	Vallegrande	1900 m
243	Chamaedorea	angustisecta	Ballivián	+/-160 m
244	Chamaedorea	angustisecta	Ballivián	220 m
245	Chamaedorea	angustisecta	Ballivián	220-235 m
246	Chamaedorea	angustisecta	Ballivián	250 m

247	Chamaedorea	angustisecta	Ballivián	250 m
248	Chamaedorea	angustisecta	Ballivián	900-850 m
249	Chamaedorea	angustisecta	Yacuma	250 m
250	Chamaedorea	angustisecta	Yacuma	250 m
251	Chamaedorea	angustisecta	Yacuma	250 m
252	Chamaedorea	angustisecta	Yacuma	250 m
253	Chamaedorea	angustisecta	Franz Tamayo	1000 m
254	Chamaedorea	angustisecta	Franz Tamayo	1350 m
255	Chamaedorea	angustisecta	Franz Tamayo	250 m
256	Chamaedorea	angustisecta	Franz Tamayo	700 m
257	Chamaedorea	angustisecta	Franz Tamayo	900 m
258	Chamaedorea	angustisecta	Iturralde	+/-250 m
259	Chamaedorea	angustisecta	Iturralde	+/-250 m
260	Chamaedorea	angustisecta	Iturralde	+/-250 m
261	Chamaedorea	angustisecta	Iturralde	+/-250 m
262	Chamaedorea	angustisecta	Iturralde	190 m
263	Chamaedorea	angustisecta	Iturralde	250 m
264	Chamaedorea	angustisecta	Iturralde	275 m
265	Chamaedorea	angustisecta	Iturralde	350 m
266	Chamaedorea	angustisecta	Iturralde	360 m
267	Chamaedorea	angustisecta	Iturralde	430 m
268	Chamaedorea	angustisecta	Nor Yungas	1500 m
269	Chamaedorea	angustisecta	Nor Yungas	550 m
270	Chamaedorea	angustisecta	Sud Yungas	+/-400 m
271	Chamaedorea	angustisecta	Sud Yungas	620 m
272	Chamaedorea	angustisecta	Sud Yungas	800 m
273	Chamaedorea	angustisecta	Sud Yungas	830 m
274	Chamaedorea	angustisecta	Nicolás Suarez	240 m
275	Chamaedorea	angustisecta	Nicolás Suarez	280 m
276	Chamaedorea	linearis	Carrasco	1300 m
277	Chamaedorea	pauciflora	Iturralde	190 m
278	Chamaedorea	pauciflora	Abuná	170 m
279	Chamaedorea	pinnatifrons	Ballivián	1000 m
280	Chamaedorea	pinnatifrons	Ballivián	160 m
281	Chamaedorea	pinnatifrons	Ballivián	220 m
282	Chamaedorea	pinnatifrons	Ballivián	220 m
283	Chamaedorea	pinnatifrons	Ballivián	220 m
284	Chamaedorea	pinnatifrons	Ballivián	235 m
285	Chamaedorea	pinnatifrons	Ballivián	900 m
286	Chamaedorea	pinnatifrons	Franz Tamayo	1500-1550 m
287	Chamaedorea	pinnatifrons	Franz Tamayo	1600 m
288	Chamaedorea	pinnatifrons	Inquisivi	1340 m
289	Chamaedorea	pinnatifrons	Inquisivi	1350 m
290	Chamaedorea	pinnatifrons	Iturralde	+/-250 m
291	Chamaedorea	pinnatifrons	Iturralde	+/-250 m
292	Chamaedorea	pinnatifrons	Iturralde	+/-250 m
293	Chamaedorea	pinnatifrons	Iturralde	+/-250 m
294	Chamaedorea	pinnatifrons	Iturralde	+/-300 m
295	Chamaedorea	pinnatifrons	Iturralde	+/-300 m
296	Chamaedorea	pinnatifrons	Iturralde	300 m
297	Chamaedorea	pinnatifrons	Iturralde	300 m
298	Chamaedorea	pinnatifrons	Larecaja	800 m
299	Chamaedorea	pinnatifrons	Nor Yungas	1250 m
300	Chamaedorea	pinnatifrons	Nor Yungas	1500 m
301	Chamaedorea	pinnatifrons	Sud Yungas	1000 m
302	Chamaedorea	pinnatifrons	Sud Yungas	2150 m
303	Chamaedorea	pinnatifrons	Sud Yungas	680 m
304	Chamaedorea	pinnatifrons	Sud Yungas	750-900 m
305	Chamaedorea	pinnatifrons	Sud Yungas	900 m
306	Chamaedorea	pinnatifrons	Nicolás Suarez	260 m
307	Chamaedorea	pinnatifrons	Nicolás Suarez	260 m
308	Chamaedorea	pinnatifrons	Nicolás Suarez	260 m

309	Chamaedorea	pinnatifrons	Nicolás Suarez	275 m
310	Chamaedorea	pinnatifrons	Nicolás Suarez	280 m
311	Chamaedorea	pinnatifrons	Ichilo	315 m
312	Chamaedorea	pinnatifrons	Ichilo	350 m
313	Chamaedorea	pinnatifrons	Ichilo	350 m
314	Chamaedorea	pinnatifrons	Ichilo	350 m
315	Chamaedorea	pinnatifrons	Ichilo	360 m
316	Chamaedorea	pinnatifrons	Ichilo	400 m
317	Chamaedorea	pinnatifrons	Ichilo	450 m
318	Chamaedorea	pinnatifrons	Ichilo	600-750 m
319	Chamaedorea	pinnatifrons	Ichilo	700 m
320	Chamaedorea	pinnatifrons	Ichilo	940 m
321	Chamaerops	humilis	Cercado	2600 m
322	Chelyocarpus	chuco	Vaca Diez	+/-150 m
323	Chelyocarpus	chuco	Vaca Diez	100 m
324	Chelyocarpus	chuco	Vaca Diez	140 m
325	Chelyocarpus	chuco	Madre de Dios	135 m
326	Chelyocarpus	chuco	Madre de Dios	165 m
327	Chelyocarpus	chuco	Manuripi	+/-150 m
328	Chelyocarpus	chuco	Nicolás Suarez	260 m
329	Cocos	nucifera	Yacuma	250 m
330	Copernicia	alba	Ballivián	200 m
331	Copernicia	alba	Cercado	150 m
332	Copernicia	alba	Cercado	230 m
333	Copernicia	alba	Trinidad	250 m
334	Copernicia	alba	Yacuma	+/-200 m
335	Copernicia	alba	Yacuma	160 m
336	Copernicia	alba	Yacuma	160 m
337	Copernicia	alba	Andrés Ibañez	+/-500 m
338	Copernicia	alba	Andrés Ibañez	325 m
339	Copernicia	alba	Cordillera	1200 m
340	Copernicia	alba	Cordillera	400 m
341	Copernicia	alba	Cordillera	700 m
342	Copernicia	alba	Velasco	300 m
343	Copernicia	alba	Gran Chaco	460 m
344	Demoncus	mitis	Ballivián	200 m
345	Desmoncus	leptospadix	Federico Román	150 m
346	Desmoncus	mitis	Franz Tamayo	900 m
347	Desmoncus	mitis	Iturralde	+/-300 m
348	Desmoncus	mitis	Iturralde	180 m
349	Desmoncus	mitis	Ballivián	300-500 m
350	Desmoncus	mitis	Iturralde	285 m
351	Desmoncus	mitis	Sud Yungas	520 m
352	Desmoncus	orthacanthos	Iturralde	300 m
353	Desmoncus	orthacanthos	Federico Román	120 m
354	Desmoncus	polyacanthos	Ballivián	+/-250 m
355	Desmoncus	polyacanthos	Ballivián	250 m
356	Desmoncus	polyacanthos	Ballivián	255 m
357	Desmoncus	polyacanthos	Cercado	+/-150 m
358	Desmoncus	polyacanthos	Mamoré	+/-200 m
359	Desmoncus	polyacanthos	Marbán	230 m
360	Desmoncus	polyacanthos	Yacuma	250 m
361	Desmoncus	polyacanthos	Yacuma	250 m
362	Desmoncus	polyacanthos	Yacuma	250 m
363	Desmoncus	polyacanthos	Iturralde	180 m
364	Desmoncus	polyacanthos	Sud Yungas	530 m
365	Desmoncus	polyacanthos	Sud Yungas	550 m
366	Desmoncus	polyacanthos	Federico Román	150 m
367	Desmoncus	polyacanthos	Ichilo	180 m
368	Desmoncus	polyacanthos	Ichilo	300 m
369	Dictyocaryum	lamarchianum	Nor Yungas	+/-1500 m
370	Dictyocaryum	lamarckianum	Franz Tamayo	1550 m

371	Dictyocaryum	lamarckianum	Nor Yungas	1500 m
372	Dictyocaryum	lamarckianum	Nor Yungas	1530 m
373	Dictyocaryum	lamarckianum	Nor Yungas	1600 m
374	Dictyocaryum	lamarckianum	Nor Yungas	1760 m
375	Elaeis	guineensis	Vaca Diez	125 m
376	Euterpe	precatoria	Ballivián	220 m
377	Euterpe	precatoria	Vaca Diez	+/-200 m
378	Euterpe	precatoria	Yacuma	250 m
379	Euterpe	precatoria	Iturralde	+/-500 m
380	Euterpe	precatoria	Iturralde	190 m
381	Euterpe	precatoria	Iturralde	200 m
382	Euterpe	precatoria	Iturralde	250 m
383	Euterpe	precatoria	Iturralde	280 m
384	Euterpe	precatoria	Nor Yungas	1300 m
385	Euterpe	precatoria	Nor Yungas	1500 m
386	Euterpe	precatoria	Nor Yungas	1500 m
387	Euterpe	precatoria	Nor Yungas	1740 m
388	Euterpe	precatoria	Sud Yungas	850 m
389	Euterpe	precatoria	Abuna	160 m
390	Euterpe	precatoria	Federico Román	110 m
391	Euterpe	precatoria	Madre de Dios	165 m
392	Euterpe	precatoria	Manuripi	+/-150 m
393	Euterpe	precatoria	Manuripi	150 m
394	Euterpe	precatoria	NIcolás Suarez	260 m
395	Euterpe	precatoria	Nicolás Suarez	240 m
396	Euterpe	precatoria	Nicolás Suarez	275 m
397	Euterpe	precatoria	Guarayos	275 m
398	Geonoma		Bautista Saavedra	1200 m
399	Geonoma		Bautista Saavedra	1200 m
400	Geonoma	bongniartii	Carrasco	250 m
401	Geonoma	brevispatha	Ballivián	240 m
402	Geonoma	brevispatha	Moxos	300 m
403	Geonoma	brevispatha	Carrasco	220 m
404	Geonoma	brevispatha	Carrasco	250 m
405	Geonoma	brevispatha	Iturralde	+/-250 m
406	Geonoma	brevispatha	Iturralde	190 m
407	Geonoma	brevispatha	Iturralde	290 m
408	Geonoma	brevispatha	Iturralde	430 m
409	Geonoma	brevispatha	Manuripi	+/-150 m
410	Geonoma	brevispatha	Manuripi	150 m
411	Geonoma	brevispatha	Nicolás Suarez	260 m
412	Geonoma	brevispatha	Nicolás Suarez	280 m
413	Geonoma	brevispatha	Nicolás Suarez	280 m
414	Geonoma	brevispatha	Velasco	800 m
415	Geonoma	brongniartii	Ballivián	1000 m
416	Geonoma	brongniartii	Ballivián	1100 m
417	Geonoma	brongniartii	Ballivián	220 m
418	Geonoma	brongniartii	Ballivián	300-500 m
419	Geonoma	brongniartii	Ballivián	700 m
420	Geonoma	brongniartii	Ballivián	965 m
421	Geonoma	brongniartii	Moxos	260 m
422	Geonoma	brongniartii	Yacuma	350 m
423	Geonoma	brongniartii	Carrasco	212 m
424	Geonoma	brongniartii	Carrasco	220 m
425	Geonoma	brongniartii	Carrasco	235 m
426	Geonoma	brongniartii	Carrasco	320 m
427	Geonoma	brongniartii	Franz Tamayo	900 m
428	Geonoma	brongniartii	Iturralde	+/- 500 m
429	Geonoma	brongniartii	Iturralde	+/-350 m
430	Geonoma	brongniartii	Iturralde	290 m
431	Geonoma	brongniartii	Iturralde	300 m
432	Geonoma	brongniartii	Nor Yungas	865 m

433	Geonoma	brongniartii	Ichilo	180 m
434	Geonoma	densa	Nor Yungas	1500 m
435	Geonoma	densa	Nor Yungas	2400 m
436	Geonoma	densa	Nor Yungas	2800 m
437	Geonoma	deversa	Ballivián	240 m
438	Geonoma	deversa	Ballivián	255 m
439	Geonoma	deversa	Moxos	250 m
440	Geonoma	deversa	Moxos	250 m
441	Geonoma	deversa	Carrasco	220 m
442	Geonoma	deversa	Carrasco	235 m
443	Geonoma	deversa	Carrasco	250 m
444	Geonoma	deversa	Carrasco	290 m
445	Geonoma	deversa	Iturralde	+/-250 m
446	Geonoma	deversa	Iturralde	+/-250 m
447	Geonoma	deversa	Iturralde	+/-250 m
448	Geonoma	deversa	Iturralde	+/-250 m
449	Geonoma	deversa	Iturralde	+/-250 m
450	Geonoma	deversa	Iturralde	+/-500 m
451	Geonoma	deversa	Iturralde	190 m
452	Geonoma	deversa	Iturralde	250 m
453	Geonoma	deversa	Iturralde	280 m
454	Geonoma	deversa	Iturralde	340 m
455	Geonoma	deversa	Iturralde	350 m
456	Geonoma	deversa	Larecaja	490-750 m
457	Geonoma	deversa	Sud Yungas	320 m
458	Geonoma	deversa	Sud Yungas	800 m
459	Geonoma	deversa	Sud Yungas	850 m
460	Geonoma	deversa	Madre de Dios	+/-130 m
461	Geonoma	deversa	Madre de Dios	+/-130 m
462	Geonoma	deversa	Madre de Dios	165 m
463	Geonoma	deversa	Nicolás Suarez	+/-250 m
464	Geonoma	deversa	Nicolás Suarez	+/-250 m
465	Geonoma	deversa	Nicolás Suarez	250 m
466	Geonoma	deversa	Nicolás Suarez	260 m
467	Geonoma	deversa	Nicolás Suarez	275 m
468	Geonoma	deversa	Nicolás Suarez	280 m
469	Geonoma	deversa	Nicolás Suarez	280 m
470	Geonoma	deversa	Nicolás Suarez	280 m
471	Geonoma	interrupta	Ballivián	220 m
472	Geonoma	interrupta	Ballivián	220 m
473	Geonoma	interrupta	Iturralde	+/- 250 m
474	Geonoma	interrupta	Iturralde	+/-250 m
475	Geonoma	interrupta	Iturralde	+/-250 m
476	Geonoma	interrupta	Iturralde	250 m
477	Geonoma	interrupta	Larecaja	490-750 m
478	Geonoma	jussieuana	Ballivián	200 m
479	Geonoma	jussieuana	Ballivián	730 m
480	Geonoma	jussieuana	Nor Yungas	1300 m
481	Geonoma	jussieuana	Nor Yungas	1400-1500 m
482	Geonoma	jussieuana	Nor Yungas	1500 m
483	Geonoma	jussieuana	Nor Yungas	1500 m
484	Geonoma	jussieuana	Nor Yungas	1530-1560 m
485	Geonoma	jussieuana	Sud Yungas	900 m
486	Geonoma	laxiflora	Federico Román	110 m
487	Geonoma	laxiflora	Federico Román	110 m
488	Geonoma	laxiflora	Federico Román	120 m
489	Geonoma	laxiflora	Nicolás Suarez	260 m
490	Geonoma	leptospadix	Vaca Diez	+/-200 m
491	Geonoma	leptospadix	Vaca Diez	230 m
492	Geonoma	macrostachys	Carrasco	235 m
493	Geonoma	macrostachys	Carrasco	250 m
494	Geonoma	macrostachys	Chapare	400

495	Geonoma	macrostachys	Manuripi	+/-150 m
496	Geonoma	macrostachys	Manuripi	+/-150 m
497	Geonoma	macrostachys	Nicolás Suarez	240 m
498	Geonoma	macrostachys	Nicolás Suarez	240 m
499	Geonoma	macrostachys	Nicolás Suarez	250 m
500	Geonoma	macrostachys	Nicolás Suarez	275 m
501	Geonoma	macrostachys	Nicolás Suarez	280 m
502	Geonoma	macrostachys	Carrasco	220 m
503	Geonoma	macrostachys	Carrasco	250 m
504	Geonoma	macrostachys	Ichilo	700 m
505	Geonoma	maxima	Manuripi	+/-150 m
506	Geonoma	maxima	Nicolás Suares	280 m
507	Geonoma	maxima	Nicolás Suarez	260 m
508	Geonoma	maxima	Nicolás Suarez	275 m
509	Geonoma	maxima	Vaca Diez	+/-150 m
510	Geonoma	maxima	Vaca Diez	230 m
511	Geonoma	maxima	Madre de Dios	240 m
512	Geonoma	megalospatha	Nor Yungas	2800 m
513	Geonoma	orbignyana	Franz Tamayo	1550 m
514	Geonoma	orbignyana	Nor Yungas	1300 m
515	Geonoma	orbignyana	Nor Yungas	1400 m
516	Geonoma	orbignyana	Nor Yungas	1400-1450 m
517	Geonoma	orbignyana	Nor Yungas	1500 m
518	Geonoma	orbignyana	Nor Yungas	1530 m
519	Geonoma	orbignyana	Nor Yungas	1600 m
520	Geonoma	orbignyana	Nor Yungas	1720 m
521	Geonoma	orbignyana	Nor Yungas	1850 m
522	Geonoma	orbignyana	Sud Yungas	2250 m
523	Geonoma	orbignyana	Sud Yungas	2250 m
524	Geonoma	orbignyana	Sud Yungas	2300 m
525	Geonoma	stricta	Carrasco	220 m
526	Geonoma	stricta	Carrasco	235 m
527	Geonoma	stricta	Carrasco	250 m
528	Geonoma	stricta	Iturralde	190 m
529	Geonoma	stricta	Federico Román	150 m
530	Geonoma	stricta	Nicolás Suarez	250 m
531	Geonoma	stricta	Nicolás Suarez	260 m
532	Geonoma	stricta	Nicolás Suarez	260 m
533	Geonoma	stricta	Nicolás Suarez	275 m
534	Geonoma	stricta	Nicolás Suarez	280 m
535	Geonoma	undata	Carrasco	1500 m
536	Geonoma	undata	Franz Tamayo	1500-1550 m
537	Geonoma	undata	Nor Yungas	1600 m
538	Geonoma	weberbaueri	Nor Yungas	2000 m
539	Geonoma	weberbaueri	Nor Yungas	2310 m
540	Geonoma	weberbaueri	Nor Yungas	2350 m
541	Geonoma	weberbaueri	Nor Yungas	2600 m
542	Hyospathe	elegans	Ballivián	200 m
543	Hyospathe	elegans	Ballivián	200 m
544	Hyospathe	elegans	Moxos	250 m
545	Hyospathe	elegans	Moxos	260 m
546	Hyospathe	elegans	Carrasco	235 m
547	Hyospathe	elegans	Carrasco	235 m
548	Hyospathe	elegans	Carrasco	250 m
549	Hyospathe	elegans	Carrasco	290 m
550	Hyospathe	elegans	Carrasco	400 m
551	Hyospathe	elegans	Carrasco	400 m
552	Hyospathe	elegans	Chapare	400 m
553	Hyospathe	elegans	Chapare	650 m
554	Hyospathe	elegans	Iturralde	400 m
555	Hyospathe	elegans	Larecaja	610 m
556	Hyospathe	elegans	Nicolás Suarez	260 m

557	Hyospathe	elegans	Nicolás Suarez	260 m
558	Iriartea	deltoidea	Ballivián	220 m
559	Iriartea	deltoidea	Ballivián	435-585 m
560	Iriartea	deltoidea	Carrasco	320 m
561	Iriartea	deltoidea	Carrasco	400 m
562	Iriartea	deltoidea	Chapare	+/-450 m
563	Iriartea	deltoidea	Iturralde	+/-500 m
564	Iriartea	deltoidea	Iturralde	200 m
565	Iriartea	deltoidea	Iturralde	250 m
566	Iriartea	deltoidea	Iturralde	280 m
567	Iriartea	deltoidea	Nor Yungas	1400 m
568	Iriartea	deltoidea	Manuripi	150 m
569	Iriartea	deltoidea	Nicolás Suarez	250 m
570	Iriartea	deltoidea	Nicolás Suarez	275 m
571	Iriartea	deltoidea	Ichilo	250 m
572	Iriartea	deltoidea	Ichilo	400 m
573	Iriartea	deltoidea	Ichilo	700 m
574	Mauritia	flexuosa	Vaca Diez	+/-125 m
575	Mauritia	flexuosa	Vaca Diez	140 m
576	Mauritia	flexuosa	Franz Tamayo	336 m
577	Mauritia	flexuosa	Iturralde	+/-500 m
578	Mauritia	flexuosa	Iturralde	180 m
579	Mauritia	flexuosa	Sud Yungas	320 m
580	Mauritia	flexuosa	Nicolás Suarez	+/-250
581	Mauritia	flexuosa	Ñuflo de Chavez	+/-500 m
582	Mauritia	flexuosa	Ñuflo de Chavez	500 m
583	Mauritiella	martiana	Vaca Diez	140 m
584	Mauritiella	martiana	Iturralde	180 m
585	Mauritiella	martiana	Iturralde	190 m
586	Mauritiella	martiana	Velasco	190 m
587	Mauritiella	martiana	Velasco	750-800 m
588	Oenocarpus	balickii	Nicolás Suarez	280 m
589	Oenocarpus	bataua	Ballivián	220 m
590	Oenocarpus	bataua	Vaca Diez	170 m
591	Oenocarpus	bataua	Carrasco	400 m
592	Oenocarpus	bataua	Bautista Saavedra	1000 m
593	Oenocarpus	bataua	Iturralde	+/- 500 m
594	Oenocarpus	bataua	Iturralde	180 m
595	Oenocarpus	bataua	Iturralde	190 m
596	Oenocarpus	bataua	Iturralde	200 m
597	Oenocarpus	bataua	Muñecas	1150 m
598	Oenocarpus	bataua	Madre de Dios	165 m
599	Oenocarpus	bataua	Manuripi	+/-150 m
600	Oenocarpus	bataua	Nicolás Suarez	250 m
601	Oenocarpus	bataua	Nicolás Suarez	260 m
602	Oenocarpus	bataua	Nicolás Suarez	275 m
603	Oenocarpus	bataua	Ichilo	400 m
604	Oenocarpus	distichus	Vaca Diez	+/- 150 m
605	Oenocarpus	distichus	Vaca Diez	+/-150 m
606	Oenocarpus	distichus	Manuripi	+/-150 m
607	Oenocarpus	distichus	Manuripi	150 m
608	Oenocarpus	distichus	Ñuflo de Chavez	275 m
609	Oenocarpus	mapora	Vaca Diez	230 m
610	Oenocarpus	mapora	Ballivián	250 m
611	Oenocarpus	mapora	Franz Tamayo	700 m
612	Oenocarpus	mapora	Iturralde	+/-250 m
613	Oenocarpus	mapora	Iturralde	+/-500 m
614	Oenocarpus	mapora	Iturralde	+/-500 m
615	Oenocarpus	mapora	Iturralde	190 m
616	Oenocarpus	mapora	Iturralde	250 m
617	Oenocarpus	mapora	Manuripi	+/-150 m
618	Oenocarpus	mapora	Nicolás Suarez	260 m

619	Oenocarpus	mapora	Nicolás Suarez	275 m
620	Parajubaea	sunkha	Vallegrande	2400 m
621	Parajubaea	torallyi	Linares	2750 m
622	Parajubaea	torallyi	Vallegrande	1800 m
623	Parajubaea	torallyi	Vallegrande	1900 m
624	Parajubaea	torallyi	Vallegrande	1900 m
625	Parajubaea	torallyi	Vallegrande	2000 m
626	Parajubaea	torallyi	Vallegrande	2810 m
627	Parajubaea	torallyi	Zudañez	2673 m
628	Parajubaea	torallyi	Zudañez	2500 m
629	Phoenix	canariensis	Murillo	3300 m
630	Phoenix	canariensis	Vallegrande	2040 m
631	Phoenix	dactylifera	Andrés Ibañez	420 m
632	Phytelephas	macrocarpa	Iturralde	+/-500 m
633	Phytelephas	macrocarpa	Iturralde	200 m
634	Phytelephas	macrocarpa	Iturralde	290 m
635	Phytelephas	macrocarpa	Iturralde	340 m
636	Phytelephas	macrocarpa	Sud Yungas/Ballivián	+/-330 m
637	Phytelephas	macrocarpa	Nicolás Suarez	260 m
638	Phytelephas	macrocarpa	Nicolás Suarez	260 m
639	Phytelephas	macrocarpa	Nicolás Suarez	275 m
640	Prestoea	acuminata	Carrasco	1480 m
641	Prestoea	acuminata	Franz Tamayo	1650 m
642	Prestoea	acuminata	Inquisivi	1900 m
643	Prestoea	acuminata	Sud Yungas	1100 m
644	Prestoea	globosa	Ballivián	850-900 m
645	Prestoea	globosa	Nor Yungas	1400-1500 m
646	Socratea	exorrhiza	Ballivián	220 m
647	Socratea	exorrhiza	Vaca Diez	+/-200 m
648	Socratea	exorrhiza	Vaca Diez	+/-200 m
649	Socratea	exorrhiza	Vaca Diez	230 m
650	Socratea	exorrhiza	Vaca Diez	230 m
651	Socratea	exorrhiza	Yacuma	250 m
652	Socratea	exorrhiza	Yacuma	250 m
653	Socratea	exorrhiza	Franz Tamayo	1500-1550 m
654	Socratea	exorrhiza	Iturralde	+/-500 m
655	Socratea	exorrhiza	Iturralde	190 m
656	Socratea	exorrhiza	Iturralde	200 m
657	Socratea	exorrhiza	Iturralde	250 m
658	Socratea	exorrhiza	Iturralde	280 m
659	Socratea	exorrhiza	Madre de Dios	165 m
660	Socratea	exorrhiza	Nicolás Suarez	250 m
661	Socratea	exorrhiza	Nicolás Suarez	280 m
662	Socratea	exorrhiza	Guarayos	275 m
663	Socratea	exorrhiza	Ichilo	+/-150 m
664	Socratea	exorrhiza	Velasco	600 m
665	Socratea	salazarii	Iturralde	360 m
666	Syagrus	cardenasii	Hernando Siles	1200 m
667	Syagrus	cardenasii	Hernando Siles	1300 m
668	Syagrus	cardenasii	Andrés Ibañez	+/-450 m
669	Syagrus	cardenasii	Cordillera	1200 m
670	Syagrus	cardenasii	Valle Grande	550 m
671	Syagrus	cardenasii	Vallegrande	1400 m
672	Syagrus	cardenasii	Warnes	400 m
673	Syagrus	petraea	Velasco	190 m
674	Syagrus	petraea	Velasco	230-800 m
675	Syagrus	sancona	Ballivián	200 m
676	Syagrus	sancona	Ballivián	235 m
677	Syagrus	sancona	Vaca Diez	125 m
678	Syagrus	sancona	Yacuma	+/-200 m
679	Syagrus	sancona	Yacuma	250 m
680	Syagrus	sancona	Yacuma	250 m

681	Syagrus	sancona	Yacuma	250 m
682	Syagrus	sancona	Iturralde	190 m
683	Syagrus	sancona	Sud Yungas	990 m
684	Syagrus	sancona	Nicolás Suarez	240 m
685	Syagrus	sancona	Nicolás Suarez	280 m
686	Syagrus	sancona	Ñuflo de Chavez	+/-500 m
687	Syagrus	sancona	Andrés Ibañez	460 m
688	Syagrus	yungasensis	Sud Yungas	700 m
689	Syagrus	yungasensis	Sud Yungas	700-1000 m
690	Syagrus	yungasensis	Sud Yungas	900 m
691	Trachycarpus	fortunei	Murillo	3300 m
692	Trithrinax	campestris	Andrés Ibañez	320 m
693	Trithrinax	campestris	Gran Chaco-O'Connor	450 m
694	Trithrinax	campestris	O'Connor	+/-800 m
695	Trithrinax	campestris	O'Connor	1200 m
696	Washingtonia	filifera	Murillo	3300 m
697	Wendlandiella	simplicifrons	Iturralde	300 m
698	Wendlandiella	simplicifrons	Iturralde	450 m
699	Wettinia	augusta	Alto Madidi	290 m

Novelties of the Genera *Parajubaea* and *Syagrus* (Palmae) from Interandean Valleys of Bolivia

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ABSTRACT. Two new species from the interandean valleys of Bolivia, *Parajubaea sunkha* and *Syagrus yungasensis* (Palmae), and a new variety, *Parajubaea torallyi* var. *microcarpa* (Palmae), are described and illustrated.

RESUMEN. Se describen e ilustran dos nuevas especies de Palmae de los valles interandinos de Bolivia, *Parajubaea sunkha* y *Syagrus yungasensis*; también se describe la variedad *Parajubaea torallyi* var. *microcarpa*.

Recent intensive neldwork, new palm collections, and the preparation of a Bolivian palm flora have increased information about the richness and distribution of Bolivian palms. The descriptions of two new species and one variety are included in treatments of the Bolivian palm flora by Moraes (in prep.).

PARAJUBAEA BURRET

Parajubaea is a small genus occurring in the interandean valleys of southern Colombia, central Ecuador, and central to southern Bolivia. All species are treelike, with pinnate leaves, and branched interfoliar inflorescences. The genus was studied by Moraes and Henderson (1990), and two species were recognized: *P. cocoides*, growing in cultivated stands of Colombia and Ecuador, and *P. torallyi*, endemic to Bolivia. The latter species was not well understood nor looked for in other areas of Bolivia. The genus *Parajubaea* now includes a third species and two varieties, which are treated in the present contribution.

Parajubaea torallyi has been recorded from the northeastern area of the Chuquisaca department, in southern Bolivia. Moraes and Henderson (1990) added another collection for this species from the southwest of the department of Santa Cruz, but this is treated here under a distinct species, *P. sunkha*.

KEY TO THE SPECIES OF *PARAJUBAEA*

1. Rachillae with short side branches, staminodial ring with three fingerlike projections, endocarp with three inconspicuous ridges; cultivated, Colombia and Ecuador, between 2500 and 3000 m . . . . . *P. cocoides*
1. Rachillae unbranched; staminodial ring not digitated; endocarp with three prominent or inconspicuous ridges; wild populations; Bolivia, between 1700 and 3400 m.
   2. Pinnae irregularly arranged; sheath fibers well developed; stem 4–10 m tall, 25–35 cm diam., densely covered by sheaths, in protected ravines, between 1700 and 2200 m . . . . *P. sunkha*
   2. Pinnae regularly arranged; scarce fibers on sheath; stem 20–26 m tall, 25–50 cm diam., smooth; on steep slopes, between 2700 and 3400 m . . . . . *P. torallyi*

Some similarities are found between *Parajubaea cocoides* and *P. torallyi*, such as in habit (e.g., smooth and tall stems, long petioles, and regularly arranged pinnae). The single seed-fruit and less obvious endocarpic ridges are characteristics of both *P. sunkha* and *P. cocoides*.

Parajubaea sunkha Moraes, sp. nov. TYPE: Bolivia. Santa Cruz: Vallegrande, El Palmar, 26 km on road from Vallegrande to Postrer Valle, 2400 m, 22 Aug. 1994, *M. Moraes & I. Vargas 1805* (holotype, LPB; isotypes, AAU, NY, QCA, UCZ, US). Figure 1.

Caudex solitarius 4–10(–14) m, cum reliquiis foliaris basis. Petioli valde fibrosi, 33–100 cm longi; pinnae utroque latere 66–92, irregulariter dispositae vel 2–5 inter se obscure aggregatae. Flores masculini staminibus 13–15; flores feminei 4–5(–8) ad rhachillae basim. Fructus ovoideus 3–5 cm longus, putamine 1(–2).

Stem 4–10(–14) m tall, 25–50 cm diam., covered to the base with old sheaths. Leaves 18–26, 2–3 m long, erect and arching in distal third portion; sheath 35–120 cm long, with a dense tough brown fiber 1–1.35 m long, 40–70 cm wide; petiole 33–100 cm long; rachis 2–2.5 m long, triangular in cross section at apex; pinnae 66–92 per side, lanceolate, irregularly inserted in groups of 2–5, 3–4 cm apart, in one plane, plicate at base, green and lustrous adaxially, glaucous abaxially; basal pinnae 45–80 × 0.4–1.1 cm; middle pinnae 62–70 × 2.5–3 cm; apical pinnae 40–52 × 0.3–0.8 cm. Inflorescences up to six per plant, 1.8–2.5 m long, buds erect becoming pendulous at anthesis; prophyll ca.

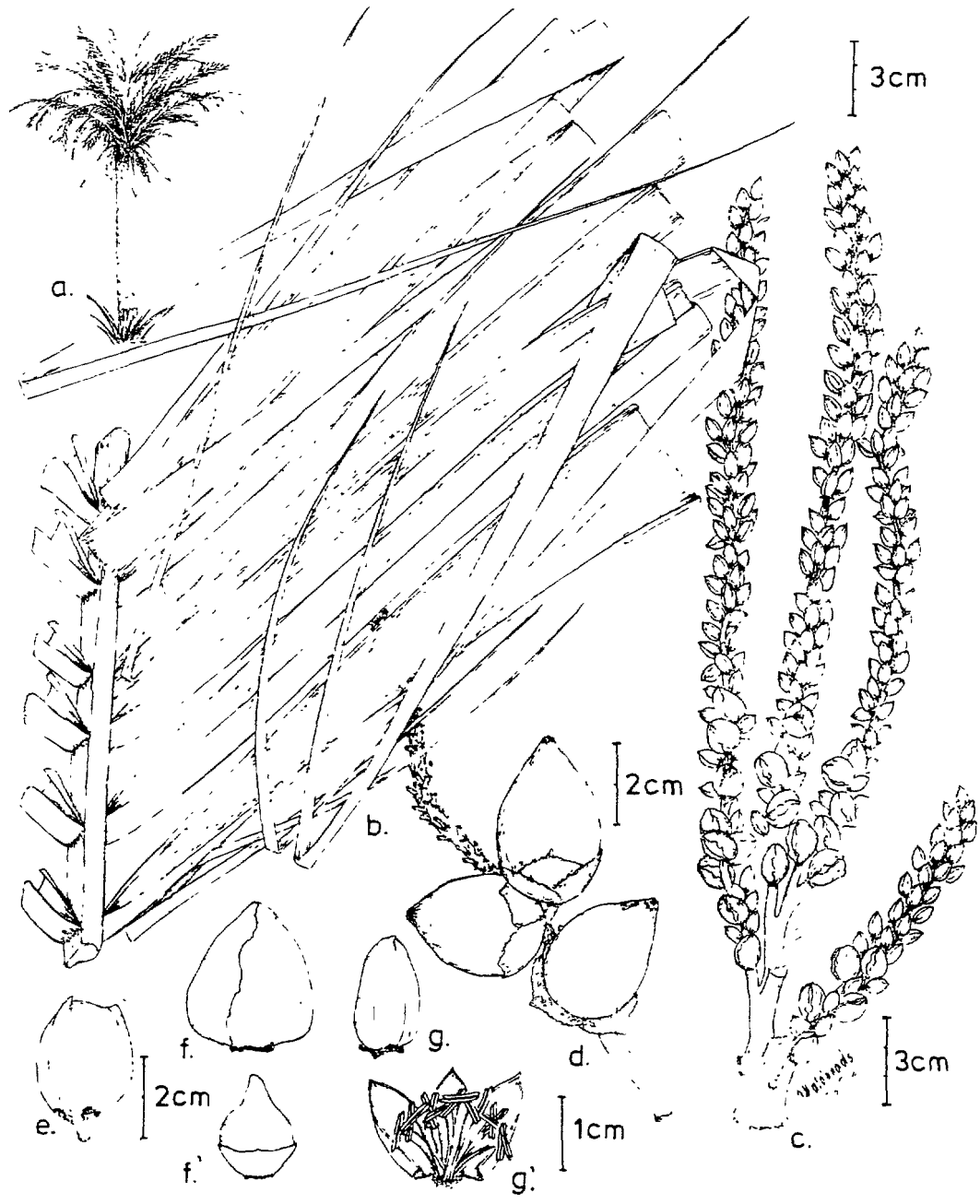

Figure 1. *Parajubaea sunkha* Moraes. —a. Habit with persistent sheaths. —b. Shape and arrangement of leaves, grouped pinnae. —c. Inflorescence, apical portion. —d. Infructescence with mature fruits. —e. Endocarp. —f. Pistillate flower. —f'. Ovary with staminodial ring. —g. Staminate flower. —g'. Open perianth showing stamens. (a based on photographs taken in El Palmar and Mataraleito, Santa Cruz; b–g on *Moraes & Vargas 1805*.)

1.4 m long and 13 cm diam. at base; peduncular bract 0.85–1.75 m long, apiculate, inflated above, woody, sulcate, brown externally, glabrous and white-cream internally; peduncle 60–80 cm long, glabrous; rachis 38–50 cm long, glabrous; rachillae 33–50 spirally arranged, spreading at anthesis, the basal ones 18–32 cm long, the middle ones 28 cm long, the apical ones 21–25 cm long; staminate flowers pedicellate, pedicel 2–6 mm, yellow-orangish; sepals free, briefly connate basally; petals

broadly triangular, 10 × 6 mm, valvate; stamens 13–15, 6 mm long; filaments 2 mm long; anthers 4 mm long, medifixed, slightly sagittate; pistillode trifid; pistillate flowers 4–5(–8) per rachilla, basally inserted, 8.5 × 10 mm; sepals and petals broadly triangular, 10 × 13 mm, petals slightly smaller than sepals; staminodial ring to 2 mm tall, with 6 short teeth; ovary brownish beige tomentose; stigmas to 1 mm long; ovule basal. Fruit ovoid, 3–5 cm long, 2.5–3 cm diam.; epicarp light green, orange at apex; mesocarp very fibrous; endocarp stonish, brown with 3 inconspicuous ridges; seeds 1(–2), 2–2.5 cm long; endosperm homogeneous with central cavity; eophyll bifid.

Etymology. The vernacular Aymaran name of *sunkha*, which refers to the density of fibers, has been adopted for the species epithet.

Common names. "Sunkha," "palma sunkha," "corozo."

Uses. This palm is exploited locally: fibers are collected for ropes, mattresses, and pads; leaves and leaflets for fans and baskets; fruits for human consumption; palmheart and young leaves for forage (Moraes & Henderson, 1990; Vargas, 1994).

Distribution. Endemic to Bolivia. Restricted to narrow valleys with low semideciduous forests in the lower parts and with *Podocarpus parlatorei* Pilger, *Alnus acuminata* HBK, and *Berberis* sp. in the upper parts, partially transformed to grassy or shrubby slopes and ridges, in the Department of Santa Cruz, Province of Vallegrande (63°26′–64°10′W, 18°10′–18°30′S). Populations occur between 1700 and 2200 m elevation in interandean dry valleys. It is locally abundant in protected ravines, but most of the population is being reduced by the cultivation of maize. This palm is much less common today than 50 years ago. Several local people referred to a formerly larger area of the sunkha palm that extended to the south of Vallegrande.

Conservation status. Due to the restricted distribution of *Parajubaea sunkha*, and the harvesting of fiber and leaves, this species is endangered.

Paratypes. BOLIVIA **Santa Cruz:** Prov. Vallegrande, Mataralcito, 2 hours E of Santa Rosita on road to Postrer Valle, 18°32′S, 64°00′W, 1900 m, 11 May 1988. *Henderson, Moraes & Saldias 760* (LPB, NY), 10 May 1988. *Moraes et al. 1048* (LPB, NY); 15 km E from Santa Rosita, 23 July 1989, *Vargas 230* (LPB, UCZ), 10 km E of Guadalupe, valley of río Piraymiri, 1 km upstream from Chorillos, 18°33′S, 63°59′W, 1800 m, 5 Feb. 1988, *Nee et al. 36179* (LPB, NY, UCZ); in Barrio Nuevo, 18°29′S, 64°06′W, 2000 m, 5 Feb. 1988, *Nee et al. 36245* (LPB, NY, UCZ).

Much material previously cited was misidentified as *Parajubaea torallyi* (Moraes & Henderson, 1990), to which the new species *P. sunkha* is undoubtedly closely related, and with which it is wholly allopatric.

Parajubaea torallyi is a tree 20–26 m tall, with a smooth and slender stem, and pinnae regularly arranged. It grows on steep western slopes of sandstone mountains ranging from 2000 to 3400 m. There are two populations, which differ in fruit size, shape of endocarp, and number of stamens. They are treated as two varieties of *P. torallyi*.

KEY TO THE VARIETIES OF *PARAJUBAEA TORALLYI*

1. Fruits 6–7.5 cm long with 2–3 seeds; endocarp with 3 prominent ridges; rachillae straight; stamens 17. . . . . *P. torallyi* var. *torallyi*
1. Fruits 4–5 cm long with 1(–2) seeds; endocarp with 3 inconspicuous ridges; rachillae zig-zag and twisted; stamens 13–15 . . *P. torallyi* var. *microcarpa*

The zig-zag and twisted rachillae shape of *P. torallyi* var. *microcarpa* is reminiscent of *P. cocoides*.

Parajubaea torallyi (C. Martius) Burret var. **microcarpa** Moraes, var. nov. TYPE: Bolivia. Chuquisaca: Jatun Palmar, Palmar Grande, 10 km E of Soroma, ravines of río Pilcomayo, 2047 m, 26 May 1995, *M. Moraes, E. Oviedo & O. Murguía 2209* (holotype, LPB; isotype, NY). Figure 2.

Flores masculini staminibus 13–15; flores feminei 1(–2) ad rhachillae basim. Fructus ovoideus 3.5–4.5 cm longus; putamine 1(–2).

Stem 10–20 m tall, 25–50 cm diam., smooth. Leaves 15–18, 4.5–5 m long, erect; sheath to 110 cm long, with few fibers to 15 cm long; petiole 70–90 cm long; rachis 2.7–3.2 m long, triangular in cross section at apex; pinnae 80–89 per side, lanceolate, regularly inserted and spreading in the same plane, plicate at base, green and lustrous adaxially, glaucous abaxially; basal pinnae 56–75 × 0.6–1 cm; middle pinnae 60–65 × 1.2–1.5 cm; apical pinnae 68–72 × 0.8–1 cm. Inflorescences up to five per plant, 1.8–2.5 m long; buds erect, becoming pendulous at anthesis; prophyll ca. 1 m long; peduncular bract 1.1–1.3 m long, apiculate, inflated above, membranous, sulcate, brown externally, glabrous and light brown internally; peduncle 60–64 cm long, glabrous; rachis 40–46 cm long with a zig-zag and twisted shape, glabrous; rachillae 13–16 spirally arranged, spreading at anthesis, the basal ones 13–15 cm long, the apical ones 17–19 cm long; staminate flowers pedicellate, 6–9 mm long; pedicel 1–4 mm long; sepals free, briefly connate basally; petals broadly triangular, valvate; stamens 13–15, 5 mm long; filaments 3 mm long; an-

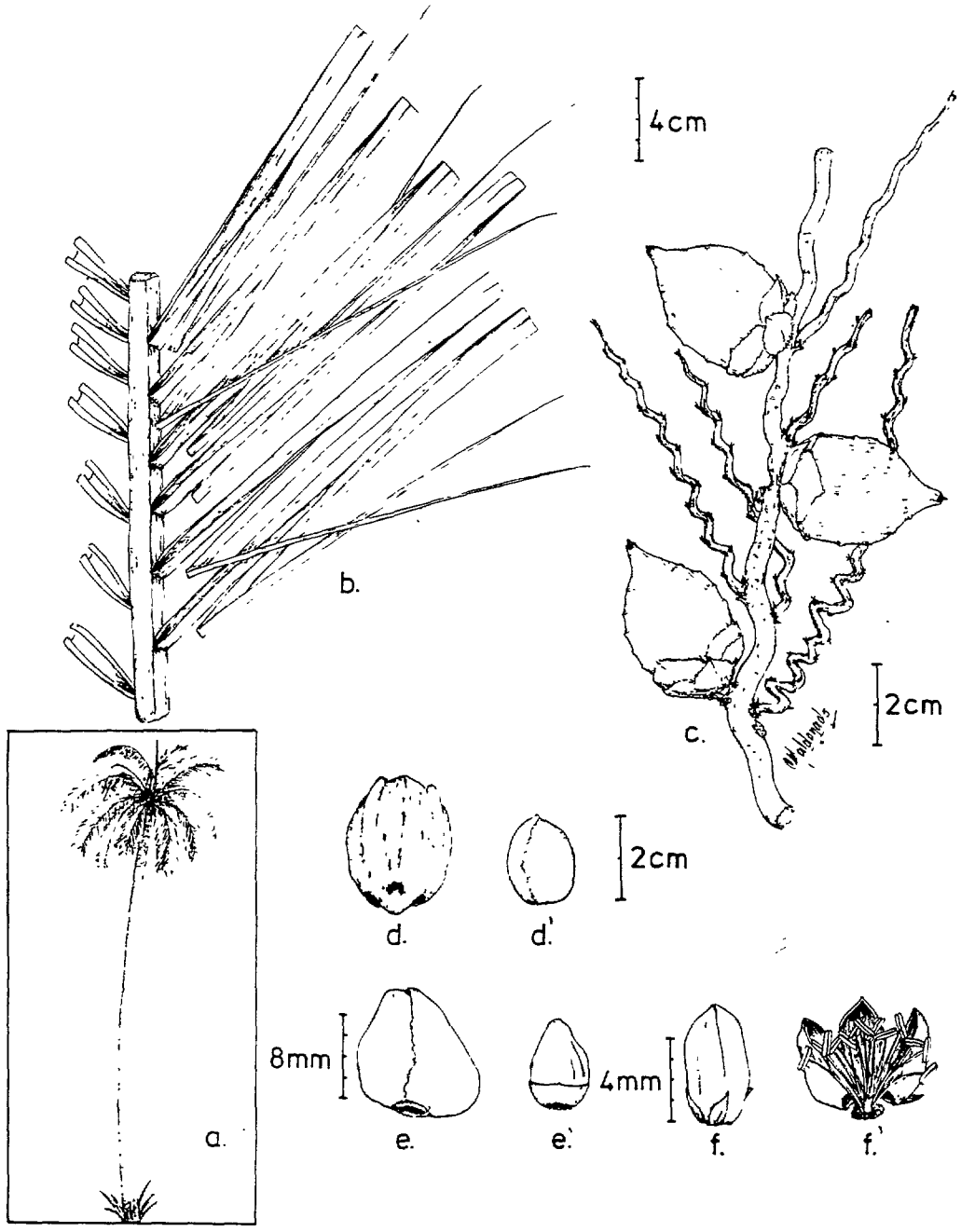

Figure 2. *Parajubaea torallyi* (C. Martius) Burret var. *microcarpa* Moraes. —a. Habit with smooth and slender stem. —b. Shape and arrangement of middle section of leaves. —c. Infructescence with mature fruits; note zig-zag shape of rachillae. —d. Endocarp. —d'. Seed. —e. Pistillate flower. —e'. Ovary with staminodial ring. —f. Staminate flower. —f'. Stamens. (a based on photographs taken in Jatun Palmar, Potosí; b–f on *Moraes et al. 2209*.)

thers 2 mm long, medifixed, slightly sagittate; pistillode trifid; pistillate flowers 1(–2) per rachillae, basally inserted, 8–12 mm long; sepals and petals broadly triangular to 9 mm long, petals slightly smaller than sepals; staminodial ring to 2 mm tall, with 3 short teeth; ovary brownish beige tomentose; stigmas to 1 mm long; ovule basal. Fruit ovoid 3–5 cm long, 2.5–3 cm diam.; epicarp light

broadly triangular, 10 × 6 mm, valvate; stamens 13–15, 6 mm long; filaments 2 mm long; anthers 4 mm long, medifixed, slightly sagittate; pistillode trifid; pistillate flowers 4–5(–8) per rachilla, basally inserted, 8.5 × 10 mm; sepals and petals broadly triangular, 10 × 13 mm, petals slightly smaller than sepals; staminodial ring to 2 mm tall, with 6 short teeth, ovary brownish beige tomentose; stigmas to 1 mm long; ovule basal. Fruit ovoid, 3–5 cm long, 2.5–3 cm diam.; epicarp light green, orange at apex; mesocarp very fibrous; endocarp stonish, brown with 3 inconspicuous ridges; seeds 1(–2), 2–2.5 cm long; endosperm homogeneous with central cavity; eophyll bifid.

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1. Fruits 4–5 cm long with 1(–2) seeds; endocarp with 3 inconspicuous ridges; rachillae zig-zag and twisted; stamens 13–15 . . *P. torallyi* var. *microcarpa*

The zig-zag and twisted rachillae shape of *P. torallyi* var. *microcarpa* is reminiscent of *P. cocoides*.

Parajubaea torallyi (C. Martius) Burret var. **microcarpa** Moraes, var. nov. TYPE: Bolivia. Chuquisaca: Jatun Palmar, Palmar Grande, 10 km E of Soroma, ravines of río Pilcomayo, 2047 m, 26 May 1995, *M. Moraes, E. Oviedo & O. Murguía 2209* (holotype, LPB; isotype, NY). Figure 2.

Flores masculini staminibus 13–15; flores feminei 1(–2) ad rhachillae basim. Fructus ovoideus 3.5–4.5 cm longus; putamine 1(–2).

Stem 10–20 m tall, 25–50 cm diam., smooth. Leaves 15–18, 4.5–5 m long, erect; sheath to 110 cm long, with few fibers to 15 cm long; petiole 70–90 cm long; rachis 2.7–3.2 m long, triangular in cross section at apex; pinnae 80–89 per side, lanceolate, regularly inserted and spreading in the same plane, plicate at base, green and lustrous adaxially, glaucous abaxially; basal pinnae 56–75 × 0.6–1 cm; middle pinnae 60–65 × 1.2–1.5 cm; apical pinnae 68–72 × 0.8–1 cm. Inflorescences up to five per plant, 1.8–2.5 m long; buds erect, becoming pendulous at anthesis; prophyll ca. 1 m long; peduncular bract 1.1–1.3 m long, apiculate, inflated above, membranous, sulcate, brown externally, glabrous and light brown internally; peduncle 60–64 cm long, glabrous; rachis 40–46 cm long with a zig-zag and twisted shape, glabrous; rachillae 13–16 spirally arranged, spreading at anthesis, the basal ones 13–15 cm long, the apical ones 17–19 cm long; staminate flowers pedicellate, 6–9 mm long; pedicel 1–4 mm long; sepals free, briefly connate basally; petals broadly triangular, valvate; stamens 13–15, 5 mm long; filaments 3 mm long; an-

green, orange at apex; mesocarp very fibrous; endocarp with 3 inconspicuous ridges; seeds 1(–2), 2.1 cm long.

Etymology. The epithet refers to the small size of fruit, compared with *P. torallyi* var. *torallyi*.

Common names. "Janchi coco." "palma de fruto chico."

Uses. According to local people, this palm is utilized for its fruits. Formerly, the stems were split in two and then cut into pieces 1 m long, in order to extract and grind the internal fibers with an ax, and finally to weave ropes from the fibers. Occasionally, baskets and fans are made from the leaves.

Distribution. Endemic to Bolivia. Restricted to steep interandean valleys with xeric, often spiny vegetation (*Prosopis, Aspidosperma*, bromeliads), in the departments of Chuquisaca (Zudañez) and Potosí (Province Linares): (64°11′–64°55′W, 19°33′–19°50′S). Monotypic stands are found between 2700 and 3400 m elevation.

Conservation status. This species is not threatened because it regenerates prolifically and because there are few roads and human settlements.

Paratypes. BOLIVIA. **Potosí:** Prov. Linares, Jatun Palmar, 167 km E from the city of Potosí on road to Turuchipa, 19°50′S, 64°55′W, 2750–3300 m, 5 Apr. 1993, *Torrico & Peña 337* (BOLA, LPB).

Parajubaea torallyi (C. Martius) Burret var. **torallyi**. Notizbl. Bot. Gart. Berlin-Dahlem 11: 50. 1930. *Diplothemium torallyi* C. Martius in d'Orbigny, Voy. Amér. mér. 7(3). Palmiers 105, t. 15, fig. 3. 1842. *Jubaea torallyi* (C. Martius) H. A. Wendland in Kerch., Palmiers 247. 1878. *Polyandrococos torallyi* (C. Martius) Barbosa Rodrigues, Contr. Jard. Bot. Rio de Janeiro 1: 8. 1901. TYPE: Bolivia. Chuquisaca: Oropeza, Garcilaso, near town, *A. d'Orbigny 51* (holotype, P).

The type collection consists only of endocarps that are smaller than those from Pasopaya stands. Alcides d'Orbigny gathered them from cultivated trees grown in Garcilaso, which lies in the north of the city of Sucre. These five trees still are alive and were estimated to be more than 300 years old.

When Cárdenas (1970) described the palm forests of the Bolivian high Andes, he noted two different fruit sizes of the Bolivian endemic species of *Parajubaea*, *P. torallyi*. Moraes and Henderson (1990) reviewed the genus *Parajubaea* and concluded that different fruit sizes were probably due to variation within the wild species. Further fieldwork and new measurements were undertaken in Bolivia to determine if these were two species of *Parajubaea* or merely a variability within a single species. Moraes and Vargas (1994) preferred the two species hypothesis, with a distinct pattern of distribution for each. Finally, there are three distinct populations, each related to different valleys and ecosystems; they belong to three hydrographic systems that are separated by several mountain ranges and are influenced by distinctive climatic conditions.

Syagrus C. Martius

Syagrus is most diverse in central Brazil and is usually found in dry habitats. Its 32 species range from Venezuela and Colombia to Argentina with a further species in the Antilles (Glassman, 1987). An ongoing revision of the genus will report more species (L. Noblick, pers. comm.). This genus is characterized by a wide variety of life forms and habits; its species occupy both the understory and the canopy. It has an aboveground stem or may be acaulescent, the inflorescence is branched or spicate and interfoliar, the pinnate leaves are regularly or irregularly spaced, and all the species have six stamens.

The following species, *Syagrus yungasensis* is described as new to science. None of the species reported by Glassman (1987) have the combination of branched inflorescences, irregularly inserted pinnae, numerous rachillae, and treelike habit. The size of the pistillate flowers and the ornamentation of a three-ridged endocarp are reminiscent of another Bolivian species, *S. cardenasii*, but many other characters differ as follows:

KEY TO *SYAGRUS CARDENASII* GLASSMAN AND *S. YUNGASENSIS*

1. Endocarp 3 mm thick, smooth and glabrous, slightly beaked apically; endocarp apex terminates in a 3-lobed little apical point; rachillae 9–11, spreading; stem to 3 cm diam., covered with sheaths or acaulescent, ovary tomentose . . . . . *S. cardenasii*
1. Endocarp 5 mm thick, rough and covered with coarse fibers, beaked basally; endocarp apex terminates in three prominent ridges that stop short of apex; rachillae 32–46, appressed to rachis; stem 7–9 cm diam., smooth; ovary glabrous . . . . . *S. yungasensis*

Syagrus yungasensis Moraes, sp. nov. TYPE: Bolivia. La Paz: Sud Yungas, 30 km on the road from Chulumani to La Asunta, 900 m, 9 Dec. 1994, *M. Moraes 1874* (holotype, LPB; isotypes, FTG, NY). Figure 3.

Caudex solitarius 4–5 m. Pinnae utroque latere 98–120, irregulariter dispositae vel 4–10 aggregatae ad me-

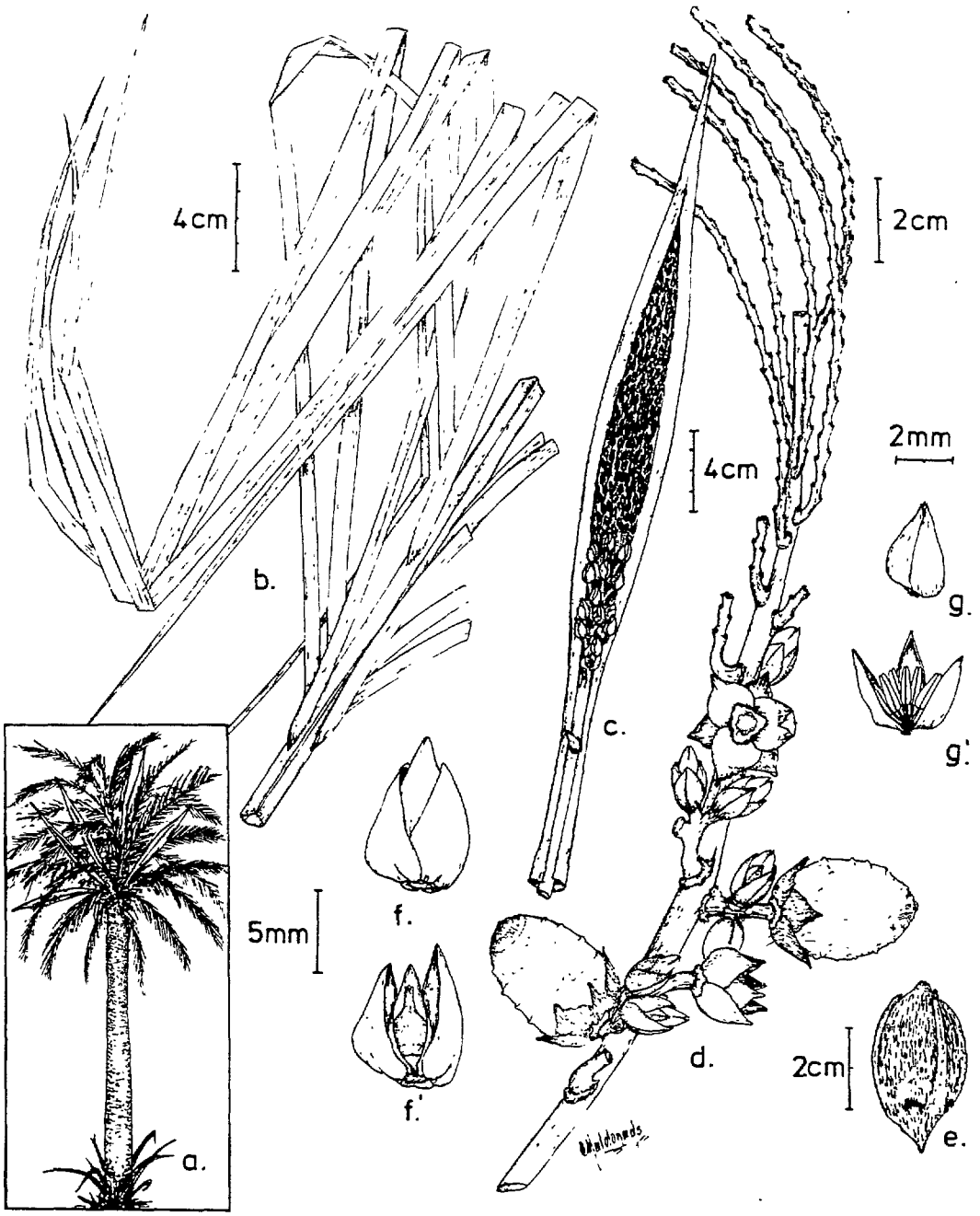

Figure 3 *Syagrus yungasensis* Moraes —a. Habit with several erect inflorescences. —b. Shape and arrangement of middle section of leaves. —c. Inflorescence; note pistillate flowers in proximal rachillae. —d. Infructescence with mature fruits. —e. Endocarp. —f. Pistillate flower. —f'. Open perianth showing ovary and staminodial ring. —g. Staminate flower —g'. Open flower showing stamens (a based on photographs taken on the road from Chulumani to La Asunta, La Paz; b–g on *Moraes 1874*.)

dium usque foliato. Rhachilla 32–46 appressus ad rhachim, flores feminei congesti ad rhachillae basim.

Stem solitary 4–5 m tall, 7–9 cm diam., smooth surface with overlapping internodes without foliar bases. Leaves 13–18, ca. 2.2 m long; sheath 12–25 cm long, fibrous; pseudopetiole 80–100 cm long, fibrous, channeled with slightly raised midridge, margins with fibers 6–8 cm long; rachis 1.2–1.4 m long, triangular in cross section at apex; pinnae 98–120 per side, lanceolate, irregularly inserted in groups of 4–10, 4–6 cm apart, open, nearly perpendicular to rachis, plicate at base, green and lustrous adaxially, glabrous with ramenta on central nerve abaxially, in each group the apical pinnae erect to apex; basal pinnae 39–68 × 0.4–0.5 cm; middle pinnae 45–63 × 1–1.2 cm; apical pinnae 4–15 × 0.1–0.2 cm. Inflorescences up to 8 per plant, 40–95 cm long; prophyll 16 cm long, fibrous; peduncular bract 80–92 cm long, apiculate, inflated above, woody, sulcate, brown externally, glabrous and dark brown internally; peduncle 56 cm long, glabrous; rachis 10–13 cm long, glabrous; rachillae 32–46, appressed to rachis, 11–15 bearing 2–4 pistillate flowers, the remaining rachillae with only staminate flowers, basal ca. 8–26 cm long and apical 2.5–10 cm long; sometimes one single rachilla inserted 10 cm from the base of peduncle, with 5–6 pistillate flowers. Staminate flowers sessile, to 6 mm long, sepals and petals apiculate; stamens 6, 2–3 mm long; filaments to 1 mm long; anthers to 2 mm long. Pistillate flowers 9–10 mm; sepals and petals apiculate; ovary glabrous with trifid stigmas; staminodial ring to 2 mm high, undulate. Fruit 3.5–4 × 2.5–3 cm; epicarp smooth, green with brown scales at apex; mesocarp fibrous; endocarp 5 mm thick covered with persistent coarse fibers, rough surface, beaked at the base and with lightly prominent ridges that stop short of apex; seed 1, endosperm homogenous.

Etymology. The specific epithet refers to the geographical region known locally as the Yungas, an area that comprises much of the east slope of the Andes in northern and central Bolivia.

Common names and uses. None recorded.

Distribution. Restricted to narrow dry valleys and steep rocky slopes in the semideciduous forests of the eastern slope of the Andes, between 700 and 1000 m elevation.

Conservation status. This species is only known from narrow valleys. Due to an increasing number of vehicles and road construction in the area its population could be endangered. However, most populations are found on inaccessible, steep slopes and are not thought to be in any immediate danger.

Paratype. BOLIVIA. **La Paz:** Sud Yungas, 82 km from Chulumani on road to La Asunta, 700 m, 30 May 1986, *Beck 12636* (LPB).

Syagrus yungasensis was found on the stretch of road between Chulumani and La Asunta growing on rocky soils and cliff faces in steep ravines. These dry interandean valleys are very different from the humid forests found in much of the *Yungas*, and are a result of orographic conditions. The linear distance from the collection sites to peaks of ca. 6500 m in elevation in the *Cordillera* is ca. 55 kilometers. The population is found within rain-shadowed valleys, and the vegetation is characterized by the presence of semideciduous and xerophytic species that withstand extended periods without rain.

Small species of *Syagrus* often turn out to be local endemics, such as in the northeast of Brazil (Larry Noblick, pers. comm.). Some acaulescent endemic species were reported from Brazil: *S. duartei* Glassman, *S. harleyi* Glassman, *S. mendanhensis* Glassman, *S. microphylla* Burret, and *S. werdermannii* Burret (Glassman, 1987). This new small species may have evolved in recent geologic periods; it has survived in a restricted habitat that is biogeographically related to the Chaqueñan flora further south, but separated by the more humid forests of the Yungas and Chapare.

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Diversity and Distribution of Palms in Bolivia

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ABSTRACT

Bolivian palms include 27 genera and 84 native species, with four of them endemic to Bolivia. They are divided among the following life forms: 46% grow as tree palms, 42% are shrubs, 7% are acaulescent, and 4% are scandent palms. Bolivian palms grow in open vegetation types and also in different forest strata from the understory to the subcanopy in many kinds of forests. Some palm species are found in monotypic stands while others grow associated with other species of palms. Their altitudinal range is from 140 m to 3300 m elevation, covering the major part of the country and the highest diversity is reached between 140 and 500 m. Bolivian palms are found in four main biogeographic regions: Amazonia (54%), the Andes (29%), the Cerrado (7%), the Gran Chaco (2%), and mixed with transitional regions (8%).

RESUMEN

La diversidad de palmas bolivianas está representada por 27 géneros y 84 especies nativas, de las cuales cuatro son endémicas de Bolivia. Las formas de vida presentan 46% de palmas arbóreas, 42% de palmas "arbustivas," 7% de palmas acaules y 4% de palmas trepadoras. Se encuentran en vegetación abierta y se distribuyen en estratos desde el sotobosque hasta el subdosel en varios tipos de bosque, siguiendo patrones monotípicos o mixtos asociados con otras especies de palmas. El rango altitudinal es de 140–3300 m y cubre la mayor parte del territorio boliviano, siendo los niveles de 140–500 m donde alcanzan su mayor diversidad por superficie. Su distribución abarca cuatro grandes unidades biogeográficas: Amazonia con 54%, los Andes con 29%, el Cerrado con 7%, el Gran Chaco con 2% y mixtos transicionales con 8%.

Alcides d'Orbigny was the first botanist who collected and studied Bolivian palms. Thirty-two of his 42 palm collections in Bolivia were considered as new by Martius in 1842. Since then, few palm collections were made in Bolivia up to the 1970s, and these have been made mostly in the montane forests of the Andes. Several authors have referred directly or indirectly to the diversity and distribution of Bolivian palms (Peña 1944, Irmay 1947, Cárdenas 1969, 1970, Meneces 1975, Antezana 1976). In addition, several descriptive works on regional distribution of palms have included checklists of Bolivian palms (Foster 1958, Glassman 1965, Uhl and Dransfield 1987), as well as the treatment of the Amazonian palm flora (Henderson 1994) and the palms of the Andes (Moraes et al. 1995b).

Based on the study of collections of Bolivian palms deposited in Bolivian, North American, and European herbaria, as well as the published literature, Balslev and Moraes (1989) presented a preliminary list of 29 genera and 90 native palm species including thirty-five new species' records for Bolivia. This detailed herbarium study revealed that 30 species had not been recollected since their first report for the country, most of them as new species.

During the last 15 yr, a concerted effort has been made to increase the information available on the distribution of Bolivian palms. Research on palms from botanically poorly known areas has produced several new records for the country. In the humid montane *Yungas* forests in northern La Paz department, *Bactris concinna*, *Chamaedorea linearis*, *Wettinia augusta*, *Wendlandiella gracilis*, and *Socratea salazarii* were registered as new for Bolivia (Parker and Bailey 1991, Moraes et al. 1995a). Rojas (1992) studied the ethnobotany of montane forest palms in the center of the eastern Andean *Cordillera* near the valley of Sacta in Cochabamba Department. Other field trips have been made to the interandean dry forest regions in Santa Cruz and Chuquisaca for more in-depth studies on the genus *Parajubaea* (Moraes and Henderson 1990, Moraes and Vargas 1994, Vargas 1994). The seasonally flooded savanna and riparian forests in northwestern Bolivia have been visited in order to obtain better data on the distribution and habitats of *Mauritiella armata* and *Mauritia flexuosa* (Haase 1990), *Copernicia alba* (Moraes 1991), and *Bactris glaucescens* (Moraes and Sarmiento 1992). Proctor et al. (1993) documented the diversity and uses of palms in the humid lowland rain forests of the Pando; this study

resulted in the collection of *Geonoma paniculigera* and *Bactris sphaerocarpa*, which were new records for Bolivia. In 1992, during an expedition in the eastern sector of the Pando department, four palms, *Chamaedorea pauciflora*, *Bactris trailiana*, *Astrocaryum gynacanthum*, and *Bactris elegans*, were added to the list of species known to occur in Bolivia (Gentry and Foster, unpublished data). Saldias (1991a, b) studied the morphology and economic botany of *Bactris gasipaes* in the humid lowland forests in northern and western Santa Cruz. Finally, several field trips done in the northeastern, western, and central regions of Bolivia have provided additional information on the distribution of many palm species, particularly *Chelyocarpus chuco*, *Mauritia flexuosa*, *Mauritiella armata*, *Astrocaryum jauari*, *A. aculeatum*, *Attalea butyracea*, *Geonoma* spp., *Chamaedorea angustisecta*, and *Euterpe precatoria* (Moraes 1989, 1990, 1993).

Several recent taxonomic studies of a monographic nature have cited numerous Bolivian exsiccatae and have made important contributions to our understanding of Palmae in Bolivia; of particular note are the following taxa: *Chamaedorea* (Hodel 1992), Iriarteinae (Henderson 1990), *Hyospathe* (Skov and Balslev 1989), *Aiphanes* (Borchsenius and Bernal 1996), *Parajubaea* (Moraes and Henderson 1990), *Allagoptera* (Moraes 1996a), and *Attalea* (Wessels Boer 1965).

This paper summarizes the current state of knowledge on species richness, life forms, foliar morphology, ecology, and biogeography of Bolivian palms, information that is included in the *Bolivian Palm Flora* by Moraes (in prep.).

Diversity

The native palms of Bolivia include a total of 84 species pertaining to 27 genera and five subfamilies (see Appendix I). The most speciose subfamily is the Arecoideae, which encompasses 70 species. The checklist published by Balslev and Moraes (1989) cited 90 species and 29 genera. The apparent reduction in diversity has resulted from a better understanding of the taxonomy of several important groups. *Scheelea*, *Maximiliana* and *Orbignya* were synonimized under *Attalea* (Wessels Boer 1965), while *Jessenia* was united with *Oenocarpus* (Henderson 1994). Nonetheless, two new generic records have been reported for *Wettinia* and *Wendlandiella*, maintaining 27 genera for Bolivia. The total numbers of species were constantly in flux due to the many new records, as well as to a series of synonymizations that resulted from recent monographic treatments.

Sixteen genera (56% of the total known to occur in Bolivia) are monotypic. The largest genera are *Geonoma* with 20 species and *Bactris* with 15 species, followed by *Astrocaryum* and *Attalea* with five species each.

Life Form

There are four basic habits within the palms: trees, shrubs, acaulescent forms, and climbers; although the same terminology is used, these growth forms are not comparable with those of dicotyledons (Dransfield 1978). In the present paper, the growth forms of Bolivian palms were related to the forest strata in which they are found and the diameter they have: trees that occupy the subcanopy and canopy, with stems that are more than 5 cm in diameter; shrubs that are found in the understory and have stems less than 5 cm in diameter; acaulescent plants with short aerial or subterranean stems; and climbers with elongate, thin, clumped stems and a cirrus, an extended leaf rachis with reflexed spines, for adhering to the branches or leaves of surrounding plants. Tree palms are the most common life form among Bolivian taxa with 39 species (46%); shrub palms occupy second place with 35 species (42%); acaulescent palms are represented with seven species (7%), and climbing palms occupy fourth place with three species (4%) (see Appendix I). The tallest palm trees found in Bolivia are *Mauritia flexuosa*, *Oenocarpus bataua*, *Iriartea deltoidea*, and *Syagrus sancona* which reaches up to 20–25 m in height, while *Parajubaea torallyi* (Fig. 1) has been recorded up to 27 m in height. The smallest palm species are only 50 cm tall and are *Wendlandiella gracilis* and *Chamaedorea pinnatifrons*.

Trithrinax, *Mauritiella*, *Oenocarpus mapora*, *Hyospathe elegans*, *Desmoncus*, *Bactris*, *Chelyocarpus*, and some species of *Geonoma* and *Astrocaryum* have clumped stems; while the majority of Bolivian palms are single stemmed. According to the basic architectural models of Hallé and Oldeman (1970), Bolivian palms are mostly represented by the unbranched polycarpic or Corner's model; only *Allagoptera leucocalyx* belongs to the dichotomously branched or Schoute's model. Some tree palms, such as *Acrocomia aculeata*, *Dictyocaryum lamarckianum*, and *Iriar-*

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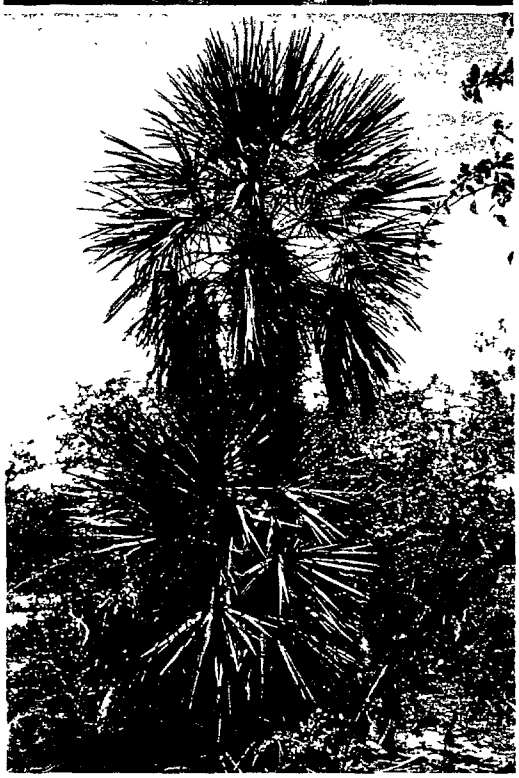


1. Upper left, *Parajubaea torallyi*, an endemic tree palm 27 m in height and distributed in dry interandean forests up to 3400 m. 2. Above, a two-ranked crown palm species, *Oenocarpus distichus*, found in northeastern Bolivia. 3. Left, the "sao" palm, *Trithrinax campestris*, a keystone species in extreme dry thorn vegetation from the Gran Chaco region.

Table 1. Generic and specific diversity of Bolivian palms, related to altitude.

Altitude (m)	Genera (% of total)	Species (% of total)
140–500	22 (81%)	66 (79%)
500–1 000	16 (59%)	28 (33%)
1 000–1 500	5 (19%)	10 (12%)
1 500–2 000	4 (15%)	11 (13%)
2 000–2 500	3 (11%)	10 (12%)
2 500–3 000	2 (7%)	7 (8%)
3 000–3 500	2 (7%)	3 (4%)

tea deltoidea are characterized by stems swollen in the medial part. The Iriarteinae and *Wettinia augusta* have stilt roots, which can be either smooth or spiny.

Leaf Types

Pinnate leaves are found in 94% of Bolivian palms (see Appendix I). Among the pinnate-leaved palms, *Hyospathe*, nine species of *Geonoma*, *Wendlandiella*, two species of *Chamaedorea*, and four species of *Bactris* have trijugate leaves. Praemorse and grouped pinnae are found among the Iriarteinae and *Aiphanes aculeata*. *Chamaedorea angustisecta*, *Attalea butyracea*, *A. speciosa*, *Bactris major*, *Parajubaea torallyi*, *Phytelephas macrocarpa*, and the Euterpeinae have regularly spaced pinnae arranged in one plane, while the remaining Bolivian species (66%) have pinnae distributed in groups and arranged in one plane or in all directions. *Oenocarpus distichus* is unique in its crown of leaves arranged in two ranks (Fig. 2).

Three genera, *Copernicia*, *Trithrinax*, and *Chelyocarpus*, have induplicate palmate leaves, while *Mauritia* and *Mauritiella* have reduplicate costapalmate leaves.

Ecology

The preferences of palms for some habitat, microclimate, soil fertility, and water relation features still remain poorly understood (Tomlinson 1979). It is not easy to delimit the distribution of genera and species in Bolivia, but there are geographic tendencies that can be discerned for some palms.

Soil Types

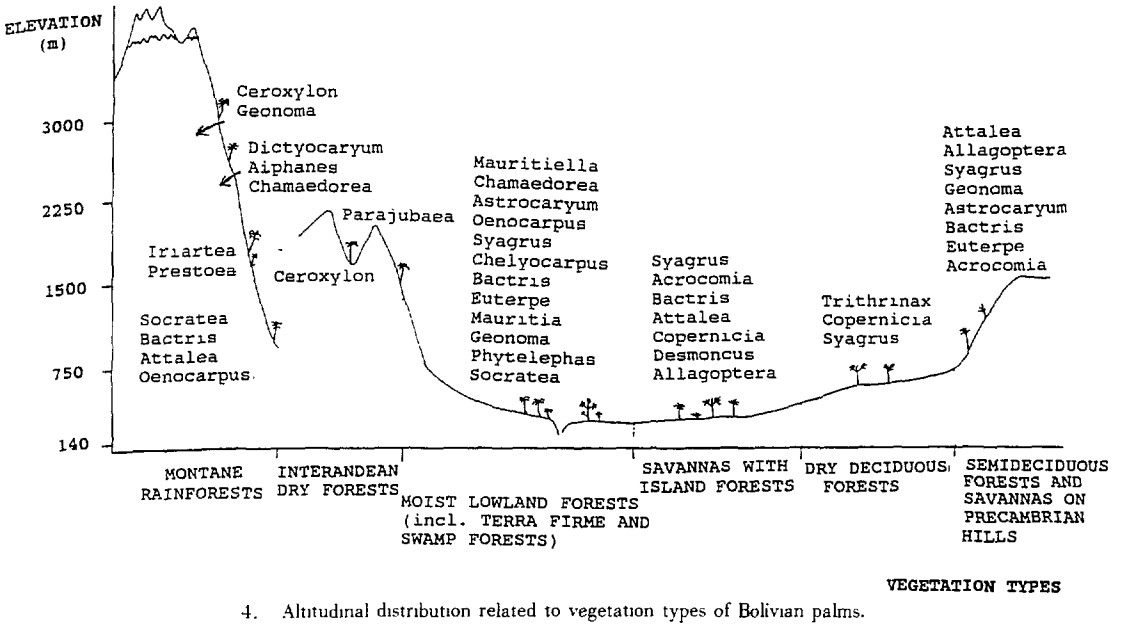
The distribution patterns for certain taxa shows some adaptations that are related to soil conditions, such as drainage and formation (see Appendix I). For example, *Geonoma deversa* is mostly found in alluvial premontane Andean forests as well as in the lowlands with well-drained sandy soils, while *Mauritia flexuosa* is restricted to inundated forests or poorly drained swamps with black water. *Copernicia alba* occurs in seasonally flooded savannas, while *Allagoptera leucocalyx* has been documented only in well-drained savannas. *Bactris riparia*, *Attalea butyracea*, and *Chelyocarpus chuco* are found only in rich soils of humid riparian forests. *Attalea speciosa* is dominant in lowland forests on well-drained and rocky substrates. *Ceroxylon*, *Dictyocaryum lamarckianum*, *Geonoma weberbaueri*, *Oenocarpus bataua*, *Parajubaea torallyi*, *Prestoea acuminata*, and *Syagrus* sp. (*S. yungasensis*, Moraes 1996b) are more adapted to colluvial soils than the majority of other Bolivian palms, which are mostly found on alluvial soils.

Precipitation

Most Bolivian palms grow in humid areas where the annual precipitation is between 700 and 2000 mm. Nonetheless, some species are adapted to extreme arid conditions, as *Trithrinax campestris* (Fig. 3), which is found in xerophytic thorn forests where the rains do not exceed 300–400 mm per year. Similarly, the genus *Parajubaea* is distributed in dry interandean valleys with less than 500 mm per year.

Altitude

The altitudinal distribution of Bolivian palms shows its highest diversity between 140 and 500 m with 22 genera (81% of total) and 66 species (79% of total) which are enriched with Andean and Amazonian elements (Table 1). In the lowland tropics altitude ranges from 140 to 1000 m where the vast majority of forest vegetation has one to several conspicuous palm taxa (Fig. 4, Appendix I). Between 500 and 1000 m *Allagoptera leucocalyx*, *Astrocaryum campestre*, *Attalea speciosa*, and *Syagrus petraea* are found on the Precambrian hills. In the premontane humid forests from 300 to 1000 m are found *Aiphanes aculeata*, *Chamaedorea leonis*, *Oenocarpus bataua*, and *Syagrus sancona*. From 1000 to 3500 m the *Yungas* montane forests are characterized by the presence of *Ceroxylon parvum*, *Geonoma weberbaueri*, while *Parajubaea torallyi* and *Parajubaea* sp. (*P. sunkha*, Moraes 1996b) are found in the interandean valleys between 2700 and 3400 m.



4. Altitudinal distribution related to vegetation types of Bolivian palms.

Vegetation

Bolivian palms are present in a wide range of vegetation types, ranging from humid forests to savannas and wetland habitats (Fig. 4, Appendix 1). Palms are found in montane rainforests, interandean dry forests, moist lowland forests (including inundated forests, swamp forests, "terra firme" forests), and semideciduous forests on laterite crusts and granite outcrops. Different types of savannas, granite valleys, river borders, and montane scrubs are also among the habitats of Bolivian palms. Twelve genera are represented in the undulating terrain forests; 11 genera in montane forests; seven genera are found in savannas with island forests; two genera in interandean dry forests; while three genera grow in the deciduous forests of the seasonal tropics and subtropical lowlands, and eight genera are found in semideciduous forest and savannas on Precambrian hills.

The most common species in the humid lowland forests are *Attalea phalerata* (Fig. 5), *A. speciosa*, *Acrocomia aculeata*, *Astrocaryum murumuru*, *Euterpe precatoria*, *Oenocarpus bataua*, *Socratea exorrhiza*, and *Syagrus sancona*. *Astrocaryum jauari*, *Attalea butyracea*, *Bactris riparia*, *B. major*, *Chelyocarpus chuco*, and *Syagrus sancona* are riparian species. In humid forests of Andean slopes are found *Aiphanes aculeata*, *Ceroxylon* spp., *Dictyocaryum lamarckianum*, *Geonoma lindeniana*, *G. weberbaueri*, *Iriartea deltoidea*, and *Prestoea acuminata*. The forests of the Andean foothills and piedmont are characterized by *Iriartea deltoidea*, *Oenocarpus mapora*, and *Phytelephas macrocarpa*, while *Socratea salazarii*, *Wendlandiella gracilis*, and *Wettinia augusta* are more frequent near the border with Peru.

Parajubaea sp. (*P. sunkha*, Moraes 1996b) and *P. torallyi* are characteristic of interandean dry forests in central mountains from eastern Andean slopes.

Well-drained woody savannas (i.e., Cerrado) and other open areas frequently have *Allagoptera leucocalyx*, *Syagrus cardenasii*, and *S. petraea*. Island forests are dominated by *Attalea phalerata*, although sometimes *Syagrus sancona* is common, and *Desmoncus polyacanthos* is common in the margins of forests islands in savannas subjected to seasonal inundation. *Copernicia alba* dominates seasonally flooded savannas, and sometimes is mixed with *Trithrinax campestris* in flooded low spiny forests in Gran Chaco region.

In general, palm species are found growing in mixed populations in the same general type of vegetation; however, they are distributed within these formations according to their adaptation to specific soil and light conditions. In general, spe-

5 Left. A common and widespread palm species, *Attalea phalerata*, in humid forests. 6. Right. *Chamaedorea linearis*, an understory palm with trijugate leaves.

cies demonstrate a regional pattern of association; for example the Amazonian taxa *Euterpe precatoria*, *Socratea exorrhiza*, *Oenocarpus bataua*, and *Mauritia flexuosa* tend to occur together and their distribution is similar to that observed in Perú (Kahn and Mejía 1990). But in most cases, individual palm species do not show a strict pattern of association among themselves. *Iriartea deltoidea* and *Euterpe precatoria* occur together in humid premontane forests in well-drained soils of the Andes piedmont. With increasing elevation, *Iriartea deltoidea* becomes rare while the montane species *Dictyocaryum lamarckianum* increases in frequency; nonetheless, *Euterpe precatoria* is uniformly dispersed up to ≈ 1000 m.

In some cases monotypic stands of certain palm species are key elements of vegetation types. For example forests occupied by *Attalea speciosa* (locally known as "cusi") are called "cusales" due to the high frequency and density of this species. Other examples of "palmares" or forest habitats with high densities of a particular species are the "siyeyi" (*Chamaedorea angustisecta*), "motacú" (*Attalea phalerata*), "jatata" (*Geonoma deversa*), "palma real" (*Mauritia flexuosa*), "asaí" (*Euterpe precatoria*), "totaí" (*Acrocomia aculeata*), "copa" (*Iriartea deltoidea*), "majillo" (*Oenocarpus mapora*), and "pachiuba" (*Socratea exorrhiza*). *Copernicia alba* or "palma blanca" is a savanna species that occurs in large numbers in the seasonally inundated landscapes west of the Mamoré river in the Beni area.

Stratification

Many vegetation types show distinct strata, which are occupied by different palm species and genera mostly according to the following pattern (see also Appendix I):

Understory (0.3–2.5 m). *Bactris* spp., *Chamaedorea* (Fig. 6), *Geonoma* spp., *Hyospathe elegans*, *Wendlandiella gracilis*, *Astrocar-*

yum campestre, Attalea eichleri, Desmoncus

Intermediate level (3–12 m). Astrocaryum murumuru, A. huaimi, A. jauari, A. aculeata, Aiphanes aculeata, Bactris gasipaes, B. riparia, Ceroxylon spp., *Geonoma weberbaueri, Trithrinax campestris, Chelyocarpus chuco, Oenocarpus, Wettinia augusta, Phytelephas macrocarpa, Prestoea acuminata*

Subcanopy and canopy (13–25 m). Attalea maripa, A. phalerata, A. speciosa, Dictyocaryum lamarckianum, Euterpe precatoria, Iriartea deltoidea, Oenocarpus bataua, Socratea exorrhiza, Syagrus sancona,

In open vegetation, with only one strata, palms that reach 0.4–2.5 m are *Allagoptera leucocalyx, Syagrus petraea, S. cardenasii*; *Acrocomia aculeata, Copernicia alba, Mauritiella armata,* and *Parajubaea* sp. (*P. sunkha*, Moraes 1996b) reach 3–12 m; *Mauritia flexuosa* reaches 13–20 m. and *Parajubaea torallyi* up to 27 m.

Biogeography

The majority of the palms (54%) are native to the Amazonian region (Fig. 7, Appendix I). This region is followed in importance in diversity by the Andes where 29% of all Bolivian palm species are known to occur. The Cerrado is represented with 7% and the Chaqueñan with 2% of all species. Species occurring in mixed transitional regions with widespread ranges that have affinities with more than one region are represented by 8% of all species. *Euterpe precatoria*, for instance, is distributed in the lowland Amazonian forest, as well as in the mountains of the Andes.

Many palms reach the southern limit of their distribution in Bolivia. This is the case for Amazonian species, such as *Bactris glaucescens* (Moraes and Sarmiento 1992), *Chelyocarpus chuco*, and *Geonoma deversa*, as well as for some Andean taxa, such as *Ceroxylon, Dictyocaryum*, and *Aiphanes*. Chaqueñan species like *Copernicia alba* meet in Bolivia their northernmost limit of distribution (Moraes 1991), as well as *Trithrinax campestris*. Also some species from the Cerrado, such as *Allagoptera leucocalyx* and *Syagrus petraea*, have their westernmost range of distribution in Bolivia.

Endemism

Four species are known to be endemic to Bolivia (see Appendix I). Both *Parajubaea* sp. (*P. sunkha*, Moraes 1996b) and *P. torallyi* grow in moist ravines in the dry interandean valleys of the eastern Cordillera of northwestern Potosí, southwestern Santa Cruz, and northeastern to southwestern Chuquisaca Departments. *Syagrus cardenasii* is distributed over a wider area in dry thorn vegetation in the subandean belt from Santa Cruz towards the south. *Syagrus* sp. (*S. yungasensis*, Moraes 1996b) is restricted to a narrow rocky valley in the montane vegetation near La Paz.

Discussion

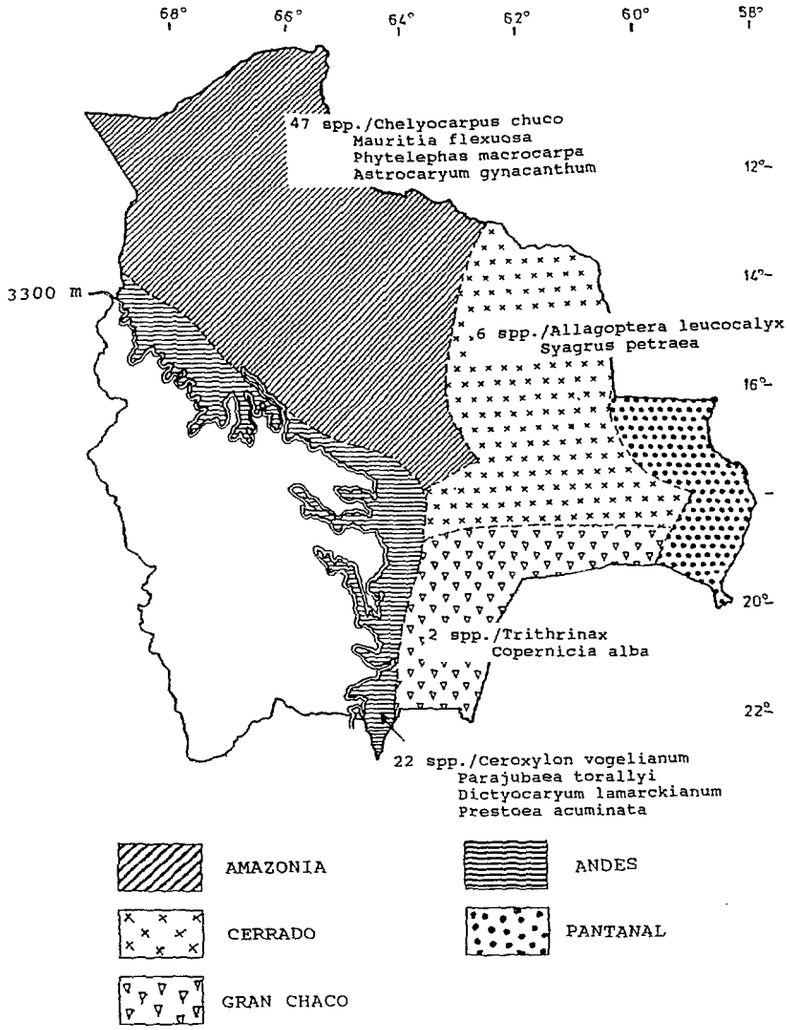
Bolivia is one of the most diverse countries in the Neotropics; this diversity is reflected in the presence of 27 genera, which represents 40% of all South American palm genera according to the inventory of Henderson, Galeano, and Bernal (1995).

The total of 84 palm species is not comparable to other richer Neotropical palm floras such as Colombia with 247 species (Galeano 1992), Ecuador with 124 species (Balslev and Barfod 1987) and Peru with 140 species (Kahn and Moussa 1994). It is slightly richer than palm flora of the Guiana, which has 82 palm species (Granville 1992).

Whether present in mixed palm forests or in monotypic stands, palms are one of the most useful floristic elements in the physiognomic recognition of ecosystems in Bolivia. Their geographic range occupies the majority of the territory of Bolivia. The variety of life forms and other vegetative characteristics enrich the structural diversity of Bolivian forests.

Bolivian palms are found in several types of forests and open vegetation, as well as in the "marginal" habitats described by Granville (1992) and in transitional zones between different types of vegetation. Their abilities to colonize disturbed habitats and unstable conditions provide them with opportunities to become established in ecologically limited spaces sometimes not available to other plant groups.

The limits of species distribution are not strictly correlated with the four major phytogeographic units of Bolivia; nonetheless, the Bolivian palms tend to be distributed in one of the major units. The most species-rich altitudinal range is between 140 and 500 m with 22% of the genera and 66% of the species. Most Bolivian palms (54%) have affinities with the Amazon region and with the



7. Map of phytogeographic units of Bolivia, based on the presence of palms with the altitudinal limit of 3300 m elevation.

Andean (29%), while fewer species have originated in the Chaqueñan, or Cerrado regions.

Many regions in Bolivia remain poorly known and further surveys are needed to get a more complete and integrated view of the biology of the palms. The conservation of this important natural resource is a priority for Bolivian natural resource managers.

Acknowledgments

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Appendix I. Checklist of Bolivian palms with their biogeographic affinities, stem, life form, leaf type, and their distribution related to altitude, soil, stratification, and vegetation types.[a]

Taxa	BG	Stm	Lf	Lt	Elev.	Soil	Str.	Veg.
Subfamily Coryphoideae								
Tribe Corypheae								
Subtribe Thrinacinae								
Trithrinax campestris (Burmeister) Drude	CH	S-C	T	Pa	250–800	A/Fs	M	Df
Chelyocarpus chuco (Mart.) H. E. Moore	AM	S-C	T	Pa	140–200	A/Fp	Cn	Mlf
Subtribe Livistoninae								
Copernicia alba Morong ex Morong	CH	S	T	Pa	250–400	A/Fs	M-Cn	Sv-Df
Subfamily Calamoideae								
Tribe Lepidocaryeae								
Mauritia flexuosa L.f.	AM	S	T	Cp	140–900	A/Fp	Cn	Az
Mauritiella armata (Mart.) Burret	AM	C	T	Cp	140–500	A/Fp	M	Mlf
Subfamily Ceroxyloideae								
Tribe Ceroxyleae								
Ceroxylon parvifrons (Engel) H. Wendl.	AN	S	T	Pi	2 000–3 000	C/Wd	M	Mf
Ceroxylon parvum Galeano	AN	S	T	Pi	2 000–3 000	C/Wd	M	Mf-If
Ceroxylon vogelianum (Engel) H. Wendl.	AN	S	T	Pi	1 800–3 200	C/Wd	Cn	Mf
Tribe Hyophorbeae								
Chamaedorea angustisecta Burret	OT	S	Sh	Pi	250–800	A/Wd	U	Mf-Mlf
Chamaedorea linearis (Ruiz & Pav.) Mart.	AN	S	Sh	Pt	300–600	A/Wd	U	Mlf
Chamaedorea pauciflora Mart.	AM	S	Sh	E	150–400	A/Fs	U	Mlf
Chamaedorea pinnatifrons (Jacq.) Oerst.	AN	S	Sh	Pt-E	250–2 500	A/Wd	U	Mlf
Wendlandiella gracilis Dammer	AN	C	Sh	Pt-E	250–400	A/Wd	U	Mlf
Subfamily Arecoideae								
Tribe Iriarteinae								
Dictyocaryum lamarckianum (Mart.) H. Wendl.	AN	S	T	Pr	1 000–2 000	C/Wd	Cn	Mf
Iriartea deltoidea Ruiz & Pav.	AN	S	T	Pr	200–1 200	C-A/Wd	Cn	Mf-Mlf
Socratea exorrhiza (Mart.) H. Wendl.	AM	S	T	Pr	150–900	A/Fp-Fs	Cn	Mlf
Socratea salazarii H. E. Moore	OT	S	T	Pr	300–500	C/Wd	M	Mlf
Tribe Wettiniinae								
Wettinia augusta Poepp. & Endl.	AN	S-C	T	Pi	300–500	A/Wd	M	Mlf
Tribe Areceae								
Subtribe Euterpeinae								
Euterpe precatoria Mart.	OT	S	T	Pi	140–2 000	A-C/Fp	Cn	Mf-Pf
Prestoea acuminata (Willdenow) H. E. Moore	AN	S	T	Pi	800–1 000	C/Wd	M	Mf
Oenocarpus bataua Mart.	OT	S	T	Pi	140–1 200	C-A/Fs	Cn	Mf-Mlf
Oenocarpus distichus Mart.	AM	S	T	Pi	140–250	A/Wd	Cn	Mlf
Oenocarpus mapora H. Karst.	AM	C	T	Pi	140–800	C-A/Fs	M	Mf-Mlf
Hyospathe elegans Mart.	AN	S-C	Sh	Pt	250–600	A/Wd	U	Mlf
Tribe Cocoeae								
Subtribe Butinae								
Syagrus cardenasii Glassman (*)	CE	S-C	Ac	Pi	250–600	A/Wd	U	Df
Syagrus petraea (Mart.) Becc.	CE	S-C	Ac	Pi	300–800	C/Wd	U	Ps
Syagrus sancona H. Karst.	OT	S	T	Pi	200–1 000	C-A/Wd	Cn	Mf-Mlf
Syagrus (*S. yungasensis*, Moraes 1996b) (*)	CE	S	T	Pi	700–1 000	C/Wd	M	Mf
Syagrus 1 cf. *S. oleracea* (Mart.) Becc.	CE	S	T	Pi	?	C/Wd	M	Ps
Syagrus 2 cf. *S. comosa* (Mart.) Mart	CE	S	Sh	Pi	?	C/Wd	M	Ps
Parajubaea torallyi (Mart.) Burret (*)	AN	S	T	Pi	2 700–3 400	C/Wd	Cn	If
Parajubaea sp. (*P. sunkha*, Moraes 1996b) (*)	AN	S	T	Pi	1 700–2 200	C/Wd	Cn	If
Allagoptera leucocalyx (Drude) Ktze.	CE	S-C	Ac	Pi	250–800	A/Wd	U	Sv-Ps
Subtribe Attaleinae								
Attalea butyracea (Mutis ex L.f.) Wess. Boer	AM	S	T	Pi	140–400	A/Fp	M-Cn	Mlf
Attalea eichleri (Drude) Henderson	AM	S	Ac	Pi	300–500	A/Wd	U-M	Pf
Attalea maripa (Aubl.) Mart.	AM	S	T	Pi	200–400	A/Wd	Cn	Mlf
Attalea phalerata Mart. ex Spreng.	AM	S-C	T	Pi	250–900	A-C/Wd	M-Cn	Mf-Mlf-S
Attalea speciosa Mart. ex Spreng.	AM	S	T	Pi	300–500	A/Wd	Cn	Pf

Appendix I. Continued.

Taxa	BG	Stm	Lf	Lt	Elev.	Soil	Str.	Veg.
Subtribe Bactridinae								
Acrocomia aculeata (Jacq.) Lodd. ex Mart.	OT	S	T	Pi	250–400	A/Fs	M	Sv
Aiphanes aculeata Willd.	AN	S	T	Pr	200–800	C-A/Wd	M	Mf-Mlf
Bactris acanthocarpa (Mart.) Henderson	AM	C	Sh	Pi	200–300	A/Fp	U	Mlf
Bactris brongniartii Mart.	AN	C	Sh	Pt	140–250	C/Wd	U	Mlf
Bactris concinna Mart.	AM	C	Sh	Pi	140–500	A/Fp	U	Mlf
Bactris elegans Barb. Rodr.	AM	C	Sh	Pi	140–250	A/Fp	U	Mlf
Bactris faucium Mart.	AN	C	Sh	Pt	400–600	A Fp	U	Mlf
Bactris gasipaes Kunth	OT	S-C	T	Pi	200–400	A/Fp	Cn	Mlf
Bactris glaucescens Drude	AM	S-C	Sh	Pi	200–300	A/Fp	U-M	Mlf
Bactris hirta Mart.	AM	S-C	Sh	Pi-E	140–250	A Fp	U	Mlf
Bactris macana (Mart.) Pittier	AN	S-C	Sh	Pi	300–800	C/Wd	U	Mf-Mlf
Bactris major Jacq.	AM	C	T	Pi	140–500	A–C/Fs	M	Mlf
Bactris maraja Mart	AM	S-C	Sh	Pi-E	140–500	A/Fp	U	Mlf
Bactris riparia Mart.	AM	C	T	Pi	140–250	A/Fp	M	Mlf
Bactris simplicifrons Mart.	AM	S-C	Sh	Pt-E	200–400	A/Fp	U	Mlf
Bactris sphaerocarpa Trail	AM	C	Sh	Pt	400–600	A/Fp	U	Mlf
Bactris trailiana Barb. Rodr.	AM	S	Sh	E	140–200	A/Fp	U	Mlf
Desmoncus mitis Mart.	AM	C	Cb	Pc	200–500	A/Fs	U-M	Mlf
Desmoncus orthacanthos Mart	AM	C	Cb	Pc	300–500	A/Fs	U-M	Mlf
Desmoncus polyacanthos Mart.	AM	C	Cb	Pc	140–600	A/Fs	U-M	Mlf
Astrocaryum aculeatum G. Mey.	AM	S	T	Pi	140–200	A/Fs	M-Cn	Mlf
Astrocaryum campestre Mart.	AM	C	Ac	Pi	350–450	A Wd	U-M	Pf-Ps
Astrocaryum gynacanthum Mart.	AM	C	Ac	Pi	140–200	A/Fp	U	Mlf
Astrocaryum huaimi Mart.	AM	S-C	T	Pi	250–400	A/Wd	M	Mlf
Astrocaryum jauari Mart.	AM	C	T	Pi	140–200	A/Fp	M	Mlf
Astrocaryum murumuru Mart.	AM	S-C	T	Pi	250–900	A/Wd-Fs	M	Mf-Mlf
Tribe Geonomeae								
Geonoma brevispatha Barb. Rodr.	AM	S-C	Sh	Pi-Pt	150–1 000	A-C/Wd	M	Mf-Pf
Geonoma brongniartii Mart.	AM	C	Ac	Pi-E	200–750	A/Wd	U	Mf-Mlf
Geonoma densa Linden & H. Wendl.	AM	C	Sh	Pi	1 800–2 500	C. Wd	U	Mf
Geonoma deversa (Poit.) Kunth	AM	C	Sh	Pt	200–500	A/Wd	U	Mf-Mlf
Geonoma dicranospadix Burret	AN	C	Sh	Pi	1 400–1 900	C/Wd	U	Mf
Geonoma interrupta (Ruiz & Pav.) Mart.	AM	C	Sh	Pi-Pt	200–750	A/Wd	U	Mf-Mlf
Geonomas jussieuana Mart.	AN	C	Sh	Pt	1 800–3 000	C/Wd	U	Mf
Geonoma laxiflora Mart.	AM	C	Sh	E	140–200	A/Wd	U	Mlf
Geonoma leptospadix Trail	AM	C	Sh	E	140–200	A/Fs	U	Mlf
Geonoma lindeniana H. Wendl.	AN	S-C	T	Pi	350–600	A-C/Wd	M	Mlf
Geonoma macrostachys Mart.	AM	C	Ac	Pt-E	200–400	A/Wd	U	Mlf
Geonoma n ıma (Poit.) Kunth	AM	C	Sh	Pi-E	200–350	A/Wd	U	Mlf
Geonoma megalospatha Burret	AN	S	T	Pt	1 500–2 200	C/Wd	M	Mf
Geonoma orbignyana Mart.	AN	C	Sh	Pt	1 300–3 000	C/Wd	U	Mf
Geonoma pachydicrana Burret	AN	C	Sh	Pt	1 000–1 600	A-C/Wd	U	Mf
Geonoma spixiana Mart.	AM	C	Sh	Pi	140–400	A Wd	U	Mlf
Geonoma stricta (Poit.) Kunth	AM	C	Sh	Pt	250–600	A Wd	U	Mlf
Geonoma undata Klotzch	AM	C	Sh	Pi	1 400–2 400	C/Wd	U	Mf
Geonoma weberbaueri Dammer ex Burret	AN	S	T	Pi	1 800–3 200	C/Wd	M	Mf
Subfamily Phytelephantoideae								
Phytelephas macrocarpa Ruiz & Pav	AM	SC	T	Pi	200–500	A/Fs	M	Mlf

Abbreviations: Columns: BG = Biogeographic origin†; Stm = stem; Lf = Life form; Lt = Leaf type; Elev. = Altitude; Soil = Formation/drainage; Str. = Strata; Veg. = Vegetation type; * = endemic to Bolivia.

† Based on Henderson (1994), Moraes (1990), Moraes and Henderson (1991), and Moraes et al. (1995).

The options for each column are the following: BG: AN = Andes; AM = Amazonia; CH = Gran Chaco; CE = Cerrado; OT = Others, mixed. Stm: S = Solitary; C = Caespitose. Lf: T = Tree palms; Sh = "Shrubs," Ac = Acaulescents; Cb = Climbers. Lt: Pa = Palmate leaves; Cp = Costapalmate; Pi = Pinnate leaves; Pr = Praemorse or grouped leaves; Pt = Pinnate, trijugate; E = Entire, Pc = Pinnate with cirrus. Soil: A = Alluvial; C = Colluvial / Fp = Permanently flooded; Fs = Seasonally flooded; Wd = Well drained. Str.: M = Medium; Cn = Subcanopy to canopy; U = Understory. Veg.: Az = Azonal, swamp forests and savannas; Df = Dry lowland forests; If = Interandean dry forests: Mf = Montane rainforests; Mlf = Moist lowland forests; Pf = Semideciduous forests on Precambrian hills; Ps = Semideciduous savannas on Precambrian hills; Sv = Savanna with island forests.

Tropical Andean Palms (Arecaceae)

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ABSTRACT

Moraes, Mónica (Herbario Nacional de Bolivia, Instituto de Ecología, Universidad Mayor de San Andres, Casilla 10077 Correo Central, La Paz, Bolivia), Gloria Galeano and Rodrigo Bernal (Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Aptdo. 7495, Bogotá, Colombia), Henrik Balslev (Department of Systematic Botany, Herbarium, Building 137, University of Aarhus, DK-8000 Aarhus C., Denmark), and Andrew Henderson (Institute of Systematic Botany, The New York Botanical Garden, Bronx, New York 10458–5126, U.S.A.). Tropical Andean palms (Arecaceae). Biodiversity and Conservation of Neotropical Montane Forests. 473–487. 1995.—The flora of the tropical Andean highlands above 1000 m includes 85 palm species in 21 genera, or 14% of all Neotropical palms. The Andean palms are composed of lowland elements that ascend the slopes to 1500 m elevation or, rarely, higher and the truly Andean elements (occurring in the belt from 3150 m downward) of which some descend into the lowlands adjacent to the cordillera. Forty-four palm species and two genera, *Ceroxylon* and *Parajubaea*, or 7%, of the Neotropical palm flora are exclusively Andean, i.e., occurring only above 1000 m. Five palm genera have reached their highest diversification in the Andes: *Aiphanes*, *Ceroxylon*, *Dictyocaryum*, *Parajubaea*, and *Wettinia*.

RESUMEN

Moraes, Mónica (Herbario Nacional de Bolivia, Instituto de Ecología, Universidad Mayor de San Andres, Casilla 10077 Correo Central, La Paz, Bolivia), Gloria Galeano and Rodrigo Bernal (Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Aptdo. 7495, Bogotá, Colombia), Henrik Balslev (Department of Systematic Botany, Herbarium, Building 137, University of Aarhus, DK-8000 Aarhus C., Denmark), and Andrew Henderson (Institute of Systematic Botany, The New York Botanical Garden, Bronx, New York 10458–5126, U.S.A.). Tropical Andean palms (Arecaceae). Biodiversity and Conservation of Neotropical Montane Forests. 473–487. 1995.—Las tierras altas de los Andes tropicales, por encima de 1000 m de elevación, albergan 85 especies de palmas, agrupadas en 21 géneros. Esta cifra corresponde aproximadamente al 14% de todas las especies de palmas que crecen en el neotrópico. Esta flora de palmas es una mezcla de elementos de las tierras bajas, que ascienden por las laderas, usualmente hasta no más de 1500 m, y elementos típicamente andinos, algunos de los cuales descienden hasta las tierras bajas adyacentes. El límite superior de las palmas en los Andes tropicales está a 3150 m de elevación. Cuarenta y cuatro especies de palmas (aproximadamente el 7% de todas las especies del neotrópico), y dos géneros, *Ceroxylon* y *Parajubaea*, son exclusivos de las elevaciones superiores a 1000 m. Cinco géneros de palmas han tenido su máxima diversificación en los Andes: *Aiphanes*, *Ceroxylon*, *Dictyocaryum*, *Parajubaea* y *Wettinia*.

Introduction

The palm family includes 200 genera and about 2700 species distributed throughout the tropics of the New World and the Old World. The family is most richly represented in Southeast Asia, where about 1400 species occur; it is most poorly represented in Africa, where only some 120 species occur. The Neotropics are intermediate in terms of species richness. Moore (1973) estimated that there are 837 palm species in South America, but recent studies of several genera suggest that there are fewer (e.g.,

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Skov & Balslev, 1989; Henderson, 1990). Our current estimate is that fewer than 600 palm species occur in South America.

Palms are a family of essentially tropical distribution, so most species not surprisingly are found in the lowlands. In South America, most species occur only in the humid parts. The highlands of South America are, however, by no means poor in palms. In this account we have put together information about the palms occurring in the tropical Andes over 1000 m elevation. This area stretches from Venezuela to Bolivia—an immense piece of land about 4500 km long and 600–700 km broad at the widest parts. In this area, palms are found mostly on the slopes where precipitation is high enough to form wet montane forests, so the actual habitat of tropical Andean palms is a narrower belt along the entire eastern slope from Venezuela to Bolivia and along the northwestern slope from Venezuela to northern Peru. Some species are found in the dry lateral valleys that cut into the slopes and some grow in the inter-Andean valleys, but the majority of species flourish in the wet forests. Of the 81 genera and approximately 600 species of palms known in South America, 21 genera and 86 species occur in the Andes above 1000 m elevation (Table I).

Systematic Position of Tropical Andean Palms

In the most recent system of classification (Uhl & Dransfield, 1987), the palm family was divided into six subfamilies, 14 tribes, and 36 subtribes. The genera occurring in the Andes above 1000 m elevation belong to three subfamilies and six tribes in this system (Table II). Subfamily Ceroxyloideae includes two of the Andean genera (*Ceroxylon*, *Chamaedorea*); 18 genera belong to subfamily Arecoideae, where they are divided among four tribes and six subtribes. A single genus belongs in the subfamily Phytelephantoideae. The genera that have the majority of their species in the high-Andean region—*Ceroxylon*, *Dictyocaryum*, *Wettinia* (including *Catoblastus*), *Parajubaea*, and *Aiphanes*—belong to two subfamilies and three tribes. The palms of the Andes obviously originated along different evolutionary lines. *Ceroxylon*'s nearest relatives (*Oraniopsis*, *Juania*, *Louvelia*, *Ravenea*) are distributed in Australia, Madagascar, the Comores Islands, and the Juan Fernández Islands. The other genera that have most of their species in the Andes are more closely related to lowland Neotropical genera.

KEY TO THE GENERA OF ANDEAN PALMS

1. Spiny palms
   2. Pinnae praemorse . . . . . *Aiphanes*
   2. Pinnae not praemorse
      3. Pinnae whitish below; fruits more than 2.5 cm diam., exocarp yellowish to brownish, brittle; in dry areas below 1300 m . . . . . *Acrocomia*
      3. Pinnae concolorous; fruits less than 2.5 cm diam., exocarp red, orange-red to black-purple, not brittle; in wet forest . . . . . *Bactris*
1. Nonspiny palms (or with only short spines on the stilt roots)
   4. Pinnae praemorse, with several primary veins, undivided or divided into several segments
      5. Pinnae white below, divided into more or less equal segments; stem stout, usually more than 50 cm diam.; eophyll bifid . . . . . *Dictyocaryum*
      5. Pinnae concolorous, if divided then the segments markedly unequal; stem more slender; eophyll bifid or undivided
         6. Stilt roots in a short cone (usually less than 50 cm tall); inflorescences several at each node . . . . . *Wettinia* (incl. *Catoblastus*)
         6. Stilt roots in a cone usually more than 1 m tall; inflorescences solitary at each node
            7. Stilt roots to 100, very tightly disposed; inflorescence buds horn-shaped; eophyll undivided . *Iriartea*
            7. Stilt roots to 30, loosely arranged; inflorescence buds not horn-shaped; eophyll bifid . . . . *Socratea*
   4. Pinnae not praemorse, always undivided
      8. Fruits brown, corky-warted, very closely packed in a globose large head, each with several large seeds; dioecious palms . . . . . *Phytelephas*
      8. Fruits more or less smooth, usually loosely disposed, never in a head; dioecious or monoecious palms
         9. Rachillae pitted (with pits or holes in which the flowers are sunken)
            10. Stout palms up to 10 m tall or more; leaves ascending; rachillae more than 2 cm thick . . . . . *Welfia*
            10. Medium-sized to small palms; rachillae usually less than 1 cm thick
               11. Fruits obovoid, with many conspicuous fibers in mesocarp . . . . . *Pholidostachys*
               11. Fruits not obovoid, without fibers in mesocarp . . . . . *Geonoma*
         9. Rachillae not pitted (the flowers superficial on the rachillae)
            12. Fruits with a bony endocarp with 3 pores
               13. Pinnae white below . . . . . *Parajubaea*

13. Pinnae concolorous
    14. Stem subterranean to very short; pinnae regularly arranged; fruit brownish . . . . . *Attalea*
    14. Stem up to 10 m tall; pinnae irregularly arranged and spreading in different planes; fruit yellow . . . . . *Syagrus*
12. Fruits lacking bony endocarp
    15. Inflorescence several times branched; stems covered with wax; pinnae whitish below; fruit globose, red . . . . . *Ceroxylon*
    15. Inflorescence once-branched; stems without wax; pinnae concolorous or glaucous below; fruit globose to ovoid, red or dark purple to black
        16. Stem bamboolike or canelike, green or brownish
            17. Stem always green; with a yellow central line on the adaxial side of leafsheath, petiole and rachis . . . . . *Chamaedorea*
            17. Stem green or brownish; leaf without a yellow line . . . . . *Hyospathe*
        16. Stem not bamboo-like, brown or grayish, or subterranean
            18. Pinnae glaucous below; inflorescence rachis very short (inflorescence horsetail shaped) . . . . . *Oenocarpus*
            18. Pinnae concolorous; inflorescence rachis elongated (inflorescence not horsetail-shaped)
                19. Leafsheaths elongate, closed, forming a crownshaft; pinnae usually pendulous; prophyll and peduncular bract more or less equal in size and shape . . . . . *Euterpe*
                19. Leafsheaths short and open or, if elongated, then not completely closed, forming an imperfect crownshaft; prophyll and peduncular bract markedly unequal in size and shape . . . . . *Prestoea*

Tropical Andean Palm Genera

ACROCOMIA

Acrocomia contains two species; they are distributed in semiarid regions from the West Indies and Mexico to Argentina (Henderson, in press). *Acrocomia aculeata*, distributed in dry lowlands throughout most of the range of the genus, reaches elevations of 1300 m in the dry inter-Andean valleys of Colombia.

AIPHANES

Aiphanes (Fig. 1) was recently revised by Borchsenius and Bernal (in press) for *Flora Neotropica*. It is characterized by being spiny and having praemorse pinnae. Most species are small to medium-sized, and they may be solitary or cespitose, sometimes with a very short subterranean stem. The genus contains 22 species, distributed along both sides of the Andes and adjacent lowlands from Venezuela to Bolivia. One species is endemic in the Lesser Antilles, and one species reaches western Panama.

Three species of *Aiphanes* occur in relatively dry or seasonal habitats: *A. minima* in the Lesser Antilles; *A. aculeata* on the eastern slopes of the Andes from Venezuela to Colombia and the dry inter-Andean valleys of Colombia and Peru to Bolivia; and *A. eggersi*, which is endemic to the coastal plain of Ecuador. The remaining 19 species are all found in humid or perhumid forests.

The main center of diversity for *Aiphanes* is in western Colombia and Ecuador, where 14 species are found. The remaining species grow on the eastern slopes of the Andes with a secondary center of distribution in northeastern Peru, where four species are found. Species of *Aiphanes* occur from sea level to 2800 m. Above 1000 m, 18 species are found, and seven of those do not grow below that elevation. The species are uncommon, and some have very limited distributions.

ATTALEA

Attalea is a genus of some 29 species distributed from Panama to Brazil and Bolivia, typically in lowland rain forests but also in semiarid habitats in Brazil. The staminate flowers are variable in petal shape and stamen number and type. *Attalea amygdalina* reaches elevations of 1000–1600 m in the middle Río Magdalena valley in Colombia.

BACTRIS

Bactris is one of the largest genera in the Neotropics, with 250 described species. It is distributed from Mexico and the West Indies to Brazil and Paraguay. It is characterized by having the staminate flowers arranged in triads or dispersed among the triads on the rachillae and by having pistillate flowers with united petals. Ecologically *Bactris* is mostly a lowland genus, but within the lowlands it occurs in a variety of habitats. On the Andean slopes, its species quickly fade out, but a few reach above the elevational limit of 1000 m applied here to distinguish Andean species. *Bactris corosilla* is distributed in Venezuela and Colombia on the lower Andean slopes up to 1400 m; *B. macana* is widely distributed from Venezuela to Bolivia, also on the lower Andean slopes up to 1500 m; and *B. setulosa* occurs from Venezuela to Ecuador at elevations up to 1700 m.

TABLE I

Distributional and altitudinal range and geographic origin of species of palms in the tropical Andes (Venezuela-Bolivia) above 1000 m elevation

Species	Distributional range*	Altitudinal range (m)	Geographic origin†
Acrocomia aculeata (Jacq.) Lodd. ex Mart.	Ven-Col, Bol	250–1300	N
Aiphanes aculeata Willd.	Ven-Col, Per-Bol	0–1300	O
A. chiribogensis Borchs. & Balslev	Ecu	1500–2100	A
A. deltoidea Burret	Per	150–1650	A
A. duquei Burret	Col	2000–2600	A
A. erinacea (H. Karst.) H. Wendl.	Col-Ecu	700–2100	A
A. gelatinosa H. E. Moore	Col-Ecu	800–1650	A
A. grandis Borchs. & Balslev	Ecu	1000–2000	A
A. hirsuta Burret	Col-Ecu	0–2200	A
A. leiostachys Burret	Col	0–1100	A
A. lindeniana (H. Wendl.) H. Wendl.	Col	1900–2700	A
A. linearis Burret	Col	1800–2600	A
A. macroloba Burret	Col-Ecu	100–1400	A
A. parvifolia Burret	Col	800–1700	A
A. simplex Burret	Col	800–2200	A
A. spicata Borchs. & Bernal	Per	1800	A
A. ulei (Dammer) Burret	Ecu-Per	150–1850	A
A. verrucosa Borchs. & Balslev	Ecu	2200–2800	A
A. weberbaueri Burret	Ecu-Per	100–1950	A
Attalea amygdalina H.B.K.	Col	1000–1600	A
Bactris corosilla H. Karst.	Ven-Col	0–1400	AM
B. macana (Mart.) Pittier	Ven-Col, Per-Bol	0–1500	O
B. setulosa H. Karst.	Ven-Ecu	0–1700	O
Catoblastus anomalus (Burret) Burret	Col-Ecu	1000–1500	A
C. distichus R. Bernal	Col	1700–2100	A
C. kalbreyeri (Burret) Burret	Col-Ecu	400–2400	A
C. microcarpus Burret	Col	1800–2200	A
Ceroxylon alpinum Bonpland	Ven-Ecu	1400–2000	A
C. ceriferum (H. Karst.) Burret	Ven-Col	2000–2800	A
C. parvifrons (Engel) H. Wendl.	Ven-Bol	2500–3150	A
C. quindiuense (H. Karst.) H. Wendl.	Col	2000–3000	A
C. ventricosum Burret	Col-Ecu	2000–3000	A
C. vogelianum (Engel) H. Wendl.	Ven-Bol	2000–2900	A
C. weberbaueri Burret	Per	1800–2000	A
C. sp. nov. 1	Ecu	900–1200	A
C. sp. nov. 2	Ecu-Per	1800–2000	A
C. sp. nov. 3	Ecu-Bol	1300–1700	A
C. sp. nov. 4	Col	1200–1500	A
Chamaedorea allenii L. H. Bailey	Col	500–1250	CA
C. linearis (Ruíz & Pavón) Mart.	Ven-Bol	50–2800	A
C. pinnatifrons (Jacq.) Oerst.	Ven-Bol	0–2700	N
C. pumila H. Wendl. ex Dammer	Col	400–1500	CA
C. pygmaea H. Wendl.	Col	1000–2000	CA
Dictyocaryum fuscum (Karst.) H. Wendl.	Ven	1000–1800	A
D. lamarckianum (Mart.) H. Wendl.	Ven-Bol	900–2000	A
Euterpe luminosa Henderson, Galeano & Meza	Per	2000–2500	A
E. precatoria Mart.	Ven-Bol	0–2000	N
Geonoma densa Linden & H. Wendl.	Ven-Bol	1800–2500	A
G. dicranospadix Burret	Col-Bol	1400–1900	A
G. euspatha Burret	Col-Bol	400–1400	AM
G. interrupta (Ruíz & Pavón) Mart.	Ven-Bol	0–1500	N
G. jussieuana Mart.	Ven-Bol	1800–3000	A
G. orbignyana Mart.	Ven-Bol	1300–3000	A
G. trigona (Ruíz & Pavón) A. H. Gentry	Per	2600–2800	A
G. undata Klotzsch	Ven-Bol	1400–2400	A
G. weberbaueri Dammer ex Burret	Ven-Bol	1800–3150	A
Hyospathe elegans Mart.	Col-Bol	0–2000	N
H. macrorhachis Burret	Ecu	1000–1850	A

(*continued*)

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TABLE I (*continued*)

Species	Distributional range*	Altitudinal range (m)	Geographic origin†
Iriartea deltoidea Ruíz & Pavón	Col-Bol	0–1900	N
Oenocarpus bataua Mart.	Ven-Bol	0–1350	A
Parajubaea cocoides Burret	Col-Ecu	2500–3000	A
P. torallyi (Mart.) Burret	Bol	1500–2400	A
Pholidostachys synanthera (Mart.) H.E. Moore	Col-Per	0–1300	CA
Phytelephas aequatorialis Spruce	Ecu	0–1500	O
Phy. macrocarpa ssp. *schottii* H. Wendl.	Col	0–1500	O
Prestoea acuminata (Willd.) H. E. Moore	Ven-Bol	1000–2000	A
P. carderi Hook. f.	Ven-Per	1000–1950	A
P. ensiformis (Ruiz & Pav.) H. E. Moore	Col-Per	350–1750	CA
P. simplicifolia Galeano	Col	900–1600	A
Socratea montana Bernal & Henderson	Col-Ecu	900–1800	A
S. rostrata Burret	Col-Ecu	1000–1400	A
Syagrus sancona H. Karst.	Ven-Bol	0–1200	O
Welfia regia H. Wendl.	Col-Ecu	0–1200	CA
Wettinia castanea H.E. Moore & Dransf.	Col-Ecu	1300–1800	A
W. cladospadix (Dugand) H.E. Moore & Dransf.	Col-Ecu	1200–2000	A
W. fascicularis (Burret) H.E. Moore & Dransf.	Col	1500–2000	A
W. hirsuta Burret	Col	400–1300	A
W. longipetala A. Gentry	Per	700–1200	A
W. maynensis Spruce	Col-Per	200–1700	AM
W. oxycarpa Galeano & R. Bernal	Col-Ecu	400–1200	A
W. praemorsa (Willd.) Wessels Boer	Ven-Col	600–2400	A
W. verruculosa H.E. Moore	Col-Ecu	1000–1400	A
W. sp. nov. 1	Ecu	1400–1700	A
W. sp. nov. 2	Col	2100–2600	A

*Bol, Bolivia; Col, Colombia; Ecu, Ecuador; Per, Peru; Ven, Venezuela.
†From Galeano, 1992. A, Andean; AM, Amazonian; CA, Central American; N, widespread Neotropical; O, other.

TABLE II

Systematic position of palm genera occurring in the Andes above 1000 m elevation in the classification of Uhl & Dransfield (1987)

Subfamily Coryphoideae (no tropical Andean genera)
Subfamily Calamoideae (no tropical Andean genera)
Subfamily Nypoideae (no tropical Andean genera)
Subfamily Ceroxyloideae
  Tribe Ceroxyleae: *Ceroxylon**
  Tribe Hyophorbeae: *Chamaedorea*
Subfamily Arecoideae
  Tribe Iriarteeae
    Subtr. Iriarteinae: *Dictyocaryum**, *Iriartea, Socratea*
    Subtr. Wettiniinae: *Wettinia** (inc. *Catoblastus*)
  Tribe Areceae
    Subtr. Euterpeinae: *Euterpe, Prestoea, Oenocarpus, Hyospathe*
  Tribe Cocoeae
    Subtr. Butiinae: *Syagrus, Parajubaea**
    Subtr. Attaleinae: *Attalea*
    Subtr. Bactridinae: *Acrocomia, Aiphanes**, *Bactris*
  Tribe Geonomeae: *Pholidostachys, Welfia, Geonoma*
Subfamily Phytelephantoideae: *Phytelephas*

*Most species developed in the high-Andean zone.

CATOBLASTUS

See *Wettinia*.

CEROXYLON

Ceroxylon (Figs. 2A, 3) contains 11 species; they are distributed along the Andes from Venezuela to Bolivia. The genus is currently under revision by G. Galeano. This is a genus of dioecious palms, with the stems clearly ringed by the leaf scars and covered by a waxy layer on the internodes. This layer gave rise to the name *Ceroxylon* (meaning wax wood) and gives the stems of some species a white appearance. The inflorescences are large and much-branched and produce numerous globular fruits that turn bright red when mature. They are eaten by certain Andean birds such as *Cyanocorax incas*, *Turdus fuscater*, *Aulacorhynchus prasinus*, and *Ara militaris*.

The 11 species of *Ceroxylon* are found in wet to very wet montane forests, usually above 2000 m elevation, although some species descend to the premontane forests or even, in the case of one (undescribed) species, to the upper limits of the humid

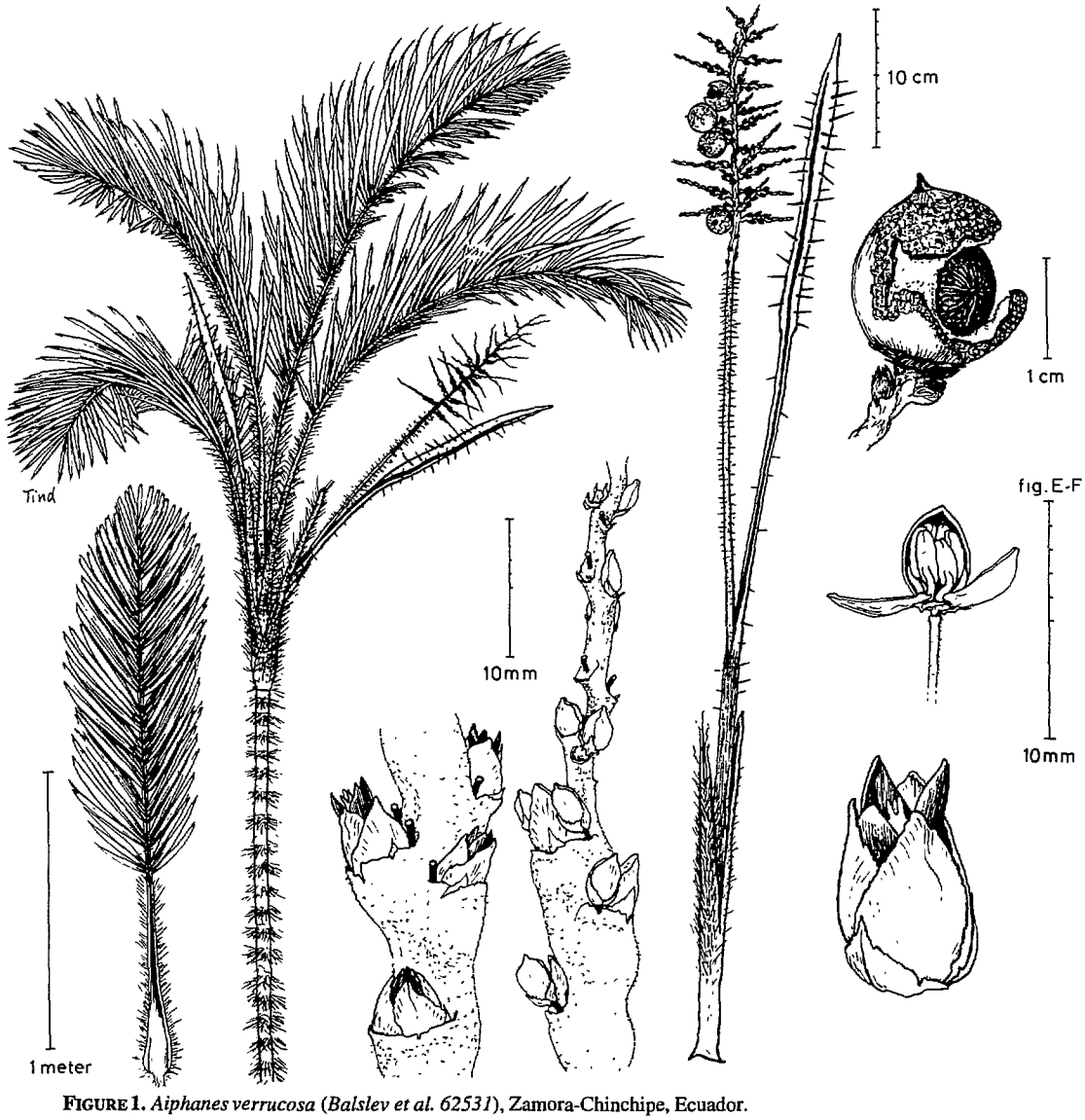

FIGURE 1. *Aiphanes verrucosa* (*Balslev et al. 62531*), Zamora-Chinchipe, Ecuador.

lowland forests. In some areas, the species of *Ceroxylon* are among the most conspicuous elements in the Andean flora.

Different distribution patterns for the species can be recognized. The most common and widespread species through the Andean highlands are *C. vogelianum* and *C. parvifrons*. This latter reaches up to 3150 m elevation, which makes it the highest growing palm in the world (together with *Geonoma weberbaueri*). The remainder of the species have more limited geographic distributions.

Although species of *Ceroxylon* are sometimes the only survivors after deforestation in the Andes, where they are found in cleared areas and pastures, they are among the most threatened elements in the Andean flora. Because of the destruction of their natural habitats, their dioecious breeding system, their slow growth, and their inability to regenerate in open areas, their conservation status is poorer than that of most other Andean plant species. The extreme cases of poor conservation status are found in the species with restricted geographic distributions and in species occurring in areas of strong human influence. *Ceroxylon alpinum*, for example, has its natural distribution in the premontane forests in areas that over the past several decades have been converted almost

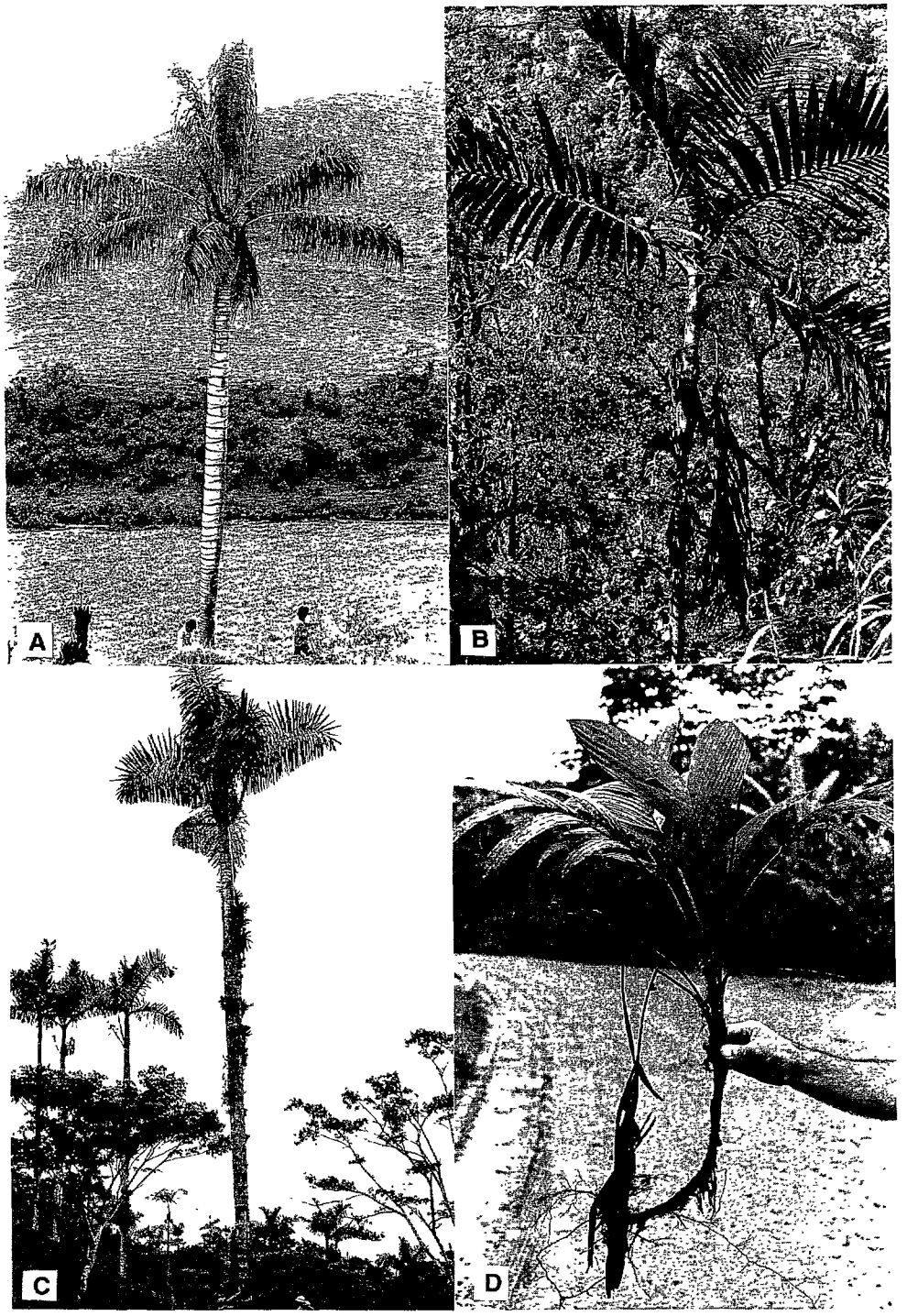

FIGURE 2. (A) *Ceroxylon ventricosum* (*Balslev et al. 62542*) Bolívar, Chillanes, Ecuador. (B) *Chamaedorea linearis* (*Balslev et al. 62008*) Pichincha, Tandapi, Ecuador. (C) *Dictyocaryum lamarckianum* (*Balslev et al. 4293*) Napo, El Chaco, Ecuador. (D) *Hyospathe macrorhachis* (*Balslev et al. 60639*) Morona-Santiago, Ecuador.

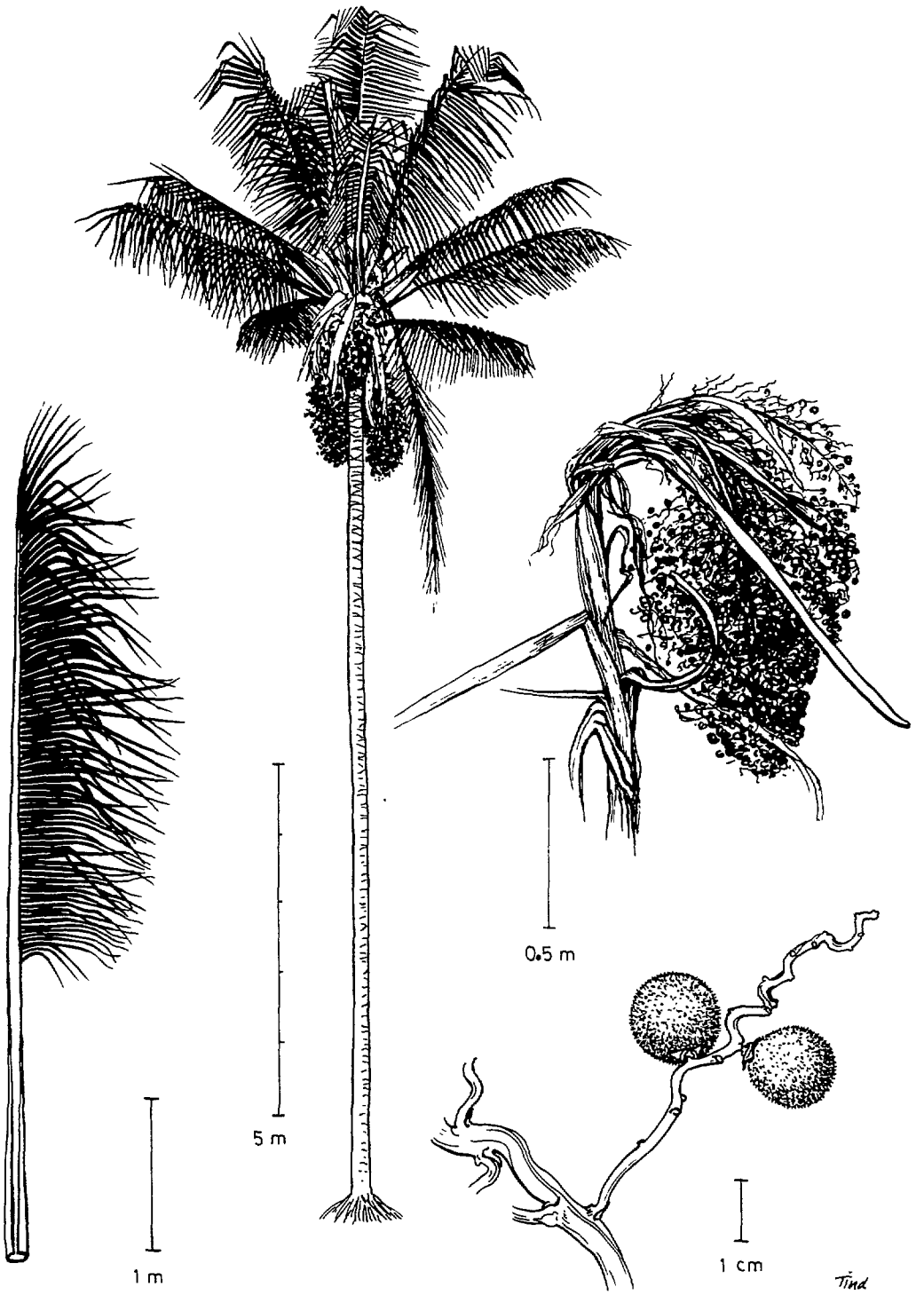

FIGURE 3. *Ceroxylon* sp. nov. (*Balslev et al. 62488*), Napo, Cossanga, Ecuador.

completely to coffee plantations. Because no conservation areas cover this life zone, this species is one of the most threatened by extinction.

The nearest relatives of *Ceroxylon* are *Juania*, an endemic to the Juan Fernández Islands, *Oraniopsis* from northeastern Australia, and *Ravenea* and *Louvelia* from Madagascar and the Comores Islands. These distributions indicate that this group of genera (the tribe Ceroxyleae) probably developed on Gondwanaland and became isolated when South America and Antarctica separated in the Late Cretaceous and Eocene. Within the Ceroxyleae, *Ceroxylon* is most closely related to *Oraniopsis* in Australia (Dransfield et al., 1985). Rather than rafting on continental fragments, *Oraniopsis* may have reached Australia via an austral route along the edge of the Antarctic continent during the Late Cretaceous or Early Tertiary, when land connections existed and when the climate was warmer (Uhl & Dransfield, 1987).

CHAMAEDOREA

In the latest taxonomic revision (Hodel, 1992) *Chamaedorea* contains 96 species. They are dioecious understory palms of rain forests and cloud forests from Mexico to Bolivia. Most species are confined to the lowlands, but six species occur above 1000 m elevation in the Andes and two species are restricted to those elevations. *Chamaedorea pinnatifrons* and *C. linearis* are distributed in the lowlands but also reach up to 2700 and 2800 m, respectively, along the Andes from Venezuela to Bolivia. They are the most common and widespread species of *Chamaedorea* in the Andes.

DICTYOCARYUM

Dictyocaryum contains three species and is distributed from eastern Panama to Bolivia and eastward to the Guayana highlands (Henderson, 1990). It is a large iriarteoid stiltroot palm with praemorse leaf segments, similar to *Iriartea* but with only six stamens in each staminate flower. *Dictyocaryum lamarckianum* (Fig. 2C) is distributed in the Andes from the border between Colombia and Venezuela to Bolivia. It grows in the montane forest at elevations of 1000–2000 m, often in large and relatively dense populations that may be separated by large distances. *Dictyocaryum fuscum* is restricted to the coastal cordillera of Venezuela between 1000 and 1800 m.

EUTERPE

Euterpe contains seven species. It is distributed from the Lesser Antilles and Central America to Brazil and Bolivia (Henderson & Galeano, unpubl.). Most of the species are found in lowland rain forests and swamps, but one species, *E. precatoria*, ascends the Andean slopes from Venezuela to Bolivia to 2000 m elevation. Another species, *E. luminosa*, is restricted to the highlands between 2000 and 2500 m in Peru.

GEONOMA

Geonoma contains about 51 species distributed from Mexico to Brazil and Bolivia. It was last revised by Wessels Boer (1968); however, the taxonomy of many of its species is not clearly defined. The species are monoecious and usually small and solitary. All species are confined to the understory of forests with high rainfall, and most of them are found in the lowlands. Some species, however, reach the highlands above 1000 m, and several of those are confined to high elevations, often with extensive distributions along the Andean slopes from Venezuela or Colombia to Bolivia. Some of them are among the commonest species in the montane forests, e.g., *G. weberbaueri*, *G. undata*, *G. orbignyana*, and *G. jussieuana*. Although *Geonoma* is most species-rich in the lowlands, it is (together with *Ceroxylon*) also the palm genus represented at highest elevations in the Andes, and indeed in the world (*G. weberbaueri*). *Geonoma* is also the best example of a genus in which the highland species are larger than the lowland species. Whereas most of the lowland species have stem diameters of up to 5 cm and heights of 5–6 m, *G. weberbaueri* has stems up to 12 cm in diameter and reaches heights of 13 m.

HYOSPATHE

Hyospathe has one widespread and variable species, *H. elegans*, and one narrowly endemic species, *H. macrorhachis* (Skov & Balslev, 1989). *Hyospathe elegans* is distributed throughout the lowlands from Costa Rica to Brazil and Bolivia and reaches up to 2000 m elevation on both sides of the Andes. *Hyospathe macrorhachis* (Fig. 2D) is confined to the forests of the eastern Andes in Ecuador between 1000 and 1850 m.

IRIARTEA

Iriartea consists of a single species distributed from Nicaragua to Bolivia and reaching into the western half of the Amazon basin (Henderson, 1990). It is easily recognized by a dense cone of numerous black stiltroots, praemorse leaf segments, and horn-shaped inflorescence buds that develop at the nodes below the crownshaft. It reaches 30 m in height and is often an important element in the forest canopy,

sometimes becoming the most abundant tree. Ecologically, *I. deltoidea* is a lowland species, but it ascends the Andean slopes frequently up to 1300 m and occasionally up to 1900 m.

OENOCARPUS

Oenocarpus is a small genus of nine species of middle-sized to large palms, widespread in the wet lowlands of northern South America (Balick, 1986; Bernal et al., 1991). One species, *O. bataua*, reaches the lower Andean slopes; in southeastern Ecuador it is common at elevations of 1100–1200 m and in a few places it grows up to 1350 m (Borgtoft Pedersen & Balslev, 1990).

PARAJUBAEA

Parajubaea has two species. Both occur at high elevations in the Andes (Moraes & Henderson, 1990). *Parajubaea cocoides* (Fig. 4) occurs in southern Colombia and Ecuador at elevations of 2500–3000 m and is peculiar among the Andean palms in being known only in cultivation. It is an important ornamental tree in Andean towns and villages. *Parajubaea torallyi* grows in the dry inter-Andean valleys of central and southern Bolivia at elevations of 1500–2400 m. The widely separated ranges of these two species and the fact that one is known only in cultivation are peculiar. A possible explanation is that the genus evolved in Bolivia and that *P. cocoides* originated from introduction and continued cultivation in southern Colombia and Ecuador.

PHOLIDOSTACHYS

Pholidostachys, with three species, is a genus of moderately sized palms in the understory of the rain forests between Costa Rica and Peru (Wessels Boer 1968; Uhl & Dransfield, 1987). The flowers are sunken into thick rachillae and differ from related genera in the tribe Geonomeae in having an androecium of six stamens with filaments united into a tube basally and being free and awl-shaped distally. All species occur in the lowlands, but *P. synanthera* reaches up to 1300 m elevation on the Andean slopes from Colombia to Peru.

PHYTELEPHAS

Phytelephas, distributed from Panama to Bolivia, has four species (Balslev & Moraes, 1989; Barfod, 1991). They are dioecious with long-pendulous, staminate inflorescences up to 2 m long. The infructescences are highly characteristic in being globular and up to 40 cm in diameter with large warty fruits. They are famous for producing the vegetable ivory, which is the seed endosperm. *Phytelephas aequatorialis* is distributed on the coastal plain of Ecuador and reaches up to 1500 m elevation in the valleys on the western Andean slopes. *Phytelephas macrocarpa* ssp. *schottii* is distributed in the Río Magdalena valley in Colombia, where it reaches up to 1500 m elevation.

PRESTOEA

Prestoea is made up of small to medium-sized palms in the rain forests from Nicaragua and the West Indies to Peru. It usually grows at high elevations (1000–1950 m) but may be found as low as 350 m. The genus is closely related to *Euterpe*, and the distinction between the two is not clear. The genus is currently being revised by Galeano and Henderson. There are four species of *Prestoea* in the Andes; the most widespread, *Prestoea acuminata*, is distributed in the Andes from Venezuela to Peru at elevations of 1000–3000 m.

SOCRATEA

Socratea is distributed from Nicaragua to Bolivia and throughout the Amazon basin to Belém. It contains five species of which one is widespread and covers the range of the genus. The remaining four species occur in the Andean region and have narrower distributions; they consist of two species pairs, one on each side of the Andes. In the Andes, northern Ecuador, and Pacific Colombia, *S. montana* occurs in the montane forests at elevations of 900–1800 m. *Socratea rostrata* is found in the montane forests in Ecuador at elevations of 1000–1400 m (Henderson, 1990).

SYAGRUS

Syagrus is a genus of treelike or acaulescent palms, mostly confined to dry or semiarid areas. Its 32 species are distributed from Venezuela to Argentina, and one species reaches the Lesser Antilles. It is nonspiny, except for a couple of species (*S. schizophylla*, *S. vagans*) that have thorny petioles. The leaves are pinnate, and the inflorescences have staminate and pistillate flowers, the staminate ones bearing six stamens. Ecologically, it is a typical lowland group, but one species, *S. sancona*, reaches elevations up to 1200 m in the drier valleys from Venezuela to Bolivia.

WELFIA

Welfia is a genus of moderately sized to large palms with thick rachillae in which the flowers are sunken

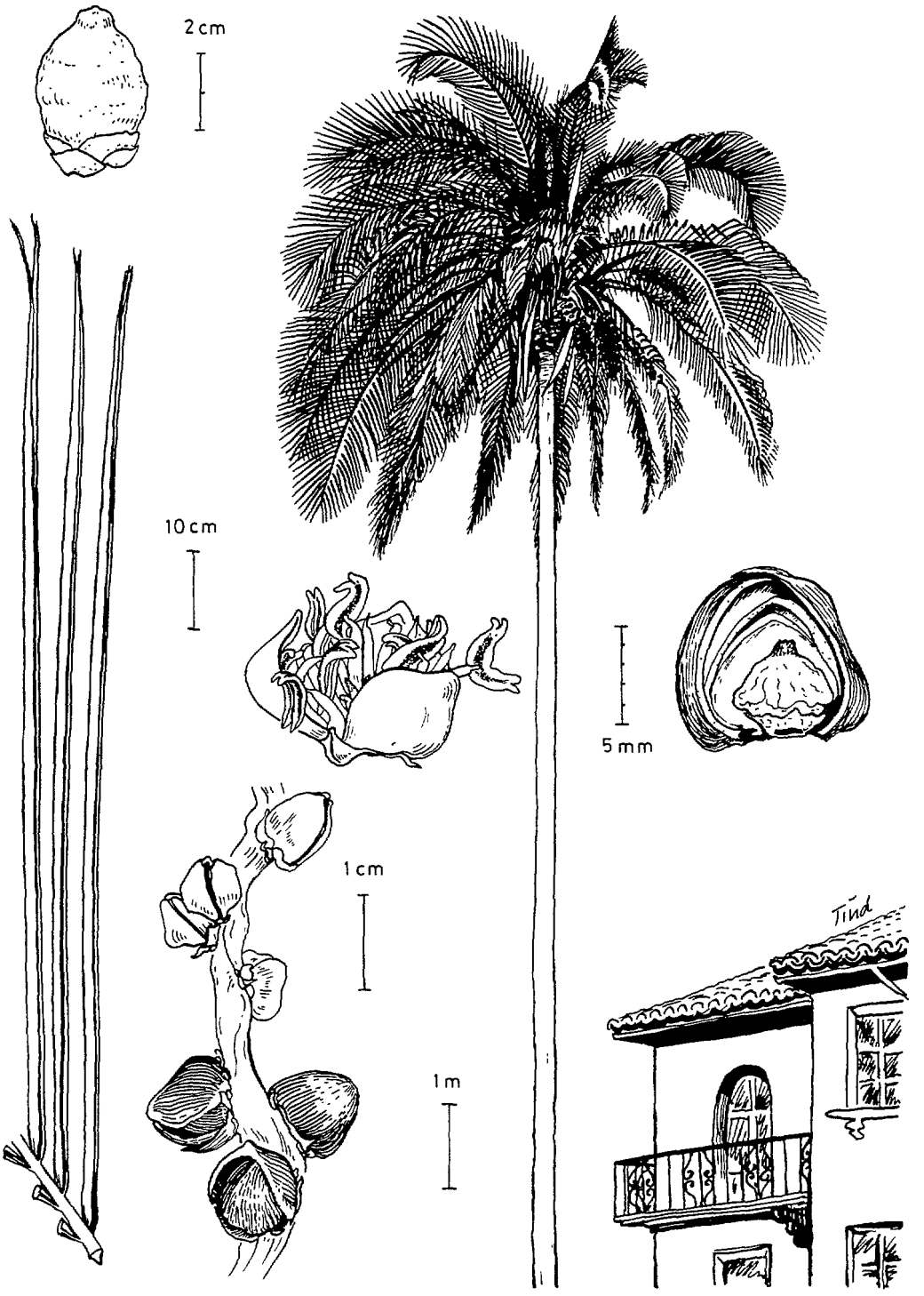

FIGURE 4. *Parajubaea cocoides* (*Padilla 2031*), Quito, Ecuador.

into pits as in other genera in Geonomeae. The genus differs from other genera in the tribe by its numerous stamens with filaments united into a tube basally but free and fleshy distally. The latest revision of the genus (Wessels Boer, 1968) contains two species. *Welfia georgii* is distributed from Honduras to western Colombia below 650 m elevation, and *W. regia* is distributed on the western Andean slopes in Colombia between 1000 and 2000 m elevation. In our opinion, these entities are not different and should be united under the oldest name, *W. regia*. Its distribution is now also known to reach into western Ecuador (Balslev & Barfod, 1987).

WETTINIA AND CATOBLASTUS

Wettinia (Figs. 5, 6) and *Catoblastus* are closely related. Wessels Boer (1988) suggested that they should be united, and recent monographic work by R. Bernal (unpubl.) suggests that the generic separation of the two cannot be maintained. For this reason, the species of these genera are treated under *Wettinia*, although some of the species of *Catoblastus* have not yet been formally transferred to *Wettinia*.

The genus differs from other members of the tribe Iriarteeae by having unisexual inflorescences that are usually inserted several at each node and staminate flowers that are usually open in the bud. It includes species of medium to large size, and the stems are usually solitary.

Wettinia is distributed along the Andes and adjacent lowlands from Venezuela to western Bolivia. Of its 22 species, 15 are found at elevations above 1000 m, 9 of which are found only above that limit.

On the western slopes of the Colombian Andes, three closely related species occur at different elevations. *Catoblastus kalbreyeri* usually grows at elevations of 1000–1700 m but rarely descends to 400 m or ascends to 2400 m. In certain places where cloud forest has developed, *C. kalbreyeri* is replaced by *C. distichus* in the zone between 1700 m and 2100 m, and this species is then abruptly displaced by an undescribed species (also with distichous leaves) at elevations of 2400–2600 m. On the eastern slopes of the Andes, two species groups display a similar pattern of adaptation to different elevations.

Conclusions

The palm flora of the tropical Andes originated along several lines, through evolution and migration. Most of the Andean species belong to genera that are more species-rich in the surrounding lowland areas. In many cases, the genera best developed in the lowlands have given rise to species that are confined to the highlands above 1000 m.

Three Andean genera have diversified strongly within the Andes: *Ceroxylon*, *Wettinia*/*Catoblastus*, and *Aiphanes*. *Ceroxylon* has it nearest relatives in Australia, the Juan Fernández Islands, and Madagascar. *Wettinia* (including *Catoblastus*) belongs in the tribe Iriarteeae, which is entirely Neotropical and mostly developed in the lowlands. The tribe is divided into two subtribes. The first is the Iriarteinae, with four lowland genera (*Dictyocaryum*, *Iriartella*, *Iriartea*, *Socratea*), of which three have some Andean elements. The second is the Wettiniinae, with only *Wettinia* (including *Catoblastus*). It represents an evolutionary line of Iriarteeae that underwent evolution in the Andes. The patterns of species distributions and elevational ranges of the species indicate that the evolutionary process in *Wettinia* was strongly affected by the Andean orogeny; several species may be grouped in a series of elevational vicariants.

The last Andean-centered genus, *Aiphanes*, belongs in the tribe Cocoeae and the subtribe Bactridinae, which is an entirely Neotropical group and again almost entirely developed in the lowlands. Among the other genera of Bactridinae, *Acrocomia* and *Bactris* have a few species that reach more than 1000 m elevation in the Andes. *Aiphanes* is a separate line within the subtribe that radiated and adapted to the conditions created by the formation of the Andes.

It is interesting that *Wettinia* and *Aiphanes* have the same number of species and that within the two genera a similar number of species have become adapted to the conditions in the highlands above 1000 m elevation. It therefore seems probable that the biogegraphic histories of the two genera include several similar events. In contrast, the biogeography of *Ceroxylon* is very different.

A common feature of many Andean palms is that the largest species are found at the highest elevations. This feature is true of *Chamaedorea*, *Wettinia*, *Bactris*, *Aiphanes*, and *Geonoma*.

Acknowledgments

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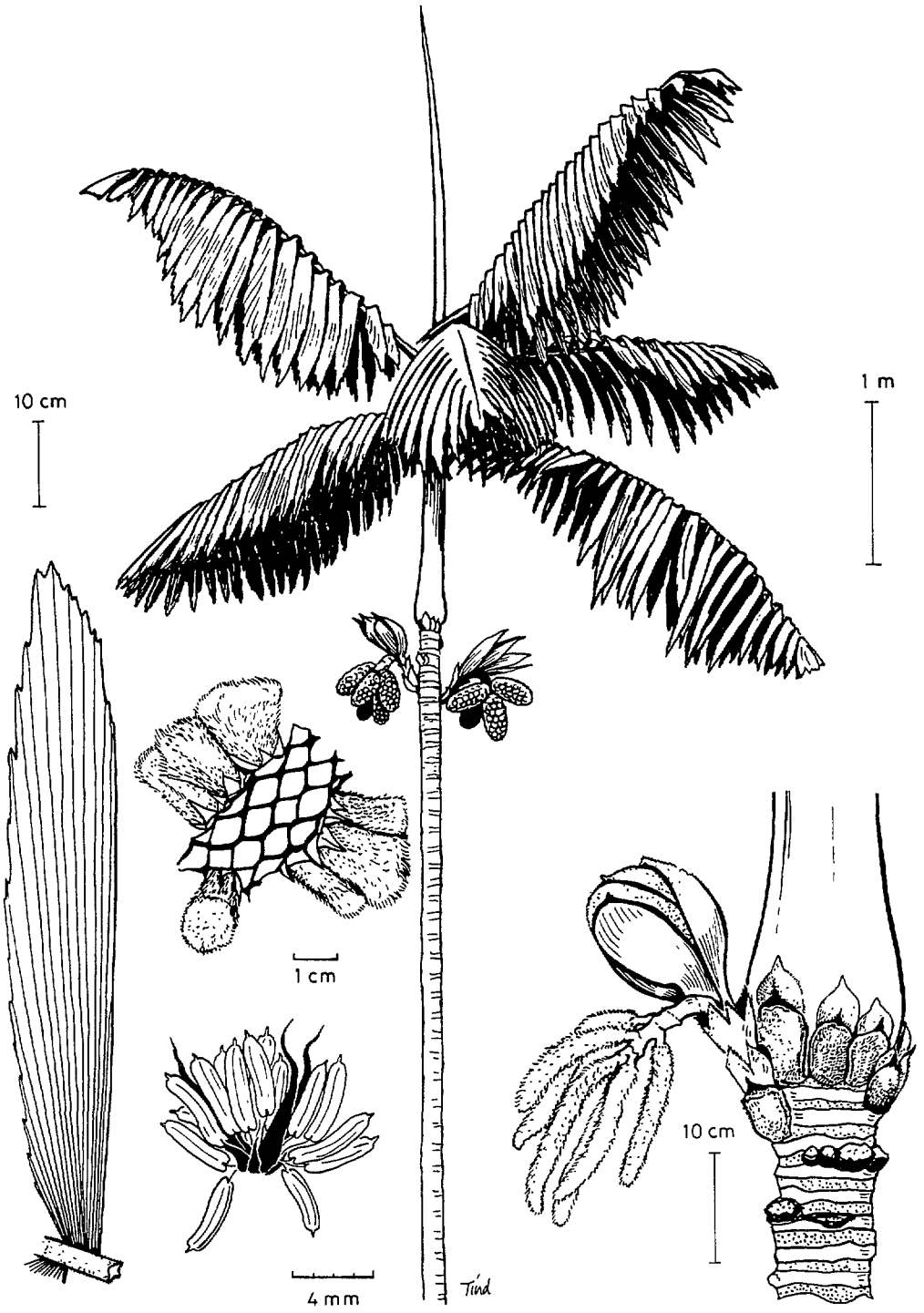

FIGURE 5. *Wettinia maynensis* (*Balslev et al. 60538*), Napo, Ecuador.

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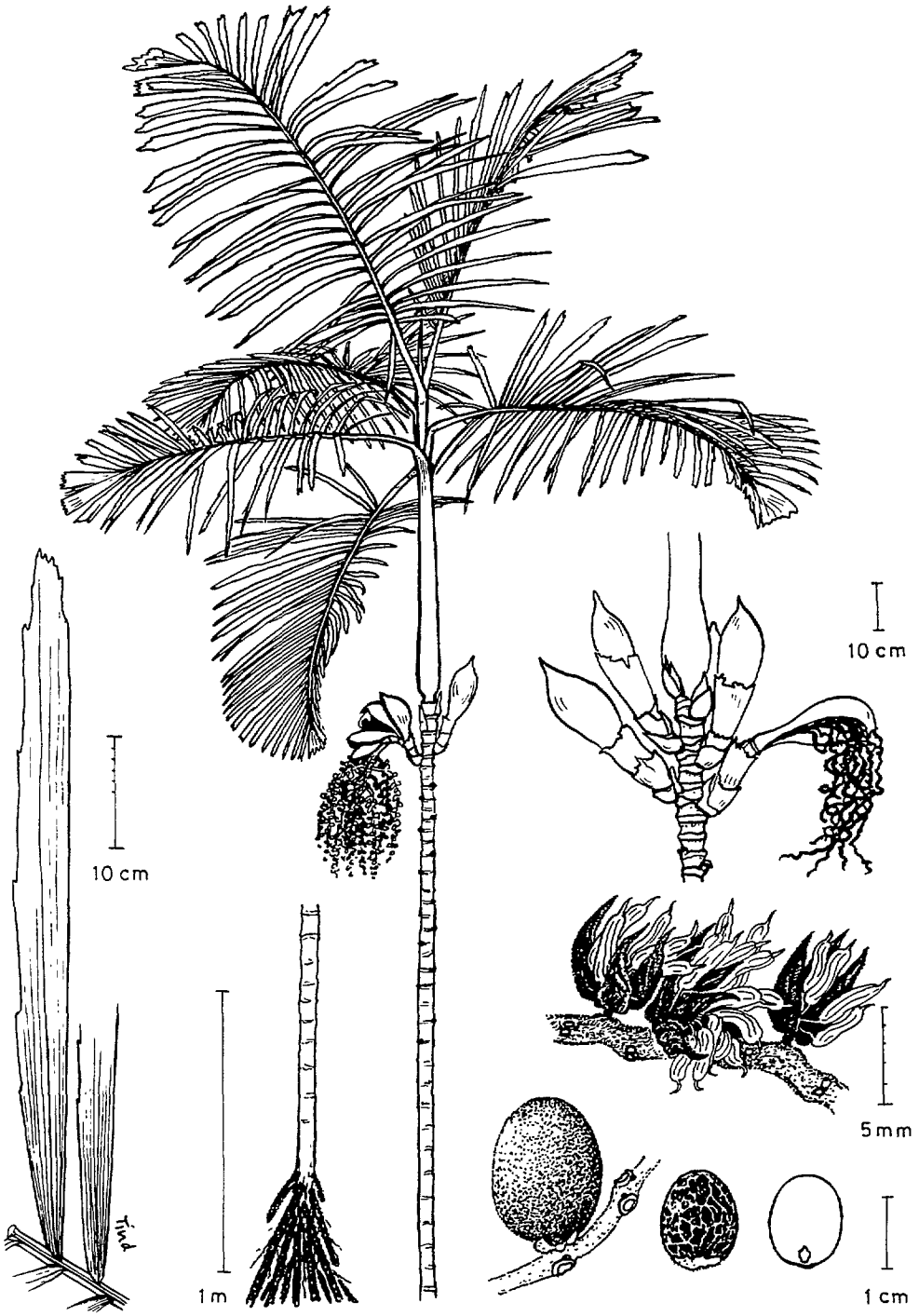

FIGURE 6. *Wettinia* sp. nov. (*Balslev et al. 4410, 60656, 62540*), Morona-Santiago, Ecuador.

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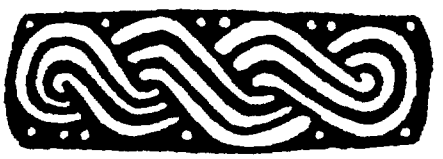

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Richness and uses in a diverse palm site in Bolivia

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The study site is located in the southern part of the Iturralde Province, Department of La Paz, in western Bolivia. This area is generally characterized by mixed vegetation types from the tropical mountain forests as well as lowland forests and savannas. It lies in an altitudinal range of 400–1850 m, with an average temperature of 24–28°C and a rainfall of 2000–5000 mm per year. The richness in palms of this region is the highest reported for Bolivia; it comprises 19 genera, 70% of all genera known in Bolivia and 29 palm species (34%). Three main phytogeographic elements are mixed and integrated in the area; palms from the Andean, Amazonian, and Central Brazilian (Cerrado) units are found in approximately 4.5 ha. Nearly 66% of these palm species are concentrated in the mountain forests between 500–1800 m, reaching the highest altitudinal limit in this area, of which the most common species is *Iriartea deltoidea*. Approximately 55% of the palm species are used by local people – the original ethnic group, the Tacanas, and settlers – in order to get materials for construction, different qualities of thatching, fruit for food and beverages, fibres for artesanal products, medicines and handicrafts.

Keywords: Bolivia; palm; diversity; uses

El área de estudio está localizada en la región sur de la Provincia Iturralde, del Departmento de La Paz, al oeste de Bolivia. Está caracterizada por una mezcla de tipos de vegetación, que incluye desde bosques montanos tropicales hasta bosques de tierras bajas y sabanas. Se encuentra en un rango altitudinal de 400–1850 m, con un promedio de temperatura de 24–28°C y una precipitación de 2000–5000 mm por año. La riqueza de palmas en esta región es la más alta reportada para Bolivia: 19 géneros, que significan el 70% del total de géneros de palmas registrado para Bolivia y 29 especies de palmas (34%). Tres elementos fitogeográficos están mezclados e integrados en el área: en ca. 4.5 ha se encuentran palmas de los Andes, de la Amazonia y del Centro brasileño (cerrado). Aproximadamente el 66% de las especies de palmas está concentrado en los bosques montanos entre 500–1800 m, que alcanzan su mayor límite altitudinal en el área y donde la especie más común es *Iriartea deltoidea*. Cerca al 55% de las especies de palmas es utilizado por la gente local—como el grupo originario Tacanas y colonos – para la obtención de material de construcción, diferentes calidades de techos, frutos para alimento y bebidas, fibras para productos artesanales, medicinas y artesanías.

Introduction

Biological studies carried out in the southern part of the Iturralde Province, Bolivia, indicate a high floristic diversity, from 275 to 988 plant species per 0.1 hectare in the different types of forests and savannas (Gentry and Foster, cit. in Parker and Bailey, 1991).

The fauna is also rich with 51 species of mammals and 403 species of birds (Parker and Bailey, 1991). Many factors such as climatic, geological and edaphic conditions account for the high ecological diversity and the richness in species due to its location in Amazonian and Andean regions with transitional sites consisting of virtually intact ecosystems.

Although the local original ethnic group, the Tacana, has a long traditional and historical relationship with the environment and the use of natural resources, today several symptoms of transcultural changes have become visible. Recently many colonists are also settling in towns and ranches. During the dry season, local agriculturists depend on trading their agricultural and cattle products along the roads between Ixiamas and San Buenaventura, to supply markets in the city of La Paz.

Timber exploitation reached peak activity during the 1980s in the south of the Iturralde Province and an organized camp was built in the Alto Madidi, which was abandoned in 1990. In other regions of the Department of La Paz, timber extraction has increased.

Palms are associated with many different vegetation types in Bolivia, but in terms of species diversity they are mostly represented in the altitudinal range of 140 to 1200 m (Moraes, 1989). Balslev and Moraes (1989) reported 29 Bolivian palm genera, and this number has been increased to 31 due to new records gathered in the Iturralde Province (Moraes, 1990). According to recent systematic generic rearrangements, the palm flora of Bolivia currently consists of 27 genera and approximately 85 species.

This contribution is part of the first phase of the project, 'Diversity and Uses of Bolivian Palms', carried out by the National Herbarium of Bolivia in order to investigate the national palm flora and its uses.

Materials and methods

Study Area

The study site is located in the southern part of the Iturralde Province (Fig. 1) and covers less than 45 000 km^2. It lies in an altitudinal range between 250 and 1650 m, and extends from 13°30'S to 14°40'S and from 67°30'W to 68°40'W. Geographically it includes the last Andean ridges, hills and valleys of the *Cordillera Oriental* with a marked NW–SE orientation, the piedmont, and a wide alluvial plain to the northeast covered with recent sediments. The precipitation is estimated to be 2000 mm per year and the average annual temperature is 26°C. The dry season spans from May to August, and the rainy season from November to April. Both seasons have the influence of cold southern winds.

The boundary of the Iturralde Province (Department of La Paz, western Bolivia) is formed by many rivers, such as the Beni river to the east, the Heath and Madre de Dios rivers to the west and north, and the Tuichi and Yariapo rivers on the south-eastern side.

The vegetation is generally characterized by moist montane forest with patches of dry and cloud forest, distributed as riparian forests, forests on slopes and ridges, as well as a range of evergreen premontane forest, and with humid savannas in the lowlands. Both Amazonian and Andean elements are typified by different palm genera which have distinctive distributions in this area.

The habitat heterogenity, the presence of both Amazonian and Andean forests, relatively high precipitation, and nearly complete absence of long-term human influence supports the recommendation to declare the south of the Iturralde Province as a conservation unit (Parker and Bailey, 1991). During the last two years the Bolivian National Park Service proposed it as a national park with ca 1 800 000 ha.

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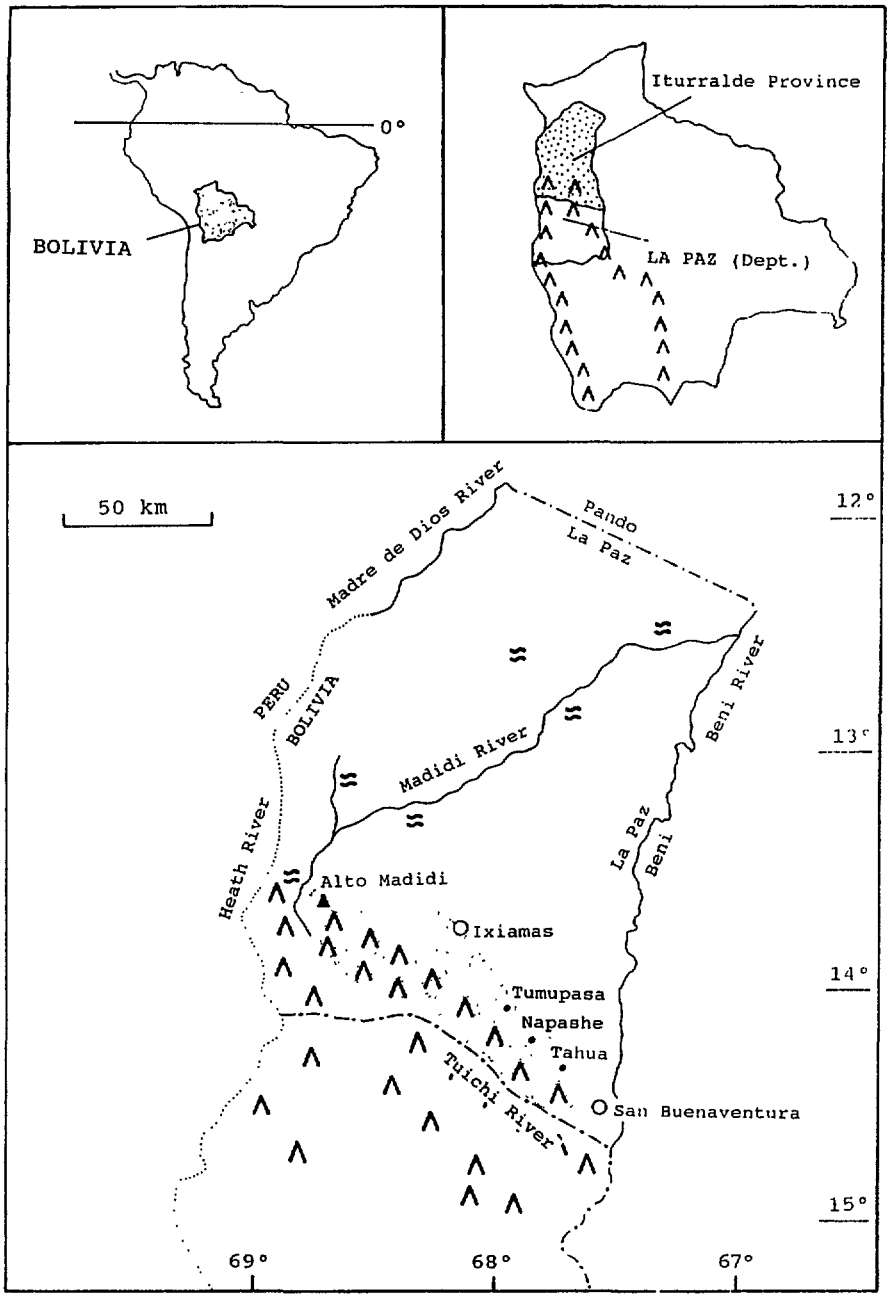

Figure 1. Study site area indicated by black dots (Iturralde Province, Department of La Paz, NW Bolivia), ○ = Towns; ● = Tacana settlements; ▲ = abandoned timber exploitation camp; ^^^^ = mountain relief; ≈ = seasonally flooded lowlands; ..... = national boundary; _·_·_·_ = departmental and provincial boundary.

Table 1. Palm diversity and distribution

Species	Height class	Vegetation type				Altitude range
		Mountain forest		Savanna	Gallery forest	
		Dry	Humid			
Acrocomia aculeata (Jacq.) Lodd. ex Mart.	4–8 m	–	–	+	–	200–450 m
Aiphanes aculeata Willd.	3–6 m	+	–	–	–	750–1800 m
Allagoptera leucocalyx (Dr.) Ktze.	2–4 m	–	–	+	–	200–400 m
Astrocaryum murumuru Mart.	5–12 m	–	–	–	+	200–800 m
Attalea butyracea (Mutis ex L.f.) Wess. Boer	6–18 m	–	–	–	+	250–500 m
Attalea phalerata Mart. ex Spreng.	5–25 m	+	+	+	+	250–1000 m
Bactris concinna var. *sigmoidea* Mart.[a]	2–3 m	–	+	–	+	200–500 m
Bactris gasipaes Kunth[c]	6–10 m	–	+	–	+	250–700 m
Bactris major Jacq.	2–3 m	–	+	–	–	400–700 m
Chamaedorea angustisecta Burret	2–6 m	–	+	–	–	250–1500 m
Chamaedorea linearis[a] (Ruiz and Pav.) Mart.	1–3 m	–	+	–	–	400–700 m
Chamaedorea pinnatifrons (Jacq.) Oerst.	0–1 m	–	+	–	–	600–1600 m
Desmoncus mitis Mart.	2–5 m	+	+	–	–	400–900 m
Desmoncus polyacanthos Mart.	2–5 m	+	+	+	–	250–600 m
Dictyocaryum lamarckianum (Mart.) H. Wendl.	8–25 m	–	–	–	–	1500–1650 m
Euterpe precatoria Mart.	10–25 m	–	+	–	–	250–1700 m
Geonoma brevispatha Barb. Rodr.	1–4 m	–	+	–	–	250–400 m
Geonoma brongniartii Mart.	1–3 m	–	+	–	–	250–450 m
Geonoma deversa (Poit.) Kunth	1–4 m	–	+	–	–	250–450 m
Hyospathe elegans Mart.	2–5 m	–	+	–	–	400–1000 m
Iriartea deltoidea Ruiz and Pav.	3–25 m	–	+	–	–	250–1500 m
Mauritia flexuosa L.f.[d]	12–30 m	–	+	–	–	250–500 m
Oenocarpus bataua Mart.	3–12 m	–	+	–	–	250–400 m
Oenocarpus mapora H. Karst.	6–15 m	–	+	–	–	250–1000 m
Phytelephas macrocarpa Ruiz and Pav.	3–8 m	–	+	–	–	250–800 m
Socratea exorrhiza (Mart.) H. Wendl.	12–25 m	–	+	–	–	250–700 m
Socratea salazarii[a] H.E. Moore	5–10 m	–	+	–	–	300–600 m
Wendlandiella gracilis Dammer[b]	0–1 m	–	+	–	–	250–600 m
Wettinia augusta[b] Poepp. and Endl.	4–8 m	–	+	–	–	800–100 m

New records for Bolivia: [a]Palm species; [b]Palm genera; [c]Cultivated in domestic sites; [d]With azonal distribution, associated to black water.

Data collection

Fieldwork data were compiled using traditional botanical collection of herbarium specimens (pressing, conserving in 60–70% alcohol, drying) and through gathering of ethnobotanical data. Due to access difficulties and logistical support, fieldwork was carried out during the dry season for three years in the surrounding towns of Ixiamas and Alto Madidi, in the Tacana's settlements of Tumupasa, Napashe and Tahua. Although the flowering phase of palms is generally concentrated in the wet season, several records were

based on observations of non-flowering individuals of known species without making botanical collections. In cases of unknown taxa, and under the same phenological conditions, collections of (non-flowering) sterile specimens were made.

A database which includes a total of 40 palm collections and 60 records represents the main reference for this report. The information gathered in Parker and Bailey (1991) and other botanical collections with recent identifications is also considered. Identifications for sterile and unknown species were made possible by comparison with specimens at the National Herbarium of Bolivia.

In order to obtain information related to the density of palms, five plots in different types of forests, each of 1 ha (100 × 100 m), were floristically and ecologically surveyed by counting and measuring vegetative categories such as adults, juveniles and seedlings. All axes of multistemmed palm species were counted.

Results

Diversity of palms

Of the 85 palm species and genera estimated to occur in Bolivia, 29 species and 19 genera are represented in the south of the Iturralde Province, equivalent to 34 and 70% respectively.

The area has a mixture of phytogeographical elements which belong to three main units: Andean (*Aiphanes*, *Euterpe*, *Dictyocaryum*, *Wettinia*), Amazonian (*Astrocaryum*, *Bactris*, *Mauritia*, *Oenocarpus*, *Phytelephas*), and Central Brazilian or Cerrado (*Allagoptera*).

Most of the palm species are found in humid mountain forest in an altitudinal range between 600–1000 m, while only eight palm species are distributed in savannas and gallery forests of the lowland alluvial area down to 250 m (Table 1). Azonal distribution in both middle and low altitudes is typical for *Mauritia flexuosa* forests.

The understorey (under 3 m) of montane and premontane forests is represented by several species of *Bactris*, *Geonoma*, *Chamaedorea*, and species such as *Hyospathe elegans*, as well as *Wendlandiella gracilis*. Many palm trees occupy the medium to high strata (4–20 m) into the mountain forest like *Iriartea deltoidea*, *Euterpe precatoria*, *Astrocaryum murumuru*, *Oenocarpus mapora*, and *O. bataua*. The genus *Desmoncus* has a climbing habit in open and secondary forests. Multistemmed palms occur in some species like *Oenocarpus mapora*, and different species of *Geonoma* and *Bactris*. The stilt-root palm species consist of *Socratea exorrhiza*, *S. salazarii*, *Iriartea deltoidea*, *Dictyocaryum lamarckianum*, and *Wettinia augusta*. Open moist forests and dry forests are characteristic for *Aiphanes aculeata*, *Attalea phalerata*, and for the genus *Desmoncus*. *Allagoptera leucocalyx* and *Acrocomia aculeata* are exclusively part of savanna vegetation, while *Attalea butyracea* and species of *Bactris* are found mostly in riparian forests and on river banks. Finally, *Dictyocaryum lamarckianum* shows the highest altitudinal range of distribution up to 1650 m, and sometimes grows together with *Euterpe precatoria* and *Iriartea deltoidea*.

Two new generic records have been added to the Bolivian palm flora: *Wettinia*, which now has its extreme southern distribution in the study area, and *Wendlandiella*, which was previously only found in the Peruvian Amazon. At the specific level, four species are new records for Bolivia: the palm species *Socratea salazarii* was reported to be mostly distributed in Peru and Brazil, with *Attalea butyracea* being found in alluvial lowlands. The

two remaining species, *Chamaedorea linearis* and *Bactris concinna* are representative of mixed Andean and Amazonian transitional sites.

In the study site, the palm diversity varies from 8 to 11 species and 6 to 10 genera per 1 ha plot (Table 2). The palm density average is 918 per ha, remarkably dominated by a medium size palm, *Iriartea deltoidea*, which ranges between 19.3 to 81.3%. In plot 5, this species is represented by 71.8% (seedlings), 20.4% (juveniles) and 7.8% (adults). Although this inventory shows a seedling-adult relationship of 9:1, this palm species has a wide distribution and is frequently common in different kinds of mountain and piedmont humid forests.

Other species which are poorly represented are *Attalea phalerata*, *Astrocaryum murumuru*, and *Socratea exorrhiza*.

Uses

As Table 3 shows, 16 palm species are considered useful by the local people. This represents 41% of the total number of species occurring in this study area. Multiple products are obtained from *Attalea phalerata* ('motacú'), *Euterpe precatoria* ('asaí'), and *Bactris gasipaes* ('chima' or 'chonta fina'). This last species is being domesticated in cultivated areas close to local settlements, as found in other regions of the Neotropical lowlands.

Selected sources for construction of building walls are derived from stems of *Iriartea deltoidea* ('copa'), *Astrocaryum murumuru* ('chonta') and *Socratea exorrhiza* ('pachiuba'). Thatching materials ('surubí' in the Tacana language) come from leaves of *Geonoma deversa* ('jatata'), *G. brongniartii* ('jatata macho'), *Euterpe precatoria*, *Oenocarpus mapora* ('majillo'), and *Attalea phalerata*.

The lifespan of thatch material differs greatly, depending on the palm species. For example, roof made of leaves of *Geonoma deversa* lasts up to 25 years, while *Euterpe precatoria* thatch may last between 12 to 15 years, *Oenocarpus mapora* up to 10 years and *Attalea phalerata* between 2 to 6 years.

The Tacana emphasized that *Geonoma deversa* stands are now found further and further away from their settlement sites, probably due to the high regional extractive pressure of this palm species. This species is highly valued all over the Bolivian lowlands and many local groups are exploiting it for thatching.

Edible fruits like those of *Bactris gasipaes*, *Attalea phalerata*, and *Allagoptera leucocalyx* ('motacú-chí') are part of the local subsistence diet. Nevertheless, they have a high economic potential for production and regional trade. Other palm species have a regional importance as forage for wild and domestic animals such as *Acrocomia aculeata* ('totaí'), *Bactris* spp., and *Astrocaryum murumuru*. Oils are also being extracted from boiled fruits such as *Oenocarpus bataua* ('majo'), *O. mapora* and *Attalea phalerata*.

Fibres are generally obtained from the leaf rachis of *Attalea phalerata* and *Euterpe precatoria* and are utilized for the production of baskets ('ditiducu' in the Tacana language) and carpets.

Other uses not recorded in Table 3 include ceremonial rituals as observed with *Phytelephas macrocarpa* ('marfil') and use of the adventitious roots of *Attalea phalerata* which possess medicinal curative properties when prepared as a vermifuge. The oil of motacú (*Attalea phalerata*) is applied for muscular and pulmonary sickness, and the leaves of *Euterpe precatoria* are used for respiratory relief.

Some palm species, such as *Mauritia flexuosa* ('palma real') and *Phytelephas*

Table 2. Palm diversity (%) in 1 hectare plots

Palm species	Plots				
	1	2	3	4	5
Astrocaryum murumuru Mart.	6.4	8.5	34	0.5	8.3
Attalea phalerata Mart. ex Spreng.	–	3.9	0.2	–	0.9
Bactris concinna var. *sigmoidea* Mart.	–	1.3	–	–	–
Bactris major Jacq.	–	–	0.1	–	–
Chamaedorea pinnatifrons (Jacq.) Oerst.	–	1.6	1.3	–	0.2
Euterpe precatoria Mart.	6.8	6.1	8.1	12.8	1.1
Geonoma brongniartii Mart.	6.4	–	–	5.5	–
Geonoma deversa (Poit.) Kunth	37.9	18.8	24	1.8	2
Iriartea deltoidea	30.8	53.3	20.8	19.3	81.3
Oenocarpus bataua Mart.	6.2	0.3	1.3	31.2	5.6
Oenocarpus mapora H. Karst.	2.7	0.3	3.8	20.2	0.1
Phytelephas macrocarpa Ruiz and Pav.	–	–	2.6	–	–
Socratea exorrhiza (Mart.) H. Wendl.	2.9	5.8	2.2	8.7	0.4
N-total	487	377	843	218	1618

Plot 1: High forest on terra firme with trees up to 35 m, situated on a steep hill, rocky substrate.
Plot 2: High forest on alluvial plain with trees up to 30 m, with dominance of ferns and *Heliconia* spp.
Plot 3: Medium forest in flooded areas on alluvial plain, dense understorey and in some places permanently flooded with common lowland species like *Bactris* and *Callycophylum spruceanum*.
Plot 4: Low and dense forest of 20 m high on steep hills, only some trees up to 30 m. If flooded, *Mauritia flexuosa* and different species of *Heliconia*.
Plot 5: High forest similar to plots 1 and 2, but in the Tuichi river valley. Highest trees of medium to canopy size and with thick trunks. Some places this type of forest has a high pendent, they are very wet and well drained. There are some isles of a dry forest in the tops of hills.
Plots 1–4 are located in the mountain slopes of the last hills to the NE. Plot 5 is close to S Iturralde Province, on the Yariapo valley which drains to the Tuichi river.

macrocarpa, are under-valued and have almost no local uses, although both are important economically in neighbouring countries like Peru and Brazil.

Conclusion

As a general conclusion, the southern part of the Iturralde Province (Department of La Paz, NW Bolivia) has the highest palm diversity in Bolivia. Approximately 34% of the species and 70% of the genera of all Bolivian palms are represented in this area.

Results obtained during this project show that this area represents an important gap for information on palms of Bolivia. The occurrence of *Dictyocaryum lamarckianum* in high Andean ridges, as well as *Wettinia augusta*, *Socratea salazarii*, and *Wendlandiella gracilis* which are common in premontane forests, confirms the influence of the Andean palm flora on the western lowlands of the Amazon basin of Bolivia. These phytogeographical elements, combined with other Amazonian taxa like *Astrocaryum murumuru*,

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Table 3. Useful native palms

	Food			Construction		Oils	Fibres	Arts and crafts	Others
	Fruit	Palmito	Beverage	Thatching	Walls				
Acrocomia aculeata (Jacq.) Lodd. ex Mart.	+	–	–	–	–	–	–	–	–
Allagoptera leucocalyx (Dr.) Ktze.	+	–	–	–	–	–	–	–	–
Astrocaryum murumuru Mart.	(+)	–	–	–	+	–	–	+	–
Attalea phalerata Mart. ex Spreng.	+	+	–	+	–	+	+	+	+[a]
Bactris gasipaes Kunth	+	–	–	+	–	–	–	–	–
Bactris major Jacq.	+	–	–	–	+	–	–	–	–
Chamaedorea angustisecta Burret	–	–	–	–	–	–	–	–	+[b]
Euterpe precatoria Mart.	–	+	+	+	+	–	+	+	+[c]
Geonoma brongniartii Mart.	–	–	–	+	–	–	–	–	
Geonoma deversa (Poit.) Kunth	–	–	–	+	–	–	–	+	–
Iriartea deltoidea Ruiz and Pav.	–	+	–	+	+	–	–	+	–
Mauritia flexuosa L.f.	+	–	–	(+)	–	–	–	–	–
Oenocarpus bataua Mart.	+	–	+	+	(+)	+	–	–	
Oenocarpus mapora H. Karst.	+	–	+	+	+	+	–	–	
Phytelephas macrocarpa Ruiz and Pav.	+	–	–	+	–	–	–	–	+[d]
Socratea exorrhiza (Mart.) H. Wendl.	–	–	–	–	+	–	–	–	–

(+) Not very common.
[a]Lye; medicinal: adventitious roots as vermifuge and oil for muscular sickness. [b]Medicinal: tea made of flowers used against diarrhoea. [c]Medicinal: leaves as respiratory relief. [d]Rituals.

Bactris concinna, *Desmoncus polyacanthos*, *Mauritia flexuosa*, and *Socratea exorrhiza*, as well as the Cerrado's influence seen by *Allagoptera leucocalyx* and *Acrocomia aculeata*, emphasize a mixed biogeographical origin for this particular region, as already suggested for birds and mammals by Parker and Bailey (1991).

Sixteen palm species are gathered traditionally by local people, of which the most intensively used are *Geonoma deversa* for thatching, *Iriartea deltoidea* for wall construction, and *Oenocarpus mapora*, *O. bataua* and *Attalea phalerata* for fruit and oils.

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