**ID 02150413**

# Population status assessment and conservation measures for *Butia marmorii* Noblick (Arecaceae) - Final report

## Paraguay, Department of Alto Paraná, Compañia Laguna

## August 2013 - February 2014

*Asociación Etnobotánica Paraguaya and Asociación Guyra Paraguay*

*We seek to know the distribution and population status of Butia marmorii and establish an ex situ conservation line*

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**January 30th, 2015**


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## Acknowledgements

We thank Guyra Paraguay staff for provide equipment for field work. To Alberto Yanosky (*Asociación Guyra Paraguay*) and Gloria Céspedes (*Asociación Etnobotánica Paraguaya*) for orientation during the execution of the project. Again to Gloria Céspedez, and Pier Cacciali (*Instituto de Investigación Biológicadel Paraguay*) for help during field work. Nelson Pérez (*Entidad Itaipú Binacional*) for field work coordination in the study area. We thank Larry Noblick (Montgomery Botanical Center) and Harry Lorenzi (*Instituto Plantarum*) for help in the identification of specimens. Also to Ricardo Pimenta (*Universidade Estadual Paulista*) who provide advices in collect and transport of the specimens. Also, we thank María Vera (*Facultad de Ciencias Exactas y Naturales*) for support in botanical analysis.

This project was founded by Conservation Leadership Programme, through the Future Conservationist grant category.

Specimens were collected under SEAM permit number 017/2014. We thank to the Herbarium of *Facultad de Ciencias Químicas* for the care and stewardship of the collected specimens.

# Section 1


## Summary

*Butia marmorii* is an endemic palm of Paraguay, critically threatened by habitat destruction. The fact that this species occurs in isolated patches on sandy soil, makes the species very susceptible to environmental disturbances. Activities were carried out in order to characterize the population of *Butia marmorii*, and identify new populations of the species. To achieve these objectives, analyses of potential distribution of species were performed, by using GIS tools, through visual interpretation using Landsat satellite imagery. *In situ* tours were conducted to verify the GIS outputs. In all the identified sites were verified the presence of vegetation of the Cerrado, however the presence of *B. marmorii* was not corroborated at all sites. In-field observations revealed that environmental alteration have trasformed the majority of the sites where *B. marmorii* is present. Only five sites with presence of the species have been recognized (four of which were not previously known for the species). Two of them hadmoderately natural environmental conditions for calculations of density. In one patch, the density of *B. marmorii* was 0.11 individuals/m2. In another patch, where the species was found coexistingwith *B. paraguayensis*, the density was 0,0054 individuals/m2. These data is useful for management plans for the species. In addition, data on acclimatization for conservation *ex situ* were obtained; moreover, local communities have recognized the existence of the species as a result of the work of environmental education.

## Introduction

Paraguay is located in a privileged area where six bioregions of great biological importance converge: Upper Parana Atlantic Forest (UPAF), Cerrado, Chaco, Natural Grasslands of the South and Pantanal (Olson *et al*. 2001). The interaction between these bioregions within a relatively small territory gives the country great importance as a site of multiple ecotones where species diversity is very high. The eastern region of Paraguay is particularly defined by these characteristics (Spichiger *et al.* 2004). In the East zone of the eastern region we find the interaction of the UPAF with relatively large patches of Cerrado. Within these patches we observe the emergence of species endemic to this ecoregion, heterogeneously distributed. The flora of palm trees of Paraguay represents a very useful example for this particular conformation, being the majority of the species native to the Cerrado (Gauto *et al.* 2011). *Butia marmorii* Noblick is a species of palm tree (Fig. 1), acaulescent, with small grass-like leaves, inflorescence at ground level with purple flowers, that has been found to date in only two adjacent populations in the vicinity of Itakyry, Department of Alto Paraná (Noblick 2006). It has been described in 2006 and classified as critically endangered by the Secretariat of Environment (Resolution 524/06). Itsstate of threat is mainly due to the loss of its natural habitat, since the eastern part of the country has suffered the loss of more than 50% of its natural vegetation cover in the last 50 years (Huang *et al.* 2009). In addition to this dramatic loss, the species is extremely rare, very inconspicuous and inhabits isolated patches of Cerrado with sandy soil. These features make the species extremely vulnerable to any disturbance of the smallarea ofremnant habitat.

**Figure 1.** Details *Butia marmorii* palm tree

However, we believe in the possibility of finding new populations in islets of similar vegetation remaining in the area. Gauto *et al*. (2011) have determined a potential range for the species, based on analyses of vegetation maps and maps of physical and soil characteristics (Fig. 2). This map provides a starting point for finding new areas that may contain populations of this particular species, and thus increase the chance of survival by achieving identify and highlight the presence of these new populations. However *ex situ* conservation work become essential for the preservation of rare, fragile and restricted range species (Johnson 1996). Getting to know their cultural requirements to ensure their growth in monitored sites will allow conserving the species and better understanding their biological characteristics, besides being an educational tool of great importance.

**Figure 2.**Potential distribution map of*Butia marmorii* in Paraguay

## Project members

**Irene Gauto**, biologist, with a Masters degree in botany. She worked in conservation of palms. She served asbiologist in conservation projects ofGuyra Paraguay Association and afterwards as Executive Director of the Ethnobotany Paraguayan Association (EPA). Currently she is still linked as an active member of the EPA.She has served asthe coordinator and administrator of this project.

**Fernando Palacios**, forester, with 6 years experience in Geomatics, currently works as an independent consultant in the unit of geoprocessingat Guyra Paraguay Association. His main activities are based on studies of LU-LC change in theGrand Chaco, the Amazon, Central America and the Andes; REDD+ projects; Adaptation to Climate Change; fires and floods monitoring; management plans for protected areas; modeling deforestation scenarios; studies of fauna, flora, ecosystems and life complexes; support to prosecution of crimes against the environment,

impartation of GIS courses to organizations of the private and public sector, among other. In this project he was responsible of the development of cartographic information and identification of new sites in the field.

**Pamela Marchi**, biologist, works on conservation of species useful to man, is coordinator of the project Paraguayan Ethnobotany of EPA. She is technical assistant at the botanical laboratory of the Faculty of Natural Sciences, National University of Asuncion. In this project, she collaborated in the identification of flora species in the sampling sites, the caracterization of species populations, and in the development of educational campaigns in local communities, surrounding populations of *B. marmorii*.

**Nelson Silva**, Agroecology technician, currently conducting specialized technical tasks in the Ethnobotanical Garden Patiño. He has extensive experience in crops, plant breeding and scientific collections. In this Project,participated in the field work and was in charge of the *ex situ* conservation of the species.

# Section 2

## Aim and Objectives

### Aim

Characterize populations; identify new areas of distribution and implement conservation measures for *Butia marmorii*.

### Objectives

1. To identify natural sites of Cerrado within the potential distribution of the species by using GIS tools.

2. To perform a characterization of the known and newly identified natural populations of *Butia marmorii*.

3. To carry out environmental education campaigns about the Cerrado, natural ecosystems and the species studied with the local communities and stakeholders.

4. To establish *ex situ* conservation action of the palm in botanical gardens for its study and preservation, while proposing local conservation measures that allow preservation of the species in the wild.

## Methodology

Prior to the implementation of the project, were conducted: literature review, contact to experts and stakeholders, collection permit application to the authorities, adjustments in methodology, and training workshops for team members (Fig. 3).

| *Botanical methods workshop* | *GIS workshop* |
|---|---|
|  |  |

**Figure3.**Training workshops

1. Search for potential sites: The methodology for identifying new areas with potential presence of *Butia marmorii* consisted of a supervised classification, together with a visual interpretation based on Landsat satellite images and a multitemporal classification analysis, that allowed to compare coverage of years 1973-1985 with the coverage of years 2012-2014, thus allowing to identify natural areas of Cerrado in the study site.
2. Characteristics of the populations of *Butia marmorii*: For data survey of the area and species under study, at the two sites of interest, were installed 1ha plotsdivided into 25 sub-plots of 20x20 meters (Dallmeier 1996), and marked by GPS device. In each sub-plot, were collected data on the amount of *Butia marmorii* and associated species, as well as soil type, amount of light and formation of the Cerrado. Density for the species *B. marmorii* was calculated.
3. Environmental Education: brochures and posters were printed for distributing to local people. The method was to visit the nearby houses, and schools in the area. A participatory workshop with students and experts was conducted in Asunción.
4. *Ex situ* conservation: specimens were collected with and without soil samples (Guerrant *et al*. 2004), and were transplanted into two botanical gardens, detailed in Results.

## Outputs and Results

1. Search for potential sites

Based on field observations made, the methodology for identifying Cerrado formation could been validated, since this type of formation was found at all sites visited. Of the proposed sites (Fig. 4), the ones visited sites were 1, 9, 10, 11, 13, 14, 15, 25, 26, 29, 31, 34, 35, 36, 44, 45, and 46. It is worthto highlightthe elevated degree of alteration observed in the Cerrado ecosystems, which were converted mainly into mechanized-agriculture lands, and afforestation with exotic species to a lesser degree.

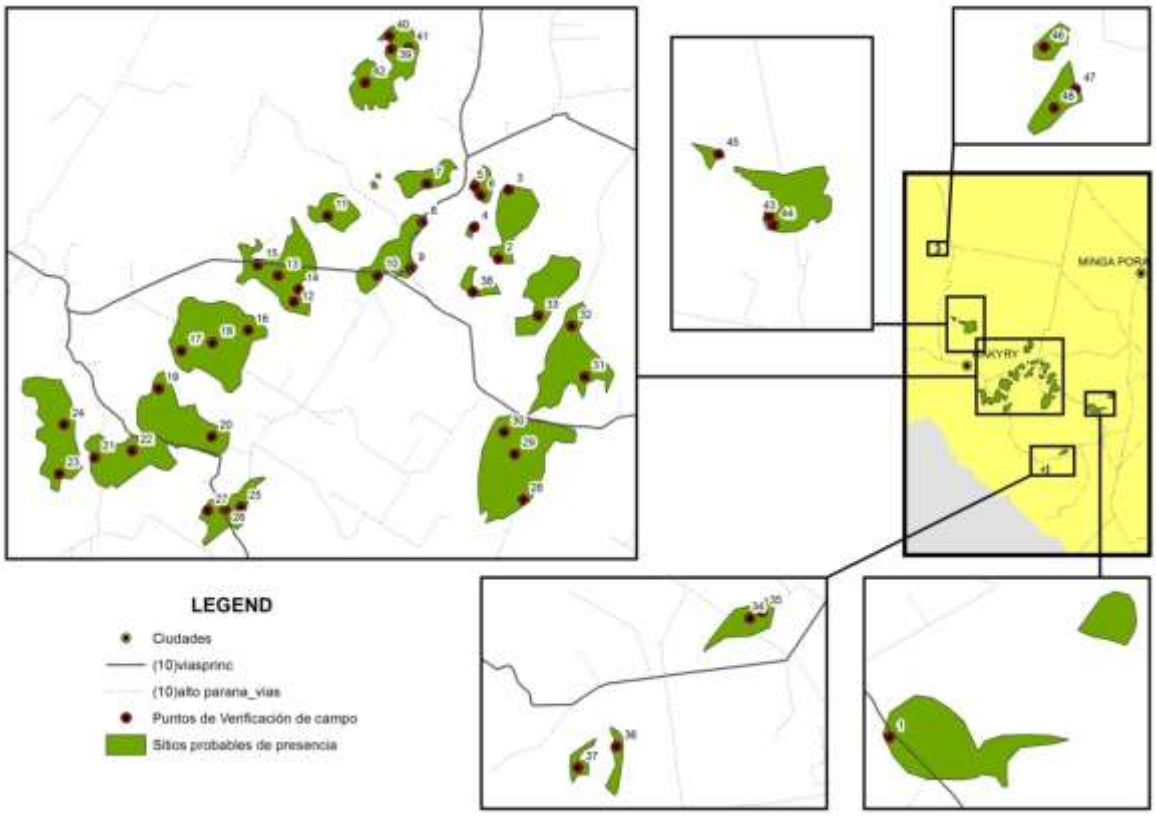


**Figure 4.**Location of proposed sites for field verification.

2. Characteristics of *Butia marmorii* populations

*B. marmorii* populations were identified in sites 1, 5-6, 11 and 25-26, according to the analysis of the search of potential sites (Fig. 5). Of these six sites, only 1 and 11 showed ecological characteristics that can be analyzed, as they exhibited a low degree of environmental disruption; while site 25-26 corresponded to a growing area, where onlya few isolated individuals were found, left by the owner of the establishment. The sites 5 and 6, are places of historical collection, with a marked reduction of original coverage by a strong anthropogenic impact.

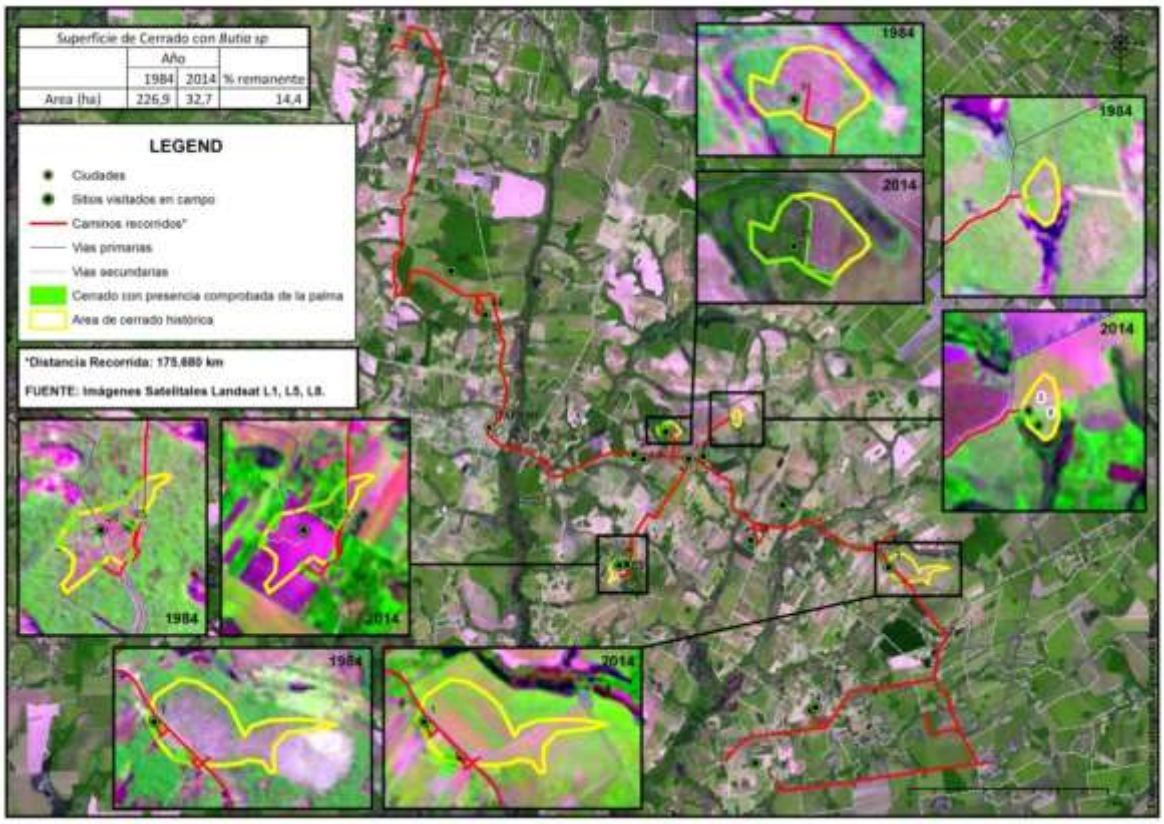


**Figura 5:**Sites with*Butia marmorii* presence and comparison of the natural vegetation cover between 1984 and 2014.

| Site | 1984cover (yellow) (ha) | 2014cover (green) (ha) | % remnant |
|---|---|---|---|
| 1 | 125,9 | 5,8 | 4,6 |
| 11 | 36,0 | 16,6 | 46,2 |
| 25 y 26 | 49,2 | 9,8 | 19,9 |
| 5 y 6 | 15,8 | 0,4 | 2,8 |

Here are detailed some characteristics of these sampling enclaves:

Site 1: Site of first collections. Surface of vegetation = 5.8 hectares. Private property in disuse, with significant anthropogenic impact. Individuals = 1142 (density = 0.11 individuals/m2) (Annex 1). Individuals in reproductive status and buds were found. Mostly sandy soil, reddish, with formations of savannas, grasslands, or secondary forest.Figure 6 shows the composition and floristic diversity (at Family level) of the site. The list of associated species in this type of vegetation is presented in Annex 2.

Site 11: Natural area with moderate anthropogenic impact. Surface of vegetation = 16.6 hectares. Individuals = 552 (54 *Butia marmorii*, 243 *B. paraguayensis*, and 318 *B. sp*(sterile specimens)). *Butia*

*marmorii* density was 0.0054 individuals/m2 (Annex 1). Individuals in reproductive status and buds, werefound. Mostly clay soil, reddish, with formations of savanna associated to scrubs. Figure 6shows the floristic composition (at Family level) of the site. The list of species of studied vegetation is presented in Annex 2.

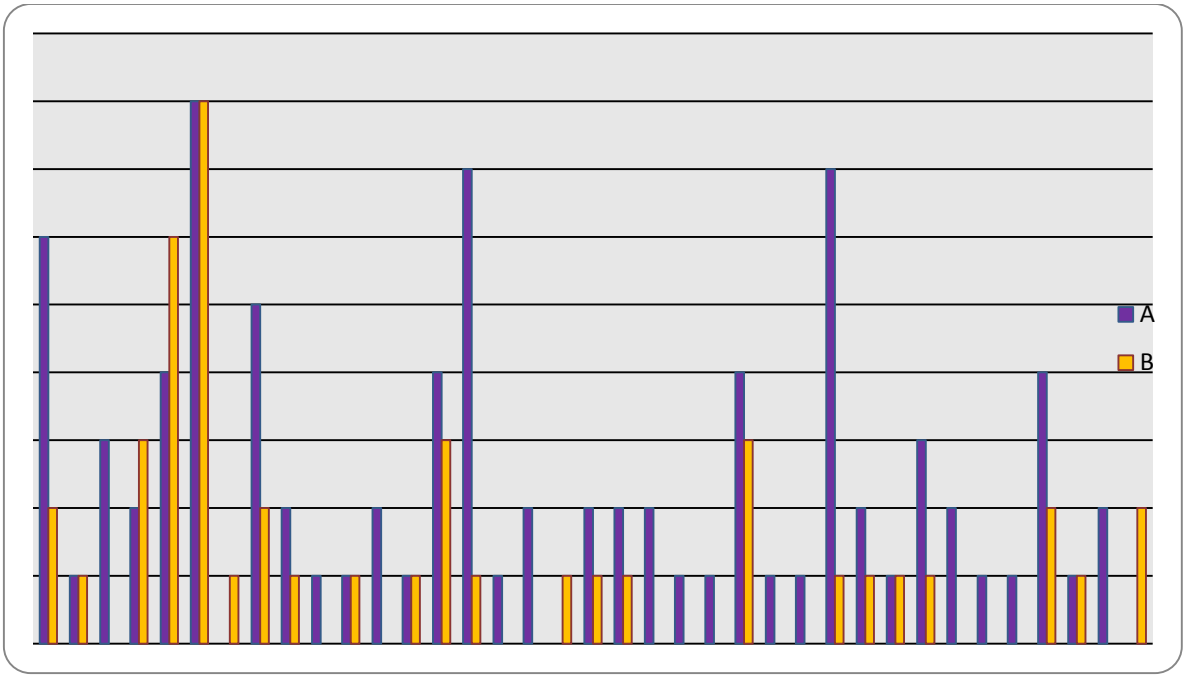


**Figure 6.**Floristic composition of Site 1 (A) and Site 11 (B), at family level.

Site 25-26: area with high anthropogenic impact (land under agricultural use). Total individuals found = 20; of which 15 were in a tilled area. Surface of vegetation = 9.8 hectares. Area with multiple owners. Mostly clay soil, reddish, with formations of savanna associated to scrubs.

Annex 3 shows photographs of sites and of the fieldwork carried out.

3. Environmental Education

Eighteen sites were visited, a total of 45 people dialogued with the team (Fig. 7). One hundred and thirty brochures were distributed in one school, municipality, and five commercial premises. Brochures were also left in the Environmental Center of Itaipu so they are available for visitors (Annex 4).

**Figure 7.**Talks with local people.

Additionally, a workshop was held in Asuncion, for the dissemination of results, with the participation of 40 attendees (professionals, students and interested). Brochures and posters were distributed (Annex 5). Four meetings with botanist experts and landowners were conducted.

We managed to publish an article about the project and the importance of the species, in a high-circulation newspaper of the country (Annex 6).

4. *Ex situ* conservation

In a first attempt, six specimens were collected, though transplant was not successful. Subsequently, four additional individuals were transplanted with the original sample substrate, but they perished after two months of acclimatization. Finally 16 specimens with original sample substrate were collected, acclimatization was successful for five copies in the Ethnobotanical Garden Patiño (EGP), and one in the medicinal nursery of the Botanical Garden and Zoo of Asunción (BGZA). Annex 7 show pictures of the collect specimens and transplant.

To date there was no growth or bloom of acclimated specimens.Monthly monitoring forms are completed (Annex 8).

## Achievements and Impacts

The most important achievement, from our point of view, is to have identified additional populations of *Butia marmorii*, expanding the knowledge of their distribution and ecological preferences. Related to this, we realize that destruction of habitat by anthropogenic factors is a real and significant threat to the remaining population. In this project, we quantified habitat loss, thus, we found that only 14% of the original area of occurrence, remains today. These results were presented publicly, and will also be published in scientific journals, this way, the information is available for public use and will help government and civil society to take conservation action.

We were able to calculate in two places the population density of the species, finding significant differences between the two sites. *Butia marmorii* density is significantly higher when occurs alone than when shares habitat with its congener *B. paraguayensis*. This is a first approach to the knowledge of the ecology of the species and their ecological relationships with other species. This can also have an important taxonomic impact. In these sites there are individuals with intermediate characteristics between *B. marmorii* and *B. paraguayensis*, making it difficult for taxonomic identification in the field; thus specimens with fertile parts were collected and identified afterwards. Therefore, more detailed taxonomic studies are recommended to better understand systematics of the genus.

Through environmental education, it was possible to make local people understand the importance and uniqueness of the species. This may help the last remaining habitat patches, where *Butia marmorii* is present, to last in time.

Finally, we must emphasize the difficulty of acclimation that presents*Butia marmorii*. The low survival and zero growth of transplanted specimens show that it is a delicate species with high care requirements. This information is important for the management of the species in botanical gardens.

According to the conservation problem identified, the project generated knowledge on the species, in local people. This may contribute positively to the long-term conservation of the species in its habitat.

Due to the significant reduction of habitat observed in the last 30 years, and the continuing trend of environmental degradation, the*ex situ* conservation tool used in the project is important to ensure a genetic reservoir, preventing its complete extinction.

# Section 3

## Conclusions

Through this project the loss of original habitat of *Butia marmorii* was confirmed, as well as the fragile state of the current small remnants existing.

In one of the studied populations we found high density (0.11 individuals/m2) within a very small remaining natural area (5.8 ha). At the second site studied, inhabiting *Butia marmorii* in syntopy with *B. paraguayensis*, we found lower density (0.0054 individuals/m2);the area of this site was larger (16.6 ha). For conservation purposes, we consider the second site more interesting, despite the low density, because of the larger surface and better natural habitat conditions.

Despite the low survival of transplanted specimens, there are some Individuals successfully acclimatized to *ex situ* conservation, which represent a sample of the species. The implication of this action is beneficial incase of a potential extinction of*Butia marmorii* population in the wild.If happens, the species can continue to be preserved by *ex situ* conservation methods.

The contribution of this project for the conservation of *Butia marmorii* is: the characterization of the populations, the extension of knowledge on distribution and vulnerability in their natural habitat, and the preservation of the species in botanical gardens as part of an *ex situ* conservation tool.

## Problems encountered and lessons learnt

- Which project activities and outcomes went well and why?

The GIS analysis was successful, identifying 50 potential sites for the species. In-field knowledge, availability of adequate maps and free access enabled obtaining good results. The sites were identified with precise coordinates, which were then used to search new populations in the field.

- Please detail any problems that the project encountered or deviations from original project plans. Describe how these problems were addressed and what solutions were found to deal with these issues.

Coordination of fieldwork dates: Due to the various individual professional commitments of each member of the team and the availability of the truck, was not easy to meet the deadlines for field trips. Though, despite being a little late and having to shorten the stay, we managed to meet the proposed trips and perform the field work.

Numerous sites on private property: When searching for new sites we encounter the difficulty of entering a few of them, because they were located on private properties and we did not get permission to access. Thus, we had to discard visit them.

Change in the methodology of population assessment (plots): Both, CLP assessors andthe adviser of the project, have recommended us to change the methodology for the botanical component, the methodology proposed was inappropriate for the species. The adviser has suggested the use of 1 ha plots divided into sub-plots of 20x20 m, allowing us to carry out a better study of the population and its environment.

Inadequate date for environmental education: due to the modification of field trips, the environmental education work could not be done in the most appropriate date, the work was done at the end of the year, when children were on vacation, so we could not make the big workshops we wanted in schools. Therefore we chose to conduct educational talks house by house within the area of influence of the project.It had some advantages though, since communication was personalized and questions were answered directly.

Slow access to funds: Another problem that has delayed the project was the slow access to the funds. AEPY account managing was slow and in two occasions, we could not access on time to the project funds.

Taxonomy problems: We were surprised to find difficulty in identifying some individuals, due topresence of intermediate characteristics between *Butia marmorii* and *Butia paraguayensis*, both species are present in the study area. We have collected these individuals and consulted with experts. In most cases we have achieved the identification, however few specimens were not identified due to be sterile.

- Briefly assess the specific project methodologies and conservation tools used.

Methodology: The GIS methodology was adequate, we have obtained the data needed for the search and discovery of new sites for the species studied. On the other side, we had to change the botanical methodology because the one initially proposed was not appropriate for the species. This change has been suggested by the reviewers from CLP and by the project adviser. The methodology employed suited best to the objectives and studied species, as itcovereda largerarea and allowed a better assessment of the population and environment.

Conservation tools: The study used *ex situ* conservation technique as primary conservation tool, which is accepted and important, thought palliative, because it not adequately addressby itself the problem of the species conservation. Ideally it should be part of a broader conservation plan that includes*in situ* conservation action. However the implementation of *in situ* action is complicated because populations of *B. marmorii*are inprivate land with high commercial value, and of multiple owners. The impact of *ex situ* conservation would be increased improving procedures ofcollection and transplantation, in order to get a better acclimatization of the species in botanical gardens. It is necessary to collect more specimens and soil samples, and place them in appropriately sized pots, instead of placing them directly on the botanical garden substrate. Finally, success would be greater if part of the collected specimens are transplanted into natural areas with similar climatic and ecological conditions nearby the habitat of the species.

- Please state important lessons which have been learnt through the course of the project and provide recommendations for future enhancement or modification to the project activities and outcomes.

We highlight the following as lessons learnt:
- The importance of good leadership (disposition, support and constant control). The presence and constant communication of the leader with team members is crucial to achieve the objectives.
- Commitment of the team. It is critical to have the commitment and enthusiasm of all members of the project to achieve objectives properly and on time.
- Good knowledge on the project and methodology. It is necessary to know as many details as possible of the problem to be addressed and the methodology to be implemented. Changes during project implementation delay the process and confuse the members.
- Have an adequate and consistent advice from the adviser of the project. A close support from the adviser facilitates and improves the performance of team members.
Recommendations: It is important to have good contact with local people prior to the implementation of the Project.

## In the future

This project allowed us to increase knowledge on a critically endangered species of palm. Now, we know better its distribution and places where we can still find it. However, its conservation is far from being guaranteed. The main problem is the lack of protected areas in their range. To face this problem we are preparing draft proposals for conservation and environmental education tools that will be presented to the Itaipu Binational entity, Paraguayan-Brazilian hydroelectric company, with many social and environmental responsibilities within the area of distribution of the palm. In addition to acquisition of land for preservation, another important option to achieve the perpetuation of the species is the transplantation of a large number of individuals from natural populations to new places with similar ecological features within protected areas, managed by Itaipu, which are located at an average distance of 60 km from the current range of the species.

Another goal we want to accomplish is to send all necessary documents for inclusion of the species in the IUCN Red List, taking into account the knowledge of its presence in Brazil and Argentina. To achieve this initiative, we are in touch with experts from both countries.

# Section 4

## Appendices

Annex 1 Botanical field data

Annex 2 Flora species of monitored sites

Annex 3 Sites pictures

Annex 4 Brochure

Annex 5 Posters

Annex 6 Newspaper article

Annex 7 Pictures of collect specimens and transplant

Annex 8 Monthly monitoring forms

Full account of income and expenditure (Financial report)

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