

Executive Summary

Defining High Conservation Value Forests (HCVFs), based on Principle #9 of the forestry certification standards (FSC), is an initiative of ProForest (2003) in partnership with WWF and IKEA. The definition of HCVFs provides a series of tools that help to improve the protection and appropriate management of important ecological and social areas. Under the framework of this project, Guyra Paraguay has carried out the first interpretation of HCVs in Paraguay. Although this methodology has been implemented at a national or sub-national level in other countries, this first experience in Paraguay has focused on applying this HCV methodology in a particularly important and representative site regarding the conservation of the Upper Paraná Atlantic Forest in Paraguay (BAAPA): the San Rafael Reserve.

The objectives of this project not only sought to identify the HCV characteristics of the forests in San Rafael, but also to identify information sources and tools that help define these characteristics; the analysis and definition of parameters and thresholds that help to measure or qualify the HCVs in San Rafael; the proposal of management and monitoring models and recommendations that guarantee the maintenance, or even the recovery, of the HCV forests identified; and the definition of future needs in terms of information collection and analysis to improve the management of the HCV forests in San Rafael.

The HCV characteristics were, for the most part, determined based on the information already analyzed by other authors and previous experiences carried out under a whole range of processes and initiatives. However, several characteristics required new analyses specific to the needs of this document. The creation of a representative and multidisciplinary work team, with experts capable of providing a wide range of views and opinions was key when defining certain attributes. Wherever possible, these characteristics have been represented in a series of maps of the San Rafael Reserve.

In light of the many criteria proposed by this methodology, it has been possible to evaluate and characterize each of the attributes that qualify the forest remnants of the San Rafael Reserve as High Conservation Value forests. In terms of the hierarchy of HCV forests identified within the boundaries of the San Rafael Reserve, the properties that stand out most are those whose future in terms of conservation is secured (such as the properties declared as Private Reserves), and have already been subject of several biological, ecological, social and cultural studies, and consequently have more information. These sites currently cover the greatest number of HCV characteristics within the Reserve, so we can conclude that these are the highest conservation priorities.

The HCV methodology has proved to be an extremely useful and appropriate tool, not only to guide and facilitate conservation and management programs carried out by forest managers and decision makers, but also to identify the information gaps that still exist and define the needs in terms of information gathering and analysis that will improve the management of the High Conservation Value Forests.

Resumen Ejecutivo

La definición de los Bosques de Alto Valor de Conservación (BAVC), basada en el principio 9 de los estándares de certificación forestal (FSC), es una iniciativa de ProForest (2003) en alianza con WWF e IKEA. La definición de BAVC proporciona un conjunto de herramientas que contribuyen a facilitar el proceso de protección y manejo adecuado de áreas importantes desde puntos de vista ecológicos y sociales. Guyra Paraguay, en el marco del presente proyecto, llevó a cabo la primera interpretación de las definiciones de AVC en el Paraguay. Si bien la metodología en cuestión ha sido implementada en otros países a escala nacional o subnacional, en esta primera experiencia el desafío fue la aplicación de la metodología de BAVCs en un sitio particularmente importante y representativo para la conservación del Bosque Atlántico del Alto Paraná en el Paraguay: la Reserva San Rafael.

Los objetivos de este trabajo no solo abarcaron la identificación de atributos AVC en los bosques de San Rafael, sino también la identificación de fuentes y herramientas de información para la definición de tales atributos; el análisis y la definición de parámetros y umbrales que permitan medir o calificar los AVC en San Rafael; la propuesta de pautas y recomendaciones de manejo y monitoreo que aseguren el mantenimiento, o incluso la recuperación, de los BAVC identificados; y la definición de las necesidades futuras de colecta o análisis de información para mejorar el manejo de los BAVC en San Rafael.

Los atributos de AVC fueron determinados, en su mayoría, en base a información ya analizada por otros autores y experiencias realizadas previamente a través de una gran variedad de procesos e iniciativas. Sin embargo, cabe destacar que algunos atributos requirieron la realización de análisis nuevos y específicos para este documento. La conformación de un equipo de trabajo multidisciplinario y representativo, con profesionales capaces de proporcionar un amplio rango de opiniones y perspectivas, fue clave en el momento de definir ciertos atributos. En la medida de las posibilidades, se intentó representar gráficamente estos atributos en mapas de la Reserva San Rafael.

A la luz de los numerosos criterios de análisis propuestos por la metodología, ha sido posible evaluar y caracterizar, de manera independiente, cada uno de los atributos que hacen que los remanentes boscosos de la Reserva San Rafael constituyan Bosques de Alto Valor de Conservación. En cuanto a la jerarquía de los BAVC identificados dentro del polígono de la Reserva, se destacan las propiedades cuyas expectativas de conservación se encuentran aseguradas a perpetuidad (en el caso de las propiedades declaradas como Reservas Privadas), y que ya han sido objeto de numerosos estudios biológicos, ecológicos, sociales y culturales, por lo que disponen de mayor información. Estos sitios presentan actualmente la mayor cantidad de atributos de AVC dentro de la Reserva, por lo que se concluye que constituyen las prioridades de conservación.

La metodología de los BAVCs ha demostrado ser una herramienta extremadamente útil y apropiada no sólo para guiar y facilitar los programas de conservación y manejo desarrollados por gestores forestales y tomadores de decisiones, sino también, para identificar los vacíos de información aún existentes y definir las necesidades de colecta o análisis de información para mejorar el manejo de los BAVC.

Introduction

All forests have social and environmental values, such as providing habitat for wildlife, watershed protection or preserving archaeological sites. When these values are considered highly significant or of critical importance, then these forests can be defined as High Conservation Value Forests (HCVF).

The key to the concept of High Conservation Value Forests is in identifying its High Conservation Values (HCV), as the presence of these is what determines whether a forest should be classified as such. The idea was originally developed by the Forest Stewardship Council (FSC) to be used in forest certification schemes, but the concept is being used by other groups, including natural resource conservation and planning, mapping and land purchase policies by large companies. The rapid adoption of the HCVF concept reflects its use, to the point of contributing to shift the debate on forest types, or extraction methods, to focus instead on those values that make that forest particularly important. By identifying these key values and guaranteeing their maintenance, it is possible to make rational decisions that are consistent with the protection of the important social and environmental values of a natural forest area.

The tools designed by ProForest (2003), in alliance with WWF and IKEA¹, provide the practical methodology to define HCVFs at a national or sub-national level. This methodology is based on the identification and maintenance of High Conservation Values (HVC) following six main criteria and their sub-criteria, summarized in the following table:

HCV 1:	<i>Globally, regionally or nationally significant concentrations of biodiversity values</i> <i>HCV 1.1: Protected Areas</i> <i>HCV 1.2: Threatened or Endangered species</i> <i>HCV 1.3: Endemic species</i> <i>HCV 1.4: Critical temporal use</i>
HCV 2:	<i>Globally, regionally or nationally significant large landscape level forests</i>
HCV 3:	<i>Forest areas that are in or contain rare, threatened or endangered ecosystems</i>
HCV 4:	<i>Forest areas that provide basic services of nature in critical situations</i> <i>HCV 4.1: Forests critical to water catchments</i> <i>HCV 4.2: Forests critical to erosion control</i> <i>HCV 4.3: Forests providing barriers to destructive fire</i>
HCV 5:	<i>Forest areas fundamental to meeting basic needs of local communities</i>
HCV 6:	<i>Forest areas critical to local communities' traditional cultural identity</i>

The identification of specific forest values and the use of this information to determine planning and management decisions is not a new concept. However, perhaps the best part of HCVF is that it is an integrating concept, and can provide a framework under which the results of many other important initiatives that seek to define key forest values can be applied. Such is the case, that the results of global analyses of forests with highest biodiversity, most endemic species and greatest loss of native

¹ IKEA is a Swedish-multinational company, dedicated to retailing house furniture and decoration, at a low price and with a modern design. IKEA has attempted to reduce their environmental impact to a minimum by employing their resources in the most economic and environmentally friendly manner. Since 2002, IKEA and WWF work together to promote responsible forestry in regions considered global conservation priorities (www.ikea.com).

forest (such as the ecoregions of WWF Global 200, or the hotspots of Conservation International) could provide critical information on the global significance of the biodiversity within a region. At the same time, national surveys on land use and management plans, as well as social, anthropological and ethnological studies, could also contribute to defining a HCV within a particular region. The focus of HCVF facilitates the integration of information from these types of sources; consequently, a large part of the effort to implement the HCVF concept consists of the identification, interpretation and correct use of already existing information.

Under the framework of this project, Guyra Paraguay carried out the first interpretation of HCV definitions in Paraguay. Although this methodology has been implemented in other countries at a national or sub-national level, this is the first experience where the challenge has been to apply the HCVF methodology in a particularly important and representative site for the conservation of the Upper Paraná Atlantic Forest (BAAPA) in Paraguay: the San Rafael Reserve.

The Upper Paraná Atlantic Forest (BAAPA), once referred to as the Interior Atlantic Forest, comprises the westernmost extension of humid forest that extends inland from the Brazilian Atlantic coast. Together with 14 other ecoregions, these make up the biome known as *Atlantic Forest*. This biome has been identified as a global conservation priority by a number of experts and initiatives. Among the most noteworthy we can mention the "Global 200" of WWF (Olson & Dinerstein 2002); the "Hotspots" of Conservation International (Myers *et al.* 2000); and the assessment of the conservation state of the terrestrial ecoregions of Latin America and the Caribbean, carried out by WWF and the World Bank (Dinerstein *et al.* 1995).

The Atlantic Forest is a priority for international conservation, not only because of its high biological value or due to being a centre of endemism, but also because it makes up one of the most threatened biomes on the planet. Only 7.4% of its original cover currently remains, although this is in the form of a highly fragmented landscape. Within this complex of 15 ecoregions, the Upper Paraná Atlantic Forest is the most noteworthy for conserving the larger fragments of remnant forest, as well as providing refuge to large herbivores and large vertebrate predators of the highest level in the food chain (Di Bitteti *et al.* 2003).

The San Rafael Reserve is the second largest remnant of the BAAPA in Paraguay, hence its conservation importance not only at a national level, but also at a regional and global scale. Its surface area of approximately 70,000 hectares is shared between the Itapúa and Caazapá Departments, and forms part of the upper Tebicuary River watershed. San Rafael comprises a wide range of habitats that vary from dense forests on steep gradients to open rolling natural grasslands, and includes a network of rivers, streams, springs and waterfalls. Several indigenous communities of the *Mbya* (Guaraní), also known by the names *Kayguá* or Monteses (Meliá 1997), not only depend on these forests for their daily subsistence and livelihoods, but also their cultural identity, as these form part of what once made up their ancestral territories. San Rafael therefore represents an important nucleus, not only for the conservation of biodiversity and complex ecological processes, but also for the conservation of cultural diversity.

By applying this methodology in the San Rafael Reserve, we sought to integrate all existing information, usually limited and dispersed, and summarize the elements that should be considered by those responsible for decision-making and those planning sustainable management activities. It is our hope that the results presented in this document will serve as a tool to facilitate forest use and management, and as a guide for the prioritization of important areas during the development of future conservation efforts.

General Objective

- Identify the elements of High Conservation Value (HCV) in the San Rafael Reserve.

Specific Objectives

- Identify the information sources and tools for defining the elements of HCV in San Rafael.
- Analyze and define parameters and thresholds that enable the identification, measurement or qualification of the elements of HCV in San Rafael.
- Propose management and monitoring guidelines and recommendations that ensure the maintenance, or even the recovery the HCVFs identified.
- Define the needs or gaps in information gathering and analysis that would improve the management of HCVFs.

Methodology

This paper represents the first interpretation of the HCV definitions in Paraguay, and more specifically the application of this methodology in a particular site. The methodology used for this interpretation was proposed by ProForest (2003), in partnership with WWF and IKEA to promote responsible forest management.

This methodology proposes the use of a set of practical tools for the identification, management and monitoring of HCVFs, divided into four sections that correspond to each of the criteria under Principle 9 of the Forest Stewardship Council (Annex II.1), and are detailed below:

1. **Defining individual HCVs:** in this first stage of this process, the HCVFs were defined based on each of the six generic HCVs mentioned above. The process for defining the individual HCVs consisted of four steps or stages:
 - a. ***Search for background and sources of information:*** all background and studies carried out in the past that were relevant to the criteria used, amongst any other sources of available information, were considered for each HCV.
 - b. ***Defining the HCV:*** this required evaluating and selecting the elements that make a forest worthy of being considered and HCV within each criteria.
 - c. ***Parameters and thresholds considered:*** based on the available information and selected attributes, parameters to measure or qualify the HCV in question. This was followed by the identification of thresholds, i.e. levels, categories types or locations that resulted in the interpretation of the HCVs with a range of gradual importance.

- d. *Interpretation of the HCV*: the gradual importance of the HCVs identified could then be interpreted using categories of importance (numeric values) depending on the number of thresholds considered.
2. **Development of consultation requirements**: this phase set out to form a multidisciplinary team made up of environmental educators, human ecologists, biologists, foresters and GIS experts who discussed and developed the requirements for involving stakeholders in the identification and management of HCVFs. This phase of consultation was of utmost importance, particularly concerning HCVs 5 and 6. Details on the consultation forum carried out with representatives from smallholder farmer, or *campesino*, groups and indigenous communities are included in Annex IV.
 3. **Development of requirements for HCVF management**: once one or more HCVs have been identified, the primary objective is to maintain or enhance those values; consequently, at this stage we sought to develop appropriate management recommendations and guidelines for forest managers and decision-makers. These recommendations were gathered from the workshops and consultations and the experience of the consulting team.
 4. **Development of requirements for HCVF monitoring**: monitoring is an integral part of forest management and is particularly important to ensure that each HCV identified shall be maintained or improved. In the last stage of this process, monitoring protocols were suggested that could contribute to achieving this goal.

The methodology for defining HCVFs is mainly based on previously undertaken studies, interpretations and experiences through a variety of processes and initiatives. Therefore, the authors of this methodology recommend that, wherever possible, the search for a HCVF be based on previous studies. The possibility of using existing information sources is an important advantage that allows the working group who wish to apply this methodology to do so without having to carry out new studies unnecessarily. Therefore, the critical step to define a HCVF becomes an issue of how to use existing information, how to evaluate the quality and extent of the information and the possibility of incorporating new data. It is then up to the working group to then discuss what parameters are to be followed, and finally define the thresholds for determining when to qualify a value as a HCV.

This methodology was applied to the San Rafael Reserve by a multidisciplinary and representative work team; in order to achieve a successful outcome, the presence of the following key elements in the work team was taken into account:

- *Experience*: the involvement of experts who when working together are capable of covering the full range of issues included under the definition of HCVF, including biology, ecology, environmental services and socioeconomic aspects;
- *Practical experience*: required the inclusion of experts with recent practical experience to ensure that the interpretation made is appropriate, achievable and accessible to forest managers, local communities and decision-makers.
- *Range of views*: the definition of a HCVF must always be based on the best scientific and technical information available, but the work team's decision as to what the threshold over which a 'value' becomes a 'High Conservation Value' can sometimes be subjective. Therefore, it was very important to carry out discussions and debates amongst the experts before adopting each criteria. These discussions were carried out during a series of meetings and workshops, where the work group was represented by experts capable of providing a wide range of opinions and perspectives. Details of these meetings and workshops, as well as a list of participating experts, are included in Annex IV.

Finally, once the HCVFs of the San Rafael Reserve were identified, the conservation priorities were then established. By superimposing the distribution maps created for each HCV criteria, a hierarchy of HCVF priorities was obtained, ranging from those sites that meet the highest level of HCV criteria possible, to those that cover no more than one criteria; the conservation of these, however, not being less important.

HCV 1

Globally, regionally or nationally significant concentrations of biodiversity values

HCV 1.1: Protected Areas

Background and Information Sources

The area of San Rafael, as a protected area, has had a somewhat particular conservation history dating back to the end of the 1980s. This section summarizes the most relevant facts of this history.

In 1990, after preliminary biodiversity studies of the site were carried out, the San Rafael range (*Cordillera y Cerro San Rafael*) were recognized by the Centre for Conservation Data as a "Priority Area for the Conservation of the Eastern Region of Paraguay", as a result of harbouring flora and fauna species considered endemic to the Alto Paraná Atlantic Forest (CDC 1990). Two years later, the government issues Decree No. 13.680/92, declaring the area comprising the San Rafael range as a "Reserve to become San Rafael National Park."

The land affected by this decree, however, was both then and is still now, private property. This is the where the problems of San Rafael originate; within this area there are a number of large farms, settlements and indigenous communities that carry out a variety of activities including farming, subsistence hunting, fires and illegal extraction of timber, medicinal plants and firewood (Acevedo et al. 1993). Similarly, the many indigenous communities settled within San Rafael not only rely on the forest for their daily subsistence, but also the source of their cultural identity, as part of what forms their ancestral territory.

Within this context, San Rafael has had a complex conservation history influenced by the existence of multiple interests in the area, the array of actors involved and the impossibility of expropriating the area. In 2002, with the intention of regulating the conservation of the area under the concept of sustainable development, the government reassigns the area under a new category of protection and management: "Managed Resources Reserve" (Decree No. 16.610/02). This category of conservation, with goals still unclear and inconsistent with those established by IUCN and UNEP², threatened the effective conservation of the area (Cartes & Yanosky, in Cartes 2006).

Once again in 2005, San Rafael was reassigned to the National Park category by Decree No. 5577/05, underpinning the degree of legal and administrative instability of the area.

The private sector, mainly comprised of conservation-minded landowners and a few NGOs focused on this area, has expressed its concern about the conservation of San Rafael on several occasions. In 1999, the "Alliance for the Conservation of San Rafael," an alliance of four NGOs (Guyra Paraguay, Procosara Association, Natural Land Trust and the Institute for Environmental Law and Economics, and Enlace - a more recently joining member) is created with the objective of developing strategic efforts to achieve the conservation of the entire San Rafael area, mainly through land purchase campaigns and the consolidation of these as conservation nucleus areas (Cartes & Yanosky, in Cartes 2006). To date, approximately 6,200 hectares have already been purchased by Guyra Paraguay on behalf of the Conservation Alliance of San Rafael. At the same time, other owners have decided to contribute to the conservation of the area through the declaration of Private Reserves within their own estates (Parex owner, personal communication).

² Based on the website: www.unep-wcmc.org/protected_areas/categories.

Definition of HCV 1.1

Considering that the entire area of San Rafael has been recognized as a “conservation priority” and a protected area, although still unstable in terms of its conservation and management category, the entire area of San Rafael, made up of 62 properties (according to the official IBR cadastre, updated by Guyra Paraguay 2007) is a HCV area.

Parameters and Thresholds Considered

For the interpretation of priority importance areas within HCV 1.1, the parameter adopted is the perpetual conservation perspective of each of the 62 properties that currently make up San Rafael (according to the IBR cadastre, updated by Guyra Paraguay 2007). Two land use categories were identified, and these are summarized in Table 1. The category corresponding to each property is illustrated in the Map HCV 1.1 (Annex 1).

Interpretation of HCV 1.1

Table 1: HCV 1.1 in San Rafael

Categories for HCV 1.1	Interpretation	Score	Surface Area (ha)
Private Reserves: properties with a main objective of perpetual conservation; these include the properties purchased by Guyra Paraguay and the Private Reserve of 'Parex' (currently in process of being declared).	High HCV	2	7,775
National Park/Managed Resources Reserve: with the objective of protecting / sustainable use of the available resources; properties that are not private reserves and Indigenous Reserves fall under this category.	Medium HCV	1	70,000 (approx.)

In the future, the forest reserves of the properties that carry out cattle ranching or forestry activities could be included as new HCV categories. However, these have not been included in this analysis due to the difficulty of accessing this information.

Recommendations for HCVF Management

Apart from the Private Reserves, which make up conservation nucleus areas, there is an urgent need to officially define the protected area categories that the remaining properties should be assigned to. Only then can the management guidelines for these properties be correctly designed, in line with the implementation of the objectives of the protected area.

Once this situation is defined, the geographical disposition or influence between the conservation nucleus areas and the management areas must be considered, as well as planning their operations in working towards maintaining the conservation priorities. Examples of good practice would be the formal coordination with Guyra Paraguay's conservation nucleus areas in order to minimize impacts, assist the protection and access control.

Recommendations for HCVF Monitoring

Forest managers should maintain and record regular contact with the administration of the nucleus areas, and be highly disciplined in carrying out the technical management norms, particularly regarding low impact management practices.

HCV 1.2: Threatened or Endangered species

Background and Information Sources

San Rafael is the second largest BAAPA remnant in the Eastern Region of Paraguay, after the Mbaracayú Forest Private Reserve. The BAAPA, an ecoregion of high biodiversity and considered a centre of flora and fauna endemism, has been identified at a global level as one of the most threatened ecosystems by deforestation, and only about 7% of its original area remains unchanged (Dinerstein et al. 1995; Olson and Dinerstein 2002; Myers et al. 2000; Di Bitteti et al. 2003).

The levels of alpha and beta biodiversity are quite high in the BAAPA ecoregion, although there are only a few places where intensive surveys have been carried out. Di Bitteti et al. (2003) highlights the ornithological value of San Rafael, made up of some 400 species of bird, as well as the flora of the Misiones Province (Argentina) with about 3,000 species of plants, amongst which 85 orchid species and more than 250 tree species have been recorded in the Iguazú National Park.

Specifically in terms of the biological diversity of San Rafael, as mentioned in the above paragraph, we can mention the efforts of Guyra Paraguay, an organization dedicated to the conservation of birds and their habitats, as one of the most comprehensive initiatives to improve the knowledge of this area. This effort, focused particularly on birds, combined recent expeditions and historical records of the major ornithological collections kept in a global network of natural history museums (Fragano & Clay, in Cartes 2006). As a result of this research, in 1997, San Rafael was designated as the first "Important Bird Area" (IBA) in the country, and the second in South America, clearly indicating the biological significance of the area, considering that the criteria for designating an IBA are quite strict (IBA criteria are summarized in Annex II.3).

However, with the exception of birds, there have been relatively few efforts to compile complete lists of species found in the San Rafael Reserve. The few studies that have been carried out have either not been published or are virtually inaccessible. Several authors have emphasized the urgent need to continue carrying out basic research, collections, inventories and reviews of scientific collections of the site (SEAM 2002; SEAM 2003; González Parini, in Cartes 2006; Fragano & Clay, in Cartes 2006, amongst others). Among the most comprehensive sources of information available to date on the biodiversity of San Rafael, we can mention the Rapid Ecological Assessment (EER) carried out by the Secretary of the Environmental (SEAM 2002), the vegetation analyses carried out by Keel, Gentry and Spinzi (1993), the unpublished technical reports prepared by Guyra Paraguay resulting from periodic surveys on some of the 62 properties which make up the Reserve (Guyra Paraguay Database 2007), and the forest inventory of the Reserve (Ramirez & Riveros 2001, quoted by SEAM 2002).

Table 2 summarizes the number of species for each taxonomic group recorded to date in San Rafael, as well as the total species estimated for Paraguay (according to SEAM 2003 and ENAPRENA 1995). Considering the great biological wealth estimated for a BAAPA remnant such as San Rafael, this comparison also gives an idea of the size of the information gaps that still exist, particularly for the plant and invertebrate groups.

Table 2: Comparison between species recorded in San Rafael and those estimated for Paraguay

Taxonomic Group	Total species recorded in San Rafael to date (SEAM 2002)	Total species estimated for the country (ENAPRENA 1995; SEAM 2003)
Plants	322	13,000
Invertebrates	650	100,000
Fish	52	200 - 250
Amphibians	33	46 - 76
Reptiles	27	100 - 150
Birds ³	399	707
Mammals ³	61	167 - 175

Being a highly endangered ecoregion, the recorded and estimated biological wealth of San Rafael is currently under great pressure. The International Union for the Conservation of Nature (IUCN)⁴ has developed categories to assess the conservation state of species at a global level under different criteria, such as the observed, estimated or inferred population reductions, the geographical distribution, the population size and the probability of extinction within a certain number of years or generations. Consequently, each species can be classified in one of the following seven categories: Extinct (E), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), and Near Threatened or of Least Concern. The Secretary of the Environment, through Resolution 524/06, introduced the list of threatened species at a national level based on the same evaluation criteria and categories proposed by IUCN (the characteristics of each of these categories are described in Annex II.2).

With this in mind, we considered it important to base the evaluation and definition of the HCV 1.2 taking the following elements into account:

- key taxonomic groups with sufficient or acceptable levels of available information on species records in the area, which reduces our scope to only consider the following groups: birds, mammals and plants;
- species within a threat category at both a global (IUCN) and national (Resolution 524/06) level (lists of these endangered species recorded in the Reserve to date are included in Annex II.4);
- the principle of IUCN, according to which a species is considered "threatened" when it is placed within one of the following categories: CR, EN or VU.
- finally, it is also important to consider the A1 criteria of IBAs within our own definition (Annex II.3), which states that "the sites that regularly maintain significant numbers of globally threatened species, or other species of global conservation interest" automatically qualify as IBAs⁵. It was decided that this principle would be adapted to the evaluation of other taxa, with certain modifications that aim to identify thresholds and importance levels.

³ Updated number of species according to Guyra Paraguay Database (2007).

⁴ Source: www.iucnredlist.org

⁵ The entire classification system and IBA database were created and managed by *BirdLife International* and can be visited at http://www.birdlife.org/action/science/sites/american_ibas/index.html

Definition of HCV 1.2

All properties within the San Rafael Reserve that hold species of birds, mammals and/or plants within one of the following three threat categories (Critical, Endangered and Vulnerable according to IUCN and Resolution 524/06 of the SEAM) shall be considered HCV. This definition also takes into consideration the A1 criteria for identifying IBAs (BirdLife International).

Parameters and Thresholds Considered

In order to prioritize the areas of importance in relation to criteria HCV 1.2, properties were analyzed so as to emphasize the value of those hosting species of bird, mammal and/or plants with a greater degree of threat at a global level, giving a lower category to those only having endangered species at a local level, as detailed in Table 3. It is important to consider that, unfortunately, not all properties within San Rafael were considered, since some of these have never been surveyed properly in terms of biological inventories, and were consequently excluded from this evaluation. The properties that were considered, and the species found in each of these, are included in Annex II.4.

Interpretation of HCV 1.2

Table 3: HCV 1.2 in San Rafael

Categories for HCV 1.2	Interpretation	Score	Number of Properties
Presence of globally threatened species under the CR, EN, and VU categories of IUCN, as well as species included under any level of threat at a national level (Resolution 524/06).	Very High HCV	4	0
Presence of globally threatened species under the EN and VU categories of IUCN, as well as species included under any level of threat at a national level (Resolution 524/06).	High HCV	3	8
Presence of globally threatened species under the VU category of IUCN, as well as species included under any level of threat at a national level (Resolution 524/06).	Medium HCV	2	3
Presence of species included under any level of threat at a national level (Resolution 524/06).	Low HCV	1	0
Non-surveyed properties.	No information	–	51

Recommendations for HCVF Management

Endangered species are a conservation priority, and their management as well as the management of habitats they depend on, should be supported by employing the best information available. We emphasize the importance of continuing flora and fauna surveys and inventories, which may provide new data on the presence and status of endangered species.

Recommendations for HCVF Monitoring

During the forest survey, forest managers must identify and mark the individual trees belonging to endangered species of commercial value, particularly the mature individuals, so that steps can be taken to avoid the reduction of their populations during the harvest. Through the employment of permanent plots or other monitoring systems, forest managers must monitor the effects of harvest on the mortality rates and isolation of threatened species. The forest manager must compile information from existing and available sources to analyze the best way of monitoring the biodiversity of the area, particularly the endangered species. The forest manager should also engage various research institutions to carry out studies and monitor species within their management unit.

HCV 1.3: Endemic species

Background and Information Sources

The Alto Paraná Atlantic Forest is considered a centre of endemism. Some 85 species of fish, 7 species of amphibians, 1 species of reptile, 80 species of birds and 11 species of mammals are strictly endemic to this ecoregion. Many more species of vertebrates, with declining population trends, currently show a distribution exclusively restricted to the Atlantic Forest remnants (Fragano & Clay, in Cartes 2006). Regarding the plant group, information on the number of endemic species is limited by a lack of detailed records, because information on this subject is usually dispersed (Fragano & Clay, in Cartes 2006). However, we can mention at least 136 plant species with distributions restricted to within the country, and many of these particularly confined to the BAAPA (Barreto et al. 2004, quoted by Cartes 2006).

In support of what was discussed in the preceding section on the biodiversity of the San Rafael Reserve, and once again excluding the bird group, very little information is available on occurrence records for endemic species of other taxonomic groups within this area. The sources of information on the biodiversity of San Rafael mentioned in the preceding paragraph summarize the available data to date on these endemic species.

The available information leads us to support the evaluation and definition of HCV 1.3 based on the following elements:

- key taxonomic groups and sufficiently acceptable or available information on the records of endemic species in the area, which limits us to consider only the following groups: birds, mammals and plants (the list of these endemic species recorded to date in the Reserve is presented in Annex II.5);
- in the specific case of birds, the A2 criteria of IBAs is considered, which states that "sites that hold a significant proportion of species with restricted distributions (33%) will be designated as IBAs, and are hot spots for the conservation of the entire biodiversity" (see Annex II.3).

Definition of HCV 1.3

All properties within the San Rafael Reserve that hold endemic species of birds, mammals and/or plants shall be considered HCV. This definition also takes into consideration the A2 criteria for the identification of IBAs (BirdLife International).

Parameters and Thresholds Considered

For the analysis of important areas in relation to the criteria HCV 1.3, properties were prioritized in order to emphasize the value of those that hold any endemic mammal or plant species, and/or more than 33% of the bird species endemic to the Atlantic Forest, as shown in Table 4. It should be noted that, unfortunately, not all the properties of San Rafael were considered, since some of these have never been surveyed and were consequently excluded from the evaluation. The properties that were included, and the species found in each of these, are included in Annex II.5.

Interpretation of HCV 1.3

Table 4: HCV 1.3 in San Rafael

Categories for HCV 1.3	Interpretation	Score	Number of properties
Presence of endemic species of plants, mammals and/or the presence of more than 33% of the endemic bird species of the Atlantic Forest.	High HCV	2	10
Presence of less than 33% of the endemic bird species of the Atlantic Forest.	Low HCV	1	1
Non-surveyed properties.	No information	–	51

Recommendations for HCVF Management

The commercial use of endemic species, or other species on which these depend, should essentially be carried out within a framework of sustainability, since these species are restricted to a certain habitat or distribution and may be more vulnerable to changes. If any endemic species are included amongst those harvested for timber or other products, every precaution should be considered to maintain the population viability. We emphasize the importance of continuing flora and fauna surveys and inventories, which may provide new data on the presence and status of endemic species.

Recommendations for HCVF Monitoring

During the forest survey, forest managers must identify and mark the individual trees belonging to endemic species of commercial value, particularly the mature individuals, so that steps can be taken to avoid the reduction of their populations during the harvest. Through the employment of permanent plots or other monitoring systems, forest managers must monitor the effects of harvest on the mortality rates and isolation of endemic species.

HCV 1.4: Critical Temporal Use

Background and Information Sources

To date, limited information is available on the existence of key sites where species of fauna seasonally concentrate to mate, migrate and feed, or that can provide shelter and connectivity between habitats during extreme conditions (floods, droughts, radical land use change). Although studies of this kind have never been carried out in a systematic manner, neither in San Rafael or any of the other conservation nucleus areas within the Paraguayan BAAPA, there are certain elements that can be taken into consideration when evaluating this criteria.

Seasonal presence of fish:

The indigenous groups that inhabit the Reserve specifically highlight the importance of the Kanguery stream, particularly during the spring, as a site where large aggregations of fish, such as *karimbatá*, salmon and *boga* congregate (indigenous representatives, during a consultative forum in June 2007). Medina & Mandelburger (SEAM 2002) also mention having observed several species of fish in juvenile stages. They concluded that, both the running and standing water resources of San Rafael present favourable conditions for spawning fish of several species and make up a temporal refuge for the development of the juvenile stages.

Migratory Birds:

To date, a total of 59 species of migratory birds have been recorded within the San Rafael Reserve (see the species list in Annex II.6). Taking into consideration the 131 migratory species recorded in Paraguay (Guyra Paraguay Database 2007), this represents just over 45% of occurrence in the area. It is important to bear in mind that this is the result of surveys carried out in only 11 of the 62 properties that make up the Reserve; consequently, these figures are not necessarily definitive. However, they do reflect the importance of San Rafael for a great number of migratory forest and grassland species.

Congregations of *Xanthopsar flavus*:

The Saffron-cowled Blackbird, *Xanthopsar flavus*, also known locally as "*Chopí Say'ju*", belongs to the icterid family and inhabits the grasslands of the Mesopotamian Region. This biogeographic region is comprised of the lowland plains of the Uruguay River in the Entre Ríos and Corrientes Provinces of Argentina, and reaches into the south of Brazil and the south of Paraguay, including some intrusions into the San Rafael area. The saffron-cowled blackbird is mainly threatened by the loss of habitat and is considered 'Endangered' by IUCN. According to recent estimates, the entire population in Argentina is of 500 - 1000 individuals. Recent studies in southern Paraguay indicate that the saffron-cowled blackbird population in the *Aguapie* watershed could be over 1000 individuals. In spite of the historic evidence that the saffron-cowled blackbird was once common, there are very few recent records of this species in Paraguay. In March 1992, the species was recorded in the wetlands of the *Aguapey* stream (Itapúa Department), and within the last two years, it has been frequently recorded in the grasslands of *Kanguery* - San Rafael. Based on this, *Kanguery* qualifies under the A4ii IBA criteria as a result of holding important numbers of migratory species.

Saltlicks:

Saltlicks are areas of outcropping clay soils that certain animal species visit to practice geophagia, the intentional intake of soil with the purpose of accessing essential minerals that are deficient in their diets, which help to neutralize toxins from other food sources and, in the case of birds, which help to grind food in the gizzard (Delgado 2006). The indigenous groups that inhabit the Reserve mention that there are a number of saltlicks, within the forests of San Rafael, which are occasionally visited by certain animal species. They mentioned two of the best known ones for them; *Barrero Naranja* and *Barrero Guabira* (indigenous representatives, during the consultation forum, June 2007). However, indications provided by these indigenous representatives were not enough to determine the exact whereabouts of these saltlicks, and it is hoped that these points shall be georeferenced during future expeditions.

Definition of HCV 1.4

The sites with specific habitats that make up biological corridors or key sites for migratory species, congregations of individuals, breeding seasons and/or feeding areas, shall be considered HCV under this criteria.

Parameters and Thresholds Considered

The elements mentioned above show the attributes to be considered a HCV 1.4; however, the exact locations of some of these are not known. Consequently, we only propose areas as HCV 1.4 where the presence of migratory bird and fish species has been recorded, as well as the presence of congregations of *Xanthopsar flavus*. However, we are aware that the amount of HCV 1.4 could increase once more information on other areas of critical use is gathered.

The recorded presence of migratory species and congregations, or any other evidence of critical temporal use in a determined area, automatically qualifies it as a HCV 1.4, and consequently all these sites should be considered of equal importance.

Interpretation of HCV 1.4

Table 5: HCV 1.4 in San Rafael

Categories of HCV 1.4	Interpretation	Score	Number of properties
Presence of migratory species.	High HCV	1	10
Presence of <i>Xanthopsar flavus</i> congregations.	High HCV	1	8
Presence of migratory fish.	High HCV	1	–
Non-surveyed properties.	No information	–	–

Recommendations for HCVF Management

Identify and map, within the management areas, the critical sites for wildlife concentrations and establish protection measures (reserves, impact minimization). Sites where many critical areas overlap should be taken into consideration to determine the protection areas of the forest management unit. In places where one or more of these special areas exist, at least twice the total surface area should be protected.

Recommendations for HCVF Monitoring

Monitoring should be carried out during the critical periods. Other special areas, that have not been included in this guide, should also be identified.

HCV 2

*Globally, regionally or nationally significant large landscape level forests***Background and Information Sources**

The Atlantic Forest, a complex of 15 terrestrial ecoregions located along the Atlantic coast of Brazil, eastern Paraguay and northeastern Argentina, has been identified as a conservation priority at a global level by a number of experts and initiatives. Among the most important of these, we can mention the "Global 200" of WWF (Olson & Dinerstein 2002; Di Bitteti et al. 2003), the "Hotspots" of Conservation International (Myers et al. 2000) and the assessment of the conservation status of terrestrial ecoregions in Latin America and the Caribbean, carried out by WWF and the World Bank (Dinerstein et al. 1995).

The Atlantic Forest is a priority for international conservation, not only because of its high biological wealth or for being a centre of endemism, but also for being one of the most threatened biomes of the world. Currently, only 7.4% of its original area remains, albeit in the form of a highly fragmented landscape. Within this complex of 15 ecoregions, the Alto Paraná Atlantic Forest (BAAPA) draws most attention for still maintaining the largest blocks of remnant forest, as well as hosting large herbivores and large vertebrate predators of the highest level in the food chain (Di Bitteti et al. 2003).

Despite the fact that Paraguay still maintains a large area of BAAPA remnants (approximately 1,152,332 hectares), this only accounts for 13.4% of the original BAAPA area within the country (Di Bitteti et al. 2003). Until very recently, Paraguay had one of the highest deforestation rates amongst American countries (Altstatt et al. 2003, quoted by Di Bitteti et al. 2003). However, this situation was contained to some extent as a result of the remarkable efforts of environmental managers from the private and public sectors, which led to the enactment and implementation of Law No. 2524/04 which "prohibits the transformation and conversion of forest areas in the Oriental (Eastern) Region" (also known as "*Ley de Deforestacion Cero*" or the "Zero Deforestation Act"), which banned the conversion of forests in the Eastern Region for two years. In 2006, a new law was enacted (Law 3139/06), which was established to extend the same prohibition until 2008.

Although the San Rafael Reserve, being the second largest native forest remnant in Paraguay represents an important opportunity for BAAPA conservation, the fragmentation, isolation and degradation of these forest remnants continue to be the main threats to the long-term conservation of the biodiversity of this ecoregion. Consequently, the challenge is to attempt to maintain the largest forest blocks intact, while connecting them with other forest blocks through a network of corridors.

This challenge leads us to attempt to specify how large the remnant forest blocks must be to maintain the main ecological processes, such as biotic interactions, the pollination of key species and predation, amongst others. Regarding these issues, it is worth mentioning that there is extensive debate amongst ecologists and conservation biologists regarding whether a number of very small fragments has the capacity to maintain approximately the same species that a large fragment is able to maintain (Bierregaard et al. 1992; quoted by Di Bitteti et al. 2003). In fact, larger forest fragments are generally superior to smaller fragments in terms of their ability to conserve biodiversity at all levels. In order to better illustrate the role of the larger forest blocks, Table 6 shows as an example, an estimate of the density and area required by individuals and by populations of different sized tropical vertebrate species of the BAAPA.

Table 6: Estimate of the density and area required by individuals and by populations of different sized tropical vertebrate species of the BAAPA (adapted from Di Bitteti *et al.* 2003).

Species	Density individuals/Ha	Area per Individual Ha/individual	Area per 50 Individuals Ha/50 individuals	Area required for viable population* Ha/150 individuals
Harpy Eagle	0.0002	5,000	250,000	750,000
Jaguar	0.0003	3,500	175,000	525,000
Tapir	0.0039	254	12,712	38,136
Deer	0.0157	64	3,191	9,574
Coati	0.0408	25	1,227	3,680
Collared Peccary	0.0414	24	1,207	3,621
Armadillo	0.1275	8	392	1,176
Capuchin Monkey	0.1366	7	366	1,098

* To guarantee a minimum population of 50 individuals (the minimum required for a population to be considered viable), it is necessary to maintain at least three times this number of individuals (150 individuals).

Di Bitteti *et al.* (2003), in their biological vision to conserve the BAAPA, mention that there are only about 28 forest fragments greater than 10,000 hectares in the entire ecoregion, and only two of these are larger than 100,000 hectares. These two fragments would, in theory, be the only remnants able to maintain minimum viable population levels of vertebrates such as harpy eagles and jaguars. However, despite the conservation problems described above, there is evidence that the few and relatively large forest remnants that remain, still hold umbrella species, including large cats, eagles and peccaries, suggesting that in these areas, biodiversity and the main ecological processes remain intact.

Based on the current situation of the BAAPA, the same authors propose certain guidelines on the minimum area that the forest remnants should have to ensure the effective conservation of the ecoregion. On the one hand, they argue that only the largest forest blocks (over 10,000 ha of continuous and relatively intact forest) are resilient to environmental change in the short term, are capable of harbouring umbrella species, and can maintain complex ecological processes. On the other hand, the authors also recognize that while the protection of large forest remnants is of utmost importance, this would not be enough to achieve the objectives of conservation; they emphasize that although efforts are focused on preserving the large blocks, one should not underestimate the value of conserving the small fragments.

There are many ways in which small fragments can contribute to conservation. Di Bitteti *et al.* (2003) mention the following: first, small forest fragments may play an important role in the protection of micro-watersheds and soils; second, they can serve as ecological springboard islands indicating the way for the creation of future biological corridors; third, they can operate as a winter shelter for local migratory birds or others from remote locations; fourth, they can provide seeds for local forest recovery programs; and fifth, some small fragments may still hold species not found in the other ecoregions or forest fragments, which would be particularly important for the invertebrate group, bearing in mind that during the Rapid Ecological Assessment of San Rafael, many species of rare and little-known insects were found in several small and isolated forest fragments (Kochalca *et al.* in SEAM 2002). Finally, they can also play important cultural, aesthetic and educational roles.

Based on the analysis carried out for the identification of HCV under the second criteria in San Rafael and other areas within the BAAPA, we recommend that the principles raised by Di Bitteti *et al.* (2003) regarding minimum areas of forest remnants that maintain complete ecological processes and viable populations of large vertebrates be considered. The concept of the importance of smaller forest fragments in the effective conservation of the ecoregion should also be incorporated into the definition of HCV for the second criteria.

Definition of HCV 2

All native forest remnants that are representative of the BAAPA ecoregion within the San Rafael Reserve are HCVs. The importance of continuous blocks of forest larger than 10,000 hectares should be prioritized as conservation nucleus areas, due to their ability to preserve complex ecological processes and viable populations of umbrella species. Similarly, the conservation of smaller forest fragments is essential to the interconnection of the larger nucleus areas.

Parameters and Thresholds Considered

The forests of San Rafael were assessed using LANSAT (scene 224-78, bands 3, 4 and 5, 2004) and CBERS II (scenes 163-129 and 163-130, 2006) satellite imagery, in order to identify and isolate the main continuous forest remnants and calculate their surface area.

As a result, it was decided to clearly reflect the importance of the blocks larger than 10,000 hectares in the hierarchy under HCV 2, and consequently this value was adopted as the upper threshold. The importance of the smaller fragments was interpreted with thresholds of 1,000 and 100 hectares, as shown in Table 7. The results of this evaluation are shown in the corresponding map.

Interpretation of HCV 2

Table 7: HCV 2 in San Rafael

Categories of HCV 2	Interpretation	Score	Surface Area (has)
Continuous forest blocks larger than 10.000 hectares.	High HCV	3	33,831
Continuous forest blocks larger than 1.000 has and smaller than 10.000 hectares.	Medium HCV	2	4,748
Forest fragments larger than 100 hectares and smaller than 1.000 hectares.	Low HCV	1	2,211

Recommendations for HCVF Management

The most important consideration for the proper management of HCVF under criteria 2 is a holistic overview: the remnant forest patches should not be evaluated in isolation, but always within a landscape level framework. The maintenance of large forest blocks necessarily implies that the activities carried out in the short or long terms should not contribute to its further fragmentation. Moreover, while planning activities in smaller forests, these fragments should be evaluated in terms of their potential for creating corridors which would help maintain the animal population flow and protect species and landscapes.

Recommendations for HCVF Monitoring

The monitoring of large forest blocks can be based on a periodic analysis of satellite images. It may also be important to manage data on the abundance and geographic positions of the umbrella species, particularly those indicator species of large forest blocks.

HCV 3

Forest areas that are in or contain rare, threatened or endangered ecosystems

Background and Information Sources

Under the HCV 3 criteria, this methodology proposes to carry out a comparative analysis at the ecoregional level, when applied at national or sub-national level. However, because this particular case focuses on a specific and representative area of one ecosystem, a more specific analysis shall be carried out at the local level, based on the BAAPA ecosystems occurring within the San Rafael Reserve.

In effect, San Rafael harbours a wide variety of particular environments and ecosystems. These include dense, semi-deciduous and humid forests that can reach heights of up to 30 metres, with several forest tree species of high commercial value. Riparian forests of up to 15 m in height follow waterways forming strips of variable width along rivers and streams which fade into the higher forests. Amid this lush vegetation, streams and rivers form a series of waterfalls and rapids of great scenic beauty. In turn, the springs from which these waterways originate determine the development of plant communities specially adapted to the specific soil and microclimate conditions found here.

In the south-eastern part of the Reserve extensive natural grasslands, characterized by a great diversity of herbaceous flora and particular bird species, have developed interspersed with forest fragments. As the topography continues to drop, the grasslands become permanent wetlands that favour the emergence of species adapted to aquatic ecosystems.

This brief overview of the main ecosystems within San Rafael gives a rough idea of the great variability of environments that can be found once different variables are combined, such as soil characteristics, slope, topography, and microclimate. While many of these ecosystems have been identified during expeditions carried out within the Reserve, as well as its buffer zone (Kochalka et al. in SEAM 2002), most of these have not been georeferenced, or are too small to be identified in satellite images and aerial photographs.

After assessing the information available on this subject, it was decided to highlight the importance of the ecosystems described below, due to either being considered particularly vulnerable or rare, for protecting watersheds or for harbouring endangered species. The exact location of all these ecosystems within the reserve is not necessarily known. In some cases, these have not yet been recorded within the Reserve, but have been recorded in the buffer zone; consequently, it is assumed that there is a high probability that they exist within the Reserve.

Springs:

These are sites, usually found in lowlands, from where water surges continuously; this creates a small pool of water that favours the development of vegetation adapted to saturated soils and constant humidity levels. These springs make up the sources of watercourses (CDC 1990); hence the importance of their protective forests, considering that these have a direct influence on the quantity and quality of water which flows from these springs.

Forests on saturated or flooded soils dominated by tree ferns:

These forests, of medium to low canopy height, develop on dark soils with abundant organic matter, usually in depressions in the land where the water table is shallow, and the soils are usually temporarily or permanently saturated or flooded. These communities are typically associated with springs and watercourses. The vegetation of these forests is fully adapted to the conditions of constant moisture; comprised almost exclusively of groups of tree ferns, Cyatheaceae of the *Cyathea*, *Alsophila* and *Trichipteris* genres, which can reach up to 6-7 meters in height. Several epiphytes (ferns, cacti, bromeliads and orchids) find ideal supporting conditions in these tree ferns for their development, creating a very particular beauty in these environments (CDC 1990; Marin et al. 1998; Jimenez and

Espinoza 2000; Cartes 2006). We consider these ecosystems threatened due to maintaining numerous plant species considered Endangered at a global and national level. Tree ferns, epiphytic bromeliads of the genus *Tillandsia* and several species of orchid and cacti, all of them typical of these forests on saturated soils, are highly valued for as ornamental species, and are consequently included within national threat categories (Resolution 524 SEAM / 06) and in Appendix I or II of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora).

Peatlands:

Peatlands are wetland communities usually small in size, with very acid and cold water, where plant matter accumulates in varying degrees of decomposition, commonly known as peat. Peatlands develop in places with poor drainage, which results in the accumulation of rainwater, and therefore delaying the decomposition of organic matter. As a result of a lack of oxygen, organic matter is produced faster than it decomposes, thus the importance of these ecosystems as carbon sinks. Peatlands have a very different floristic conformation from their surroundings, with a dominance of moss species of the genus *Sphagnum* (CDC 1990). Kochalca et al. (2002) mention having found a peatland in the upper *Kamba'y* stream and highlight the uniqueness of its vegetation; however, this peatland does not fall within the boundaries of the Reserve, but the same authors emphasize the need to search for these ecosystems within the Reserve.

Cliffs and ravines with epilithic vegetation:

These are vertical or nearly vertical rocky walls, with very special plant associations (CDC 1990). Plants associated with these environments make up what is referred to as epilithic vegetation, and considering the few of these environments in the country, this type of vegetation obviously includes species that can be considered rare or uncommon. Kochalka et al. (SEAM 2002), highlight having found an ecosystem of this type within the property of Antebi, where it is believed rare species of invertebrates are associated with this particular vegetation.

Rapids and waterfalls:

A number of streams and rivers within San Rafael present, at certain points of their course, abrupt and significant natural drops, usually with more than a 60% grade (CDC 1990). Depending on the greater or smaller difference in height, either waterfalls or rapids can occur, respectively, in both cases resulting in increased current acceleration and water oxygenation. These characteristics create microclimates where plant species adapted to these conditions develop (CDC 1990). Two waterfalls are particularly noted for their scenic beauty, the *Salto Takuapi* (also known as *Salto Poty*) and the *Salto Tembey*.

Hill ranges:

Hills are important not only for their scenic beauty, but also for their natural and cultural heritage. The main hill within the reserve is called *Cerro San Rafael*. Other hills in the buffer zone, such as *Matoví*, *Violeta*, *Tacuapí* and *Ñu Kañy*, amongst others, could eventually be considered HCV, but are not included in this analysis because they do not lie within the boundaries of study area.

Definition of HCV 3

The sites that hold ecosystems or natural communities considered rare or vulnerable, that protect watersheds and/or harbour rare or threatened species shall be considered HCV under this criteria.

Parameters and Thresholds Considered

While all communities described above, considered rare or vulnerable, could potentially be HCVs within the San Rafael Reserve, the presence of all these ecosystem types within its boundaries has not been confirmed, or their exact location is still unknown. Based on these information gaps, in order to propose areas with HCV 3 characteristics, the available GIS tools were used to carry out an analysis of *potentially* rare or vulnerable sites.

Using digitized information of the Tebicuary watershed (DGEEC 2002) and topography (USGS 2004), we attempted to locate sites that, due to certain particular characteristics, could potentially be rare or endangered ecosystems. This analysis sought to locate the following elements within the Reserve:

- **Areas with gradients greater than 30%:** could indicate the presence of cliffs or gorges, possibly with epilithic plant communities.
- **Areas with gradients greater than 30% associated with water courses:** could indicate the presence of waterfalls or rapids.
- **Springs:** make up the upper watersheds and potentially indicate the presence of plant communities specially adapted to saturated or flooded soils, as well as forests dominated by tree ferns or peatlands.
- **Hills:** the *Cerro San Rafael* is included in this analysis, due to its scenic beauty and because it forms part of the territory designated as "Reserve to become San Rafael National Park", by Decree N° 5577/05.

The results of this analysis are illustrated in the HCV 3 map. The presence of one of the ecosystems mentioned above in a given area, or another environment that complies with the characteristics mentioned in the definition of HCV 3 makes this area automatically qualify as HCV 3; consequently, all these sites must be considered of equal importance.

Interpretation of HCV 3

Table 8: HCV 3 in San Rafael

Categories of HCV 3	Interpretation	Score	Estimated area (ha)
Areas with gradients greater than 30%.	High HCV	1	481
Springs with forest cover within the buffer area radius of 300 meters.	High HCV	1	3,396
Cerro San Rafael	High HCV	1	254

Recommendations for HCVF Management

Forest managers must be aware of the different types of forest they are managing and verify if these are threatened or maintain threatened or rare species. In the case of the management unit being within or containing areas defined as HCVF, the forest manager should take the necessary good management measures and record the location, extension, condition and activities that are carried out in these forests.

Recommendations for HCVF Monitoring

The establishment and monitoring of permanent plots in these sites is imperative.

HCV 4

*Forest areas that provide basic services of nature in critical situations***HCV 4.1: Forests critical to water catchments****Background and Information Sources**

The importance of forests is critical to the conservation of watersheds and micro-watersheds, for the maintenance of water quantity and quality, and the conservation of the associated fauna. Consequently, any change in the forest, including the loss of biomass and biodiversity could disrupt the flow dynamics and the water recharge. Apart from these potential changes in the quantity, quality and continuity of water flows, deforestation processes could also often imply an increase in sediment load, with varying impacts on habitat further downstream (UNESCO 2006).

Within national legislation there are certain legal frameworks, such as Law No. 422/73 (Forest Code) and Decree No. 18.381/86 (which establishes environmental protection standards), through which the importance of forests in the protection of watersheds and springs is recognized. More specifically, under Decree 18.831, the concept of "protection forests" is considered for the first time, and it establishes the obligation to ensure the protection of water courses, lakes and springs, by means of preserving a strip of protective forest at least 100 meters wide on each bank; this decree also vaguely mentions that the width of this strip could be increased in relation to the breadth and importance of the particular watercourse.

As the second largest BAAPA forest remnant in Paraguay, and as part of the upper river basin of the Tebicuary River, a main tributary of the lower Paraguay River (OAS 1971), the San Rafael Reserve is critical to the protection of watercourses and catchment areas (Cartes and Yanosky, in Cartes 2006). The Tebicuary river basin covers an estimated 26,000 km² area (OAS 1971). The entire San Rafael Reserve lies within this watershed, and protects approximately 159 springs within its boundaries.

There are numerous qualitative and quantitative studies on the Tebicuary River and river basin, although sometimes, this available information is either widely dispersed or not readily accessible. In 1992, the Department of Meteorology and Hydrology published data on the surface-water hydrology of Paraguay, and amongst these, data on the Tebicuary basin. Facetti (2002) also mentions that the direct and indirect pollution of water resources comprises a major threat for the middle and lower sections of this basin, as a result of pesticide use in agriculture and the discharge of organic waste from the alcohol and sugar industries in the area. Hydrometric and water quality studies were also carried out in the Tebicuary-mi River sub-basin (Caceres et al. 2005; Facetti et al. 2006). Regarding the ichthiofauna of the Tebicuary River, Medina and Mandelburger (SEAM 2002) mention that very few studies have been carried out, and that there are still many information gaps.

In 2005, through Resolution 430/05, the SEAM cancelled all environmental licenses issued to agricultural projects carried out within the Tebicuary watershed, after having detected a dangerous drop in the river level that was attributed to the large quantities of water used to irrigate rice fields in the area (extracted from approximately 44 sources for some 56 growers). As a result, a detailed study of the entire watershed was carried out, under the responsibility of the General Department for the Protection and Conservation of Water Resources, and the report is available in this Department of the Secretary of the Environment.

In addition to the elements mentioned above, there is a third factor which further emphasizes the importance of forests in San Rafael for watershed protection, although in this case, we refer to a specific underground water system: the Guarani Aquifer.

The Guarani Aquifer is the world's largest underground fresh water reserve in the world. Its extension overlaps with a large portion of the BAAPA, stretching from the Midwest region of Brazil through Paraguay, north-eastern Argentina and mid-western Uruguay (Facetti & Stichler 1995, quoted by Di Bitteti et al. 2003). In the particular case of Paraguay, the aquifer has a major socioeconomic impact, since as a source of drinking water, it does not require any chemical treatment due to the geological and morphological characteristics that, to date, ensure a good water quality (Facetti, in Cartes 2006).

The protection of the aquifer is mainly based on the sustainable use of the resource and the maintenance of its good quality conditions. The latter is closely linked to the preservation of the BAAPA, as this ecoregion covers the estimated area of the aquifer. In fact, it has been noted that in densely populated urban areas, chemical and bacteriological contamination of the aquifer do occur (Aquifer Monitoring Programme of Paraguay 2000, quoted by Facetti, in Cartes 2006). Consequently, the preservation of the last remnants of the BAAPA, such as the San Rafael Reserve, is of utmost importance, since the loss of forest cover causes a series of physical and chemical phenomena that ultimately alter the infiltration capacity of soils, the renewal times and quality of the aquifer water (Facetti, in Cartes 2006).

Based on the background and available records provided in this section, we propose that the definition of HCVF be based, according to criteria 4.1, on the principles established by the existing national legislation on protection forests (Law 422/73 and Decree 18.831/86). It is also recommended that an extra 300 meter protection radius for the headwaters and springs be incorporated, because of the importance of these forests in protecting the headwaters of micro-watersheds.

Definition of HCV 4.1

All forests with a width of at least 100 meters that protect both margins of watercourses that make up the Tebicuary River watershed, as well as forests that protect a 300 meter radius around springs, shall be considered HCVF.

Parameters and Thresholds Considered

The parameters taken into consideration while interpreting the importance of the protection forests of watercourses and springs are the width and quality of these forests. To accomplish this, digitized information of the Tebicuary watershed (DGEEC 2002) were used to analyze the most important watercourses within the Reserve. Buffer areas of 100 metres on either side of these watercourses, as well as a 300 meter radius around springs, were added. Finally, this information was integrated with the forest cover of the Reserve. The interpretation of the importance levels prioritizes the value of springs due to their importance as watershed headwaters (Table 9).

Interpretation of HCV 4.1

Table 9: HCV 4.1 in San Rafael

Categories of HCV 4.1	Interpretation	Score	Surface Area (has)	Number of Springs
Springs with forest cover within the 300 meter buffer area.	High HCV	3	3,396	136
Watercourses with forest cover of at least 100 meters width on both margins.	Medium HCV	2	6,254	–
Springs and watercourses without at least 100 meters of forest cover on both margins.	Low HCV	1	3,691	23

Recommendations for HCVF Management

We recommend that timber extraction in watercourse protection forest areas should be restricted.

Recommendations for HCVF Monitoring

Long-term monitoring can be achieved by checking the water levels of wetlands and springs, the water quality, the verification of possible problems such as sedimentation or eutrophication and the changes in the watershed's micro-climate. Monitoring must be carried out by field visits, the installation of equipment for ongoing monitoring of water levels, weather stations, or others, and the use of tools such as satellite imagery to monitor changes in the watershed. It is important that this monitoring will also consider the impacts that occur outside the area of the Reserve.

HCV 4.2: Forests critical to erosion control

Background and Information Sources

Forests are important for maintaining soil stability, including erosion and landslide control. Most forest standards for forest management take this into account. However, in some cases, the risk of severe erosion is extremely high and the consequences in terms of a loss of productive soil and damages to the ecosystem are potentially catastrophic. In these cases, the protective service that the forest ecosystem provides is critical and must then be designated as HCVF.

Moreover, land use planning and the planning of sustainable use activities should be based on the scientific knowledge about the characteristics, properties and nature of the soil, as well as their geographic distribution. Vasquez Morera (1997) argues that the rational use of forests and the conservation of natural vegetation in fragile or strategic areas are practices that require knowledge of the physical and chemical characteristics, mineral nature, spatial distribution and limitations of the land for their development or conservation.

Based on these principles, it is assumed that the interpretation of soil aptitude for the most common uses (agriculture, livestock, forestry, engineering, protection, urbanization, amongst others) should be based on thorough studies on the characteristics of the soil.

Regarding the protection of soils against erosion, in 1986 the national legislation incorporated the concept of "protection forest" against erosion by signing the Decree No. 18.831/86, which prohibits the clearing of land on slopes greater than 15%. The same decree recommends that soils with slopes greater than 5% which are dedicated to agricultural practices should carry out conservation measures that prevent erosion.

In addition to legislation, as a reference and useful tool for evaluating criteria in the process of identifying critical areas for erosion, it is worth highlighting the work of Lopez et al. (1995, quoted by Vásquez Morera 1997) on the soils of Eastern Paraguay, under the framework of the project "*Racionalización del Uso de la Tierra*" (Rationalizing Land Use), carried out with financial support from the World Bank, and in collaboration with the United Nations Development Program and the National Government. The objective of this project was to facilitate decision-making process at a local level and the appropriate management of soils in the Eastern Region of the country, and included the creation of maps that described the soils and their land use capacity, as well as developing proposed methodologies for determining the land use capacity and planning.

The methodology proposed by Lopez et al. (1995) for determining the land use capacity in the Eastern Region is an adaptation of the procedures of the USDA (Klingebiel & Montgomery 1965). According to this methodology, the soils of the Eastern Region are grouped into eight categories, under which each steadily increases in terms of its limitations on land use. Each category, or class, is designated with a Roman numeral I to VIII. In turn, each class can be broken down further into subclasses, according to their specific limitations. The limitations that determine each subclass are summarized into four parameters: the risk of erosion, unless a dense vegetation cover is maintained (E); water, either in the soil or on the surface, which interferes with the plant growth and cultivation (W); the constraints and limitations that arise from the soil's characteristics, which can be superficial, rocky, etc. (S); and finally, the constraints determined by the weather, such as when it is too cold, too dry, and so on (C).

For the purpose of identifying forests critical to erosion control within the San Rafael area, the methodology proposed by Lopez et al. (1995) was adapted to our need to assess the risk of erosion attributed to each of the eight types of soil. Consequently, each land use class shall only be considered in relation to parameter E.

Bearing in mind that the value of E is measured as a percentage of slope ranging from 0 to 30%, the following table summarizes the ranges proposed by the authors to evaluate E:

Table 10: Definitions of the Classes of Land Use Capacity of the Eastern Region of Paraguay, in relation to parameter E (adapted from López *et al.* 1995)

Class of Land Use Capacity	General Definition	E Slope (%)
I	These soils have no or few limitations that restrict their use.	0-3
II	These soils have moderate limitations that reduce the selection of possible crops, or require moderate conservation practices to cultivate them.	3-8
III	These soils have strong limitations that reduce the selection of possible crops, or require special conservation practices to cultivate them, or both.	8-15
IV	These soils have very strong limitations that reduce the selection of possible crops, or require very careful management, or both.	15-30
V	These soils do not tend to erode, but have other limitations that are very hard to resolve, that limit their use.	0-3
VI	These soils have severe limitations that for the most part make them unsuitable for cultivation.	3-8
VII	These soils have very severe limitations that make them completely unsuitable for cultivation.	8-15
VIII	These soils and other miscellaneous areas have limitations that virtually preclude their use for commercial production.	>15

In his "methodology for land use planning", Lopez et al. (1995) also mention that classes III and VII, with slope gradients between 8 and 15%, as well as classes IV and VIII, with slopes greater than 15%, are not suitable for agricultural or forestry development, and must therefore be set aside for protection. In fact, these ranges are consistent with the standards of protection established by Decree No. 18.831/86 mentioned above.

Based on the elements considered and GIS tools available (USGS 2004), we proceeded to identify areas within San Rafael that have slopes greater than 8%.

Definition of HCV 4.2

All forests located on land with slopes greater than 8% will be considered HCVF for their protection against erosion processes that can result in the loss of soil and other damages to the ecosystem. The soils in these areas, considered unfit for agriculture or forestry development (Lopez et al. 1995), present a high risk of erosion, and its forests should consequently be properly protected.

Parameters and Thresholds Considered

The hierarchy of HCV 4.2 reflects the fact that, the greater the slope gradient, the greater the importance of its forest cover in terms of controlling erosion levels. Three thresholds are taken into consideration, as shown in Table 11. The distribution of HCV 4.2 within San Rafael is illustrated in the corresponding map.

Interpretation of HCV 4.2

Table 11: HCV 4.2 in San Rafael

Categories of HCV 4.2	Interpretation	Score	Surface area (has)
Forests on soils with slopes >15 % (classes IV and VIII).	High HCV	3	3,797.75
Forests on soils with slopes between 8 - 15 % (classes III and VII).	Medium HCV	2	12,577.92
Forests on soils with slopes between 0 - 8 % (classes I, II, V and VI).	Low HCV	1	27,817.24

Recommendations for HCVF Management

It is recommended that the natural vegetation cover is maintained, avoiding logging in areas with high erosion potential (forests on slopes greater than 15%). In regions of intermediate potential, the impacts of forestry activities and the harvesting of timber should be minimized.

Recommendations for HCVF Monitoring

Long-term monitoring can be carried out by means of water quality measurements from the network of rivers that flow from the reserve, the use of satellite imagery to monitor the condition of forests in critical regions, and the identification of landslides and worsening erosion. Field visits to the areas identified as critical are important in the long-term monitoring process.

HCV 4.3: Forests providing barriers to destructive fire

Background and Information Sources

Every year, Paraguay suffers from fires in almost all parts of the country, whether these are naturally occurring or human induced; these fires also severely affect the BAAPA region. It is not common to see such high numbers of fires in this ecorregión, as humid or sub-humid subtropical forests are usually less prone to fire due to their high moisture content and relatively low fuel biomass at ground level (litter and undergrowth). However, these high numbers of fires recorded in the BAAPA region may indicate the occurrence of slash-and-burn practices for opening up new cropland areas, the burning of highly altered forest remnants, crop residues (mulch) or small savannahs surrounded by forest, and even the intentional burning of forest blocks (Rhodes & Cartes, in Cartes, 2006).

By mapping and monitoring fires over several months or years, one can attain an accurate vision of the occurrence patterns of fires at any one particular site. The current use of a series of analytical techniques based on the use of Remote Sensing and Geoprocessing, allows the multi-temporal study of the incidence of certain recurring events, such as fires. This type of analysis is referred to as multi-temporal because it includes changes detected over a given period of time (Rodas & Cartes, in Cartes, 2006).

Among some of the most important tools available for studying multi-temporal events are the publicly accessible databases on fire distributions, which collect data detected by NOAA, MODIS and GOES sensors, including coordinates and occurrence dates. These are readily available through the Internet on the following websites:

- Instituto Nacional de Pesquisas Espaciales (INPE) - Brazil.
<http://www.cptec.inpe.br/queimadas/>
- MODIS RAPID RESPONSE SYSTEM - University of Maryland - North American Space Agency (NASA).
<http://maps.geog.umd.edu>

In 2005, under the framework of project PAR/98/G33, Guyra Paraguay applied these tools through a fire monitoring programme of the San Rafael Reserve and other protected areas of the country. This study sought to identify and determine the surface area affected by fires in protected areas and their buffer zones between the years 2002 and 2004.

To carry this out, the team proceeded to compile the occurrence of fires within the country, available from the publicly accessible databases mentioned above. The data collected helped to establish an annual trend of fires in the protected areas, as well as identify areas with a higher occurrence and a higher intensity of fires. In order to determine the areas of direct and indirect impact of these fires, a process based on assigning buffer areas (600 metres in radius) around each of the central fire points was adopted. The threshold of a 600 metre radius was adopted, because the authors mention that this distance more accurately adjusts to the traces of fires generated in satellite images employed for these study areas (Guyra Paraguay 2005a).

The results of this study show that fires have a significant impact on the protected areas surveyed. Table 12 summarizes the results for the San Rafael Reserve and its buffer zone.

Table 12: Summary of the fires and areas affected by these, for the San Rafael Reserve and its buffer area, between 2002 y 2004 (adapted from Guyra Paraguay 2005a)

Year surveyed	Number of fires recorded	Surface area affected by fires (hectares)	Percentage of the surface affected by fires (%)
2002	203	12,278.1	3.7
2004	1.236	104,705.4	31.5

The same authors mention that, within the San Rafael area, the season with highest occurrence of fires usually coincides with the end of winter and most of spring, clearly highlighting the months of September and October as those with greatest intensity of fires and when the highest number of fire outbreaks are concentrated.

Based on the above background and the tools available for identifying forests providing barriers to destructive fires within the San Rafael Reserve polygon (excluding the buffer zone), an adaptation of the methodology undertaken by Guyra Paraguay (2005a) is adopted for this criteria.

Definition of HCV 4.3

All forest remnants that are within the 600 metre radius buffer area surrounding fires within the San Rafael Reserve polygon shall be considered HCVF.

Parameters and Thresholds Considered

The multi-temporal study of fires and their behaviour within the Reserve during the 2001 - 2005 period resulted in the distribution of fires within the Reserve area shown in the corresponding map. A 600 metre radius buffer area was assigned to each of these, resulting in areas considered directly and indirectly affected by fires.

Interpretation of HCV 4.3

Table 13: HCV 4.3 in San Rafael

Definition of HCV 4.3	Interpretation	Score	Surface area directly or indirectly affected by the occurrence of fires (hectares)
Fires with forest cover within the 600 metre buffer area.	High HCV	2	12,249
Forest cover outside of the buffer areas that are affected by fires.	Low HCV	1	31,954
Fires without forest cover within the 600 metre buffer area.	–	–	12,072*

* A minimal percentage of this value occurs outside the Reserve's polygon.

Recommendations for HCVF Management

It is recommended that phenological studies of ecosystems present in the Reserve be carried out in order to achieve a better understanding of the seasonal phenomena that affect them. The areas most vulnerable to fires must be particularly assessed when preparing management plans.

Recommendations for HCVF Monitoring

The multi-temporal analysis is appropriate for monitoring fires and their consequences. One must consider that all areas show some degree of variability in terms of vegetative cover due to seasonality, which requires a careful selection of images from the same period each year to improve the accuracy in determining the types of land use and cover, as well as other changing trends. It is also recommended that the GIS work be backed up with field observations, in order to improve the quality of available information for future analyses, incorporating all these observations into a general database, preferably in the form of georeferenced reports and records.

In terms of the areas of fire concentrations, it is recommended that reconnaissance visits and field verifications be carried out in order to correlate these with intensive anthropogenic activities on the same sites (such as intentional burning for clearing forests and grassland, pasture and crop management).

HCV 5

Forest areas fundamental to meeting basic needs of local communities

Background and Information Sources

In Paraguay, there are a number of human populations that have a total dependence on their environment to meet the basic needs of their livelihoods, such as food, medicinal plants, shelter, water and fuel, amongst others. For the most part, these communities do not have the opportunity to meet their basic needs directly through market economy mechanisms; consequently, they rely directly on what their natural environment, in this case the forest, can provide. This HCV attempts to preserve the forest resources these communities continue to rely on for their livelihood alternatives without being negatively affected by the forest exploitation of other forest users.

In the San Rafael area, there are two types of human populations closely associated with the forests of San Rafael: smallholder farmer, or '*campesino*', communities and indigenous communities.

The *campesino* communities develop within a rural setting. They normally meet their basic subsistence needs directly through agriculture, breeding livestock and domestic animals and trading their products in a market.

The indigenous communities that inhabit the area belong to the Guarani-speaking Mbyá ethnic group. This ethnic group has developed over hundreds of years in close association with the forests of the Eastern Region (BAAPA), specifically in the areas covered by high-canopy forests. This environment provides a suitable habitat for this ethnic group, known generally, but not exclusively, as the *Kayngué* or *Monteses* (Melia 1997).

In order to define the attributes of HCVF under criteria 5, a particular methodology was adopted that can be summarized in the following three steps:

FIRST STEP: compilation and assessment of available information

As a starting point, all the information required to identify the communities settled within the study area and to understand their level of attachment and dependence on the surrounding forests was gathered.

Smallholder '*Campesino*' Communities

Among the most important available information sources on the *campesino* communities settled within the San Rafael are the Participatory Rural Appraisals (PRAs) carried out in the past with a number of these communities, under the framework of several projects; two of these were carried out by Guyra Paraguay and funded by the Canadian International Development Agency (CIDA). Another campaign called Pride, also carried out by Guyra Paraguay with the support of RARE, involved surveying some 1,039 local inhabitants of the San Rafael Reserve area. These results were also considered and evaluated. Of the 1,039 surveys, 41% were carried out in the District of Itapua Poty; 29.5% in Alto Vera and other 29.5% in Tava-i, taking into account 15 communities belonging to all three districts and 2.24% of the total population (46,488 people).

This initial information survey allowed us to identify 17 main '*campesino*' communities settled in the study area:

1. Alto Vera	6. Las Mercedes	11. Pirapoi	16. Tavai
2. Amistad	7. Libertad del Sur	12. Poncho	17. Vialidad 6ta línea
3. Caronay	8. Lima	13. San Miguelito	
4. Ciervo cua	9. Mbatovi	14. Santa Ana	
5. Kavaju Kangué	10. Perlita	15. Taruma	

The assessment of the available documents on these communities helped develop the following profile of a typical '*campesino*' community within the study area:

- All are located in the buffer zone of the Reserve, relatively distant from the main forest remnants. The main exception is the community known as "La Amistad" whose location is shown on the corresponding map (HCV 5 and 6).
- The main activity is agriculture. All family members, including children, work in the field. Cotton, soybean and other crops are grown to market. Traditional technology is mainly employed, and some producers are familiar with organic farming practices. Soils are prepared by 'slash and burn practices'. Corn, peas, manioc and beans, amongst other crops, are cultivated for on-farm consumption and can be marketed if necessary.
- The sale of farm produce is carried out within the community and/or in the district centres, with the limitations of a small market size and the poor condition of roads that hamper transporting the produce from the farm to the market. The marketing of produce is carried out individually (in the absence of middlemen).
- A small percentage of the community may raise a few livestock and domestic animals usually for on-farm consumption (not for sale). Fewer families may have dairy cows and oxen.
- Many communities rely on the water from rivers and streams for their daily livelihoods, both for consumption and for crop irrigation. In some communities groundwater is used from wells, either with or without pumps. The villagers mentioned that these waters are polluted as a result of the surrounding large farmers who spray their crops with pesticides which are then washed down into the communities. The effects of sediment silting in the watercourses, as a result of clearing buffer strips and the lack of soil conservation practices, can also be observed.
- Subsistence hunting is carried out, especially when there is no work, although according to the settlers, there are no longer as many animal species that can be hunted. The main species sought after include: tatú (armadillo), guazú (deer), ka'l (monkey), koatí (coati), acutí (small rodent), tapití (rabbit) and carpincho (capybara)⁶. Sometimes hunting is carried out with the purpose of sale (despite its prohibition); however, this happens less often than in the past.
- The main resources collected directly from forests include medicinal plants and honey. The main medicinal plants used include: doradilla, ka'avo roty, kokú, jatevu ka'a, kuña brava, casco romano ka'aguy, jatei ka'ay and cerillo⁶.
- Timber species are harvested mainly for construction and fuel. The main species used include: rabo, incienso, ybyra pyta, guayaka, anchico, ñangapiry, ñandu apysa, inga, aratiku and guavira⁶. At times, some timber species are marketed at a small scale.

⁶ The vernacular names of animals and plants were used as they were mentioned by the local inhabitants.

Indigenous Communities

The information sources on indigenous communities in Paraguay, and particularly on the existing settlements in the study area, are also numerous. As one of the more complete and updated of these references, we can mention the publication of the results of the second Indigenous Population and Housing Census carried out in 2002 (DGEEC 2004). This publication summarizes data on all indigenous communities in Paraguay, specifying details on the geographical location, cultural identification, status, socio-demographic status, economic activities and services available in their communities. For further information on the evolution of these communities over the last decade, we suggest you refer to the results of the National Census of Population and Housing of 1992 (Melia 1997).

The second Indigenous Census (DGEEC 2004) identified some 27 indigenous settlements in the study area, both within the San Rafael Reserve and in its buffer zone. Of these 27 communities, 14 are located on their own land granted through the INDI, 11 still do not have land titles (some of them are in the process of being issued) and 2 have refused to participate in the census, resulting in a lack of information related to the land tenure of these communities. The 27 communities are listed below:

- | | | | |
|--|-----------------------------------|---------------------------------|----------------|
| 1. Arroyo Morotí | 8. Jukeri - Aldea Cerro Pe | 16. Ko'êju | 24. Takuaro |
| 2. Arroyo Paloma | 9. Jukeri - Aldea Cerro Seis | 17. Mberu - Pirapo'i | 25. Tingasu |
| 3. Cerrito | 10. Jukeri - Aldea Karanda | 18. Mbói Ka'ê | 26. Tuna Guasu |
| 4. Comunidad Tapysaguy -
Arroyo Claro | 11. Jukeri - Aldea Tres
Marias | 19. Mbya 9 - Asentamiento 9 | 27. Ysapy'y |
| 5. Guapo'y | 12. Jukeri - Aldea Tuna'i | 20. Ñu Kañy - Gaona-Paso
Ita | |
| 6. Jatyty'i | 13. Ka'aguy Pa'ú | 21. Pindo'i | |
| 7. Jukeri - Aldea Arroz
Tygue | 14. Karaguatá | 22. Pindoju | |
| | 15. Karumbey | 23. Taguato Sauco | |

The results of this most recent indigenous census reveal the close ties and dependence that still exist between indigenous settlements and the surrounding forest. In fact, many villages are located in the heart of large forest remnants. Annex III presents a summary of the main forest elements that these indigenous groups still rely on for their livelihoods and basic maintenance, such as: sources of available water; animal species that are subject to hunting and fishing; elements collected to supplement diets, treat diseases and development tools and crafts; sources of light and fuel used and the main activities carried out in each community.

SECOND STEP: consultation stage with local community leaders

The next step involved carrying out a consultation forum with leaders of the affected *campesino* and indigenous communities. During this consultation stage the information gathered could be confirmed and updated, filling the information gaps identified from the previous analysis, as well as to evaluate other key aspects, such as the distances people had to travel, in relation to their homes, to access forest resources.

This consultation session was held in June 2007, in the *Kanguery* Reserve of Guyra Paraguay, and was led by the institution's specialists in human ecology, environmental education and related areas. 26 *campesino* leaders and 15 indigenous community leaders participated in these activities (the list of participants has been included in Annex IV).

The following summarizes the key conclusions obtained from this consultation forum regarding the main resources that the forests of San Rafael provide them:

Campesino Communities

Main forest resources used*	Use	Observations made by participating <i>campesino</i> leaders
Tajy, cedro, alecrín, ybyra pytá, ybyra ró, marmelero, guayayvi, timbó, incienso, guatambú, laurel, petereby, kurupay, cancharana, mura.	Construction materials	Used for doorframes, windows, beams, roofs, planks, furniture and posts.
María pytá, guavirá, alecrín, guatambú, canela, aguai, rabo, guayayvi, kurupa'y rá, tatajyva.	Firewood and charcoal	Domestic use; kurupa'y rá wood is sold
Mbovevi, jabalí, cateto, jaguareté, jaku apetí.	Subsistence hunting	No longer carried out as often due to the fewer wild animals that can be found in the forest.
Jakarati'a, pakurí, guavirá, pindó, guavijú, yvapovó, asepú ka'aguy, aratikú, mbokajá.	Food	–
Doradilla, kokú, guajakau, karoba, jatevu ka'a, jate'i ka'a, ysypó mil hombres, cedrillo, cola de caballo, rabo, ortiga (pynó guazú), uña de gato.	Medicinal	–
Fresh water springs.	Drinking water	Most of the communities source their water from wells or springs within their communities, with the exception of Amistad, whose only sources of water are the springs found within the Reserve.

* The vernacular names of animals and plants were used as they were mentioned by the local inhabitants.

Indigenous Communities

Main forest resources used*	Use	Observations made by participating indigenous leaders
Jatevo (a type of bamboo), takuapí, pindo rogue, ysypo, guembepí, horcón, guatambú, petereby, guayaibí, ybyra ovi, varana.	Construction materials	The stated that they do not want to sleep in brick and mortar houses: <i>"it is something that has to do with our culture; we do not need nice modern houses, just health and food"</i> .
A number of non-specified plant species.	Firewood	Not lacking in any of the communities. Firewood is essential for cooking and warmth in cold weather; consequently, it is a resource whose use is carefully planned. Once the forest is used, always consider leaving something for the <i>"yepéé"</i> .
Guembepí, guemberembó, kapi'i à, amongst others.	Arts and Crafts	They mainly make baskets and other utensils; they mention that they have everything they need to make the arts and crafts, extracting fibres and dyes from the forest; everything is <i>"natural eté"</i> . It is a cultural activity, although they do sell these articles wherever possible.
Tatú, ka'i, koatí, guazú, carpincho, jaku apetí y pira (karimbatá, salmón and boga).	Subsistence hunting and fishing	There is always <i>pira</i> (fish) in the streams; the problem is that it is being polluted. To hunt, they walk an entire day (30 km en 6 hours), and sometimes do not find animals. They mention having placed traps; now they have to venture further.
Gathering fruits and seeds; harvest.	Food	They grow cumandá, avati, avati mitá (their own variety of maize), avatíti, abatí chipá. They store their own seeds in order to guarantee a supply, they share them, and they smoke them against pests. Other forest species they harvest include: guaporoity, pindó, guaviyu, jacarati'a, naranja ka'aguy.
Honey from jate'i.	Honey	They use honey produced by the queen and <i>Tapesuá</i> . They currently have problems with other people using the honey, which is now running out.
A number of non-specified plant species.	Medicinal	The traditional medicines are found in the forest. Now there are more diseases that they do not know how to cure. There used to be fewer diseases, and they knew what to use to cure them. A community doctor prepares the medicines.
Fresh water springs.	Drinking water	The streams that spring from outside the forest are already polluted; those that spring from within have good water.
The forest (in general).	Shade	It is hotter now than before; good shade can only be found in the forest, and one can sleep well there.

* The vernacular names of animals and plants were used as they were mentioned by the local inhabitants.

THIRD STEP: assessment of the relationship and dependence of these communities on the San Rafael forests

The following conclusions can be made from the assessment of the available information and the results of the consultation forum:

- The *campesino* communities do not show a total dependence on forest resources. Except for the use of some resources, such as timber, medicinal plants and water, which they source from outside the Reserve, they usually meet their basic subsistence needs directly through agriculture, the breeding of domestic animals and trading their products.
- In contrast, the indigenous communities show an almost exclusive dependence on the resources that the forest provides. These resources are the basis of their daily subsistence and are closely linked to their customs and their traditional and cultural beliefs. In fact, it is clear that to some extent they employ the concept of *sustainability*; their culture determines the rational use of resources and the necessary measures to ensure they are not depleted.
- Finally, it may be considered that all the forest remnants of San Rafael may qualify as HCVF under this criteria, considering that the indigenous groups that inhabit the Reserve could cover the entire area in search of necessary resources in just a few days.
- It is considered that a 1 km buffer area radius around the indigenous villages represents the area of greatest importance in ensuring the subsistence of these settlements.

Definition of HCV 5

All forest remnants of San Rafael that provide indigenous communities with the necessary resources to ensure their critical subsistence needs are considered HCVF. Priority is given to the 1 kilometre radius buffer area taken from the central point of the community, due to constituting primary areas of coverage and protection.

Parameters and Thresholds Considered

The definition of HCV 5 contemplates as a threshold, the presence of indigenous communities because of their strong dependence on the native forests. The *campesino* communities, however, do not depend exclusively on the forest for their livelihoods; "*La Amistad*", due to its geographical location in relation to the Reserve and its relative isolation from other communities, is the only *campesino* community that shows a stronger relationship to the forests than other similar rural communities, especially regarding the use of firewood from the Reserve.

The proximity of these human settlements to the forest remnants, as well as their degree of dependence on the resources of these forests, are the parameters for interpreting the importance levels of the 27 indigenous and 17 *campesino* communities settled in the area of the San Rafael Reserve. The location of these communities and their forests considered HCV under this criteria can be seen in the corresponding maps (HCV 5 & 6).

Interpretation of HCV 5

Table 14: HCV 5 in San Rafael

Definition of HCV 5	Interpretation	Score	Number of communities
Indigenous communities located within the Reserve polygon, and their 5 km radius buffer area.	High HCV	2	18
Indigenous communities and <i>campesino</i> communities located outside the Reserve polygon, and their 5 km radius buffer area.	Low HCV	1	9
Campesino communities outside the Reserve polygon, with limited relationship and dependence on the forests.	–	–	17

Recommendations for HCVF Management

Discuss with the communities about the possible impacts of forestry and other activities related to forest management (road construction, censuses, etc.), as well as other forest resources. Define strategies to mitigate the impact of those activities that could be critical. Create maps of areas with the forest resources necessary to meet local needs. Develop mechanisms for conflict resolution, in the event of local people feeling that their resources have been damaged, or if consensual agreements for the conservation of the area have been violated. The rules for resolving conflicts must be specified in writing and, where possible, signed by both sides. It is also recommended that a correlation be made between the common names of fauna and flora species listed by the indigenous groups, and their scientific names, in order to correctly identify the species better known and most used by these communities, with the purpose of facilitating the monitoring programs.

One of the comments made by the indigenous groups who own property within San Rafael is that they are fully aware that their use of the forest resources will eventually lead to their depletion in the near future. According to their leaders, is necessary to apply a moratorium of at least three years in the use of these resources, particularly wildlife, to allow populations to recover. However, due to the absolute dependence of communities on these resources, this would not be possible unless they received some form of support or food assistance.

Recommendations for HCVF Monitoring

A participatory monitoring plan that includes a set of indicators and a specific methodology should be designed and implemented. The methodology proposed should be discussed with the community to validate its applicability. Individuals within the communities should also be identified to collaborate in the implementation of this monitoring program. The results of this monitoring should be analyzed and socialized to receive feedback from the community in forest management activities. This will help to determine the current status of the forest resources.

HCV 6

Forest areas critical to local communities' traditional cultural identity

In the same way forests are essential to people's livelihoods, they can also be important for the maintenance of cultural identities. Throughout Paraguay, this is an obvious reality given the wide variety of ethnic groups and the number of indigenous settlements that, as presented in the preceding section, still maintain a strong relationship and dependence on the forests they inhabit.

The criteria for HCV 6 is designed precisely to promote the protection and maintenance of these cultures that, although primitive, have preserved to this day certain knowledge and traditional behavioural patterns in relation to their natural environment.

The area within the Departments of Caazapá and Itapúa, where the San Rafael Reserve is located, is considered an important part of the ancestral lands of the Mbyá ethnic group, originally associated with areas typically covered by high-canopy forests. In fact, the BAAPA provides suitable habitat for this ethnic group, generally (but not exclusively) known as *Kaynguá* or *Monteses* (Melia 1997).

At a national level, indigenous societies and cultures are protected and defended by several legal mechanisms, which must be taken into account when deciding the fate of sites associated with these cultures. Article 64 of the National Constitution declares the right of indigenous people to land ownership, of size and quality sufficient for the conservation and development of their distinctive ways of life. The same article determines that "*the state will provide these lands free of charge, and which would be inalienable, indivisible, non-transferable, perpetual, and not likely to guarantee contractual obligations or to be leased; they shall also be exempt from tax. It is prohibited to remove or relocate their habitat without their explicit consent*". A few other important legal tools include Law No. 904/81 of the Indigenous Communities Statutes, Law No. 234/93 that approves Convention No. 169 on indigenous and tribal groups in independent countries, adopted during the 76th International Labour Conference held in Geneva on June 7, 1989.

However, reality presents itself in a very different way for many indigenous groups. During the last decades, the *Mbyá* groups of the Eastern Region have been victims of deforestation, expulsion and the occupation of their lands by the so-called "landless *campesinos*"; facts that have led to the abandonment of their ancestral territories and a migration in search of new sites. As a result of this process, there have been signs of critical cultural disintegration, which for some academics, can be considered a crime of ethnocide, since it is impossible to preserve *Mbyá* cultural patterns in an urban context. The consequences of this process would be, in the short term, the rapid dissolution of the ancestral contents of these forest-dwelling indigenous groups (Zanardini & Biedermann 2001).

According to L. Cadogan (1967, quoted by Zanardini & Biedermann 2001), under the *Mbyá* vision, land is not only a productive resource, but also an important area for social and religious components. In *Mbyá* culture, non-material needs are just as important as subsistence needs, and are closely linked to the symbolic level that gives meaning to existence. These conclusions, although very broad and general, try to summarize the role of forests in the identity of the *Mbyá*.

Many authors have attempted to interpret the subjective linkages between the *Mbyá* culture and surrounding native forest. Social structure, family life, economy, education, food, and even artistic events, religion and mythology; everything related to the *Mbyá* culture is based on their surrounding environment. Since the objectives of this report limit us from presenting further detail on the complex *Mbyá* ancestral culture, we can only refer interested readers to the studies of some renowned anthropologists such as L. Cadogan, B. Susnik, J. Zanardini, C. Mordo, amongst others.

Finally, it is worth mentioning two important aspects that *Mbyá* leaders emphasized as their main current concerns during the consultation forum held in *Kanguery* (June 2007):

- **The loss of their cemeteries:** each community has its cemetery, which is a site highly respected by all community members and considered a holy place. The deforestation of these sites, and subsequent use as pasture fields, represents sacrilege for them.
- **The loss of important sites for carrying out traditional rituals:** these sites are normally hidden and not frequented by the "whites". They also mention the existence of traditional paths, some of which are also found outside the Reserve.

Regarding the location of these key sites to their culture, the leaders stated that, in order to protect the integrity of these places, they could not provide this information to people external to the community.

The background information presented here, together with the fact that, according to the indigenous leaders, they have the ability to cover the entire Reserve within a few days (see previous section), lead us to consider all forest remnants within the San Rafael Reserve as HCV 6.

Definition of HCV 6

All forest remnants of San Rafael that have a cultural, religious or subjective meaning for indigenous groups, and consequently form the basis for their social and cultural identity, are considered HCV 6. Priority is given to the 1 kilometre radius buffer areas surrounding each indigenous settlement, due to making up primary areas in terms of coverage and protection.

Parameters and Thresholds Considered

The definition of HCV 6 only takes into consideration the indigenous communities, due to the critical aspects of their culture and social structure, such as religion, education, traditional beliefs and daily activities being closely linked to the natural environment. The *campesino* communities, however, do not share such a close social or cultural link with the forests of San Rafael.

It is considered that the 27 indigenous communities that inhabit the area within the San Rafael Reserve and its buffer zone should be protected under this criteria. The location of these communities and their forests considered HCVF are illustrated in the corresponding maps (HCV 5 & 6).

Interpretation of HCV 6

Table 15: HCV 6 in San Rafael

Definition of HCV 6	Interpretation	Score	Number of communities
Indigenous communities located within the Reserve polygon, and their 1 kilometre radius buffer area.	High HCV	2	19
Indigenous communities located outside the Reserve polygon, and their 1 kilometre radius buffer area.	Low HCV	1	7

Recommendations for HCVF Management

The areas within the Reserve that represent historic sites or those used for cultural and traditional rituals by *Mbyá* indigenous communities should be more accurately identified, so as to not interfere with these cultural events at the time of decision-making. This can be a very difficult task, taking into account the discretion of indigenous leaders in sharing such information.

It is important that, in the future, contact be made with the indigenous communities that did not participate in the last indigenous census in 2002, in order to fully understand their reality and value with a greater objectivity their dependence on the resources provided by forests of San Rafael.

Recommendations for HCVF Monitoring

A participatory monitoring plan that includes a set of indicators and a specific methodology should be designed and implemented. The methodology proposed should be discussed with the community to validate its applicability. Individuals within the communities should also be identified to collaborate in the implementation of this monitoring program. The results of this monitoring should be analyzed and socialized to receive feedback from the community in forest management activities. This will help to determine the current status of the forest resources.

Analysis of Conservation Priorities

Hierarchy of HCV within the San Rafael Reserve

As a final goal, based on the results of each individual HCV, we have carried out an analysis of the conservation priorities within the San Rafael Reserve.

To accomplish this, the ten layers of information previously developed, corresponding to the ten maps generated for each respective HCV, were collated using the ArcGis Geographic Information Systems software and the application of the numerical values assigned to each HCV category.

Each layer of information entered was equally weighted at the time of union. As a result, each layer represents 10% of the total value attributable to an area which could potentially be seen as either a high (or very high) HCV under all criteria considered (10 layers or criteria X 10% each = 100%), so that each polygon generated has been evaluated in accordance with the parameters adopted for each criteria.

The result of this analysis allows us to identify which are the sites within the Reserve to which most conservation values are attributed, as well as those that present least attributes. The first group would correspond to the priority sites for the conservation of San Rafael, and the latter group with the sites of less importance.

The following table summarizes the results of this analysis. The corresponding map (Annex I) shows the hierarchy of HCVF priorities, ranging from the sites that meet the most HCV criteria possible, to those that only qualify under no more than one criteria.

Table 16: Conservation Priorities in San Rafael

Sites previously identified as HCV	Interpretation
Sites that present 80 to 100% of the attributes defined as HCV	Very High HCVF
Sites that present 60 to 79% of the attributes defined as HCV	High HCVF
Sites that present 40 to 59% of the attributes defined as HCV	Medium HCVF
Sites that present 20 to 39% of the attributes defined as HCV	Low HCVF
Sites that present 0 to 19% of the attributes defined as HCV	Very Low HCVF

Final Discussions and Conclusions

The importance of the San Rafael Reserve as the second largest forest remnant of the BAAPA in Paraguay, as the first national and second Latin American IBA, as a protected area, as ancestral lands of indigenous cultures, amongst other criteria, has been well supported by numerous studies and previous initiatives. However, through this innovative HCVF methodology proposed by ProForest (2003) and implemented for the first time in Paraguay, it has been possible to assess and breakdown, in light of several analysis criteria considered, the set of attributes that make the forest remnants of the San Rafael Reserve qualify as *High Conservation Value Forests*.

One of the main lessons learned from this first experience is that the HCV methodology has proved to be an extremely useful and appropriate tool, not only to guide and facilitate the management and conservation programs developed by forest managers and decision-makers, but also for several other purposes. We highlight the following: *first*, to identify, characterize and emphasize attributes that are often considered secondary in the conservation of regionally or globally threatened areas, such as the social and cultural dependence of certain human populations on the resources provided by the forests; *second*, to integrate the efforts of previous initiatives and the information already available on an area in a document which could be used as a guide for future projects; and *third*, to identify the information gaps that still exist on the area being surveyed, which facilitates defining the information gathering requirements to improve the management of the HCVF.

The analysis of conservation priorities within the Reserve (see map), is the result of overlapping layers of information obtained for each HCV criteria. The resulting map is intended to give an overview and summarized idea of the HCVF hierarchy, ranging from those sites that meet as many HCV criteria as possible, to those that only qualify under no more than one criteria.

However, it should be noted that information gaps that still exist limit the accuracy of this final analysis. For example, one of the biggest information gaps is the absence of detailed biological inventories in some of the private properties that make up the Reserve. While these properties have shown a number of attributes, such as large areas of forest remnants, springs, rare ecosystems or indigenous communities that have inhabited the area for several decades, the lack of detailed evidence of their biological wealth reduces their importance in relation to other properties that share the same characteristics, but have more biological information available. Despite this, one should not automatically assume that the property lacks the same biological wealth that can be found in neighbouring properties.

On the other hand, it is logical to conclude that the properties whose conservation expectations are guaranteed in perpetuity (in the case of properties declared as Private Reserves), and which have already been subject to numerous biological, ecological, social and cultural studies and surveys, resulting in a greater amount of information, currently present the largest number of HCV attributes and are conservation priorities. It is worth mentioning that, as these information gaps are filled, new priority analyses shall be required.

Summary

Definition of the High Conservation Values within the San Rafael Reserve

Definition of HCV 1.1

Considering that the entire area of San Rafael has been recognized as a “conservation priority” and a protected area, although still unstable in terms of its conservation and management category, the entire area of San Rafael (made up of 62 properties according to the official IBR cadastre, updated by Guyra Paraguay 2007) is a HCV area.

Definition of HCV 1.2

All properties within the San Rafael Reserve that hold species of birds, mammals and/or plants within one of the following three threat categories (Critical, Endangered and Vulnerable according to IUCN and Resolution 524/06 of the SEAM) shall be considered HCV. This definition also takes into consideration the A1 criteria for the identification of IBAs (BirdLife International).

Definition of HCV 1.3

All properties within the San Rafael Reserve that hold endemic species of birds, mammals and/or plants shall be considered HCV. This definition also takes into consideration the A2 criteria for the identification of IBAs (BirdLife International).

Definition of HCV 1.4

The sites with specific habitats that make up biological corridors or key sites for migratory species, congregations of individuals, breeding seasons and/or feeding areas, shall be considered HCV under this criteria.

Definition of HCV 2

All native forest remnants that are representative of the BAAPA ecoregion within the San Rafael Reserve are HCVs. The importance of continuous blocks of forest larger than 10,000 hectares should be prioritized as conservation nucleus areas, due to their ability to preserve complex ecological processes and viable populations of umbrella species. Similarly, the conservation of smaller forest fragments is essential to the interconnection of the larger nucleus areas.

Definition of HCV 3

The sites that hold ecosystems or natural communities considered rare or vulnerable, that protect watersheds and/or harbour rare or threatened species shall be considered HCV under this criteria.

Definition of HCV 4.1

All forests with a width of at least 100 meters that protect both margins of watercourses that make up the Tebicuary River watershed, as well as forests that protect a 300 meter radius around springs, shall be considered HCVF.

Definition of HCV 4.2

All forests located on land with slopes greater than 8% will be considered HCVF for their protection against erosion processes that can result in the loss of soil and other damages to the ecosystem. The soils in these areas, considered unfit for agriculture or forestry development (Lopez et al. 1995), present a high risk of erosion, and its forests should consequently be properly protected.

Definition of HCV 4.3

All forest remnants that are within the 600 metre radius buffer area surrounding fires within the San Rafael Reserve polygon shall be considered HCVF.

Definition of HCV 5

All forest remnants of San Rafael that provide indigenous communities with the necessary resources to ensure their critical subsistence needs are considered HCVF. Priority is given to the 1 kilometre radius buffer area taken from the central point of the community, due to constituting primary areas of coverage and protection.

Definition of HCV 6

All forest remnants of San Rafael that have a cultural, religious or subjective meaning for indigenous groups, and consequently form the basis for their social and cultural identity, are considered HCV 6. Priority is given to the 1 kilometre radius buffer areas surrounding each indigenous settlement, due to making up primary areas in terms of coverage and protection.

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