Land Use Planning in the Yungas Biosphere Reserve in Argentina

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Abstract

ProYungas is an NGO that works toward the sustainable development and conservation of subtropical montane forests (Yungas) in northwestern Argentina. The Yungas is one of the most diverse eco-regions of Argentina, and due to the ecological services these forests provide, they are considered as a high priority area, both for research and conservation activities. This area has recently been established as a UNESCO biosphere reserve, where the main priority is to establish a land-use plan that takes into consideration the social, economic, and ecological dynamics of the region. This paper will present progress toward creating a Yungas Biosphere Reserve GIS framework, which seeks to integrate across disciplines, bringing together the social, environmental, landscape structure, and biodiversity regional GIS working groups. This project, together with other initiatives ongoing in the region, constitutes a conservation strategy that addresses the gap between generating sound scientific information and the actual knowledge transfer to policy makers.

Keywords: conservation, land use planning, subtropical montane forest, Yungas, sustainable management, UNESCO biosphere reserve, Argentina.

1. Introduction

On November 2002 the "Man and the Biosphere" (MAB) committee from the United Nations Educational, Scientific and Cultural Organization (UNESCO) incorporated approximately 13 000 km^2 of 'Yungas' in Northwestern Argentina into the world network of biosphere reserves. Together with the forest in Northeastern Argentina, these forests occupy less than 2% of Argentina's land base, but represent more than 50% of the country's biodiversity (Brown & Grau, 1993). Yungas is a word used to describe tropical and subtropical forests that can only be found on the eastern slopes of the Andes Mountains in South America. The Yungas region is an area of varied topography ranging from humid forest ecosystems and sub-tropical seasonal forest to misty pastures. This narrow ecological band runs for more than 4000km, from Northern Venezuela to the province of Catamarca in Northern Argentina (Brown et al., 2001) as seen in Figure 1. The Yungas forms an ecologically diverse transition zone between the high Andean peaks to the west and lowland Amazon rainforest and dry forest zones to the east. As warm, moist air from the Amazon rainforest moves westward, it rises up the eastern side of the Andes, cools and condenses, forming a zone of high precipitation and seasonally persistent cloud cover. Precipitation levels and type vary along steep altitudinal gradients and result in the formation of different forest types and associated fauna (Brown & Grau, 1993).

Figure 1. Distribution of the Yungas forest

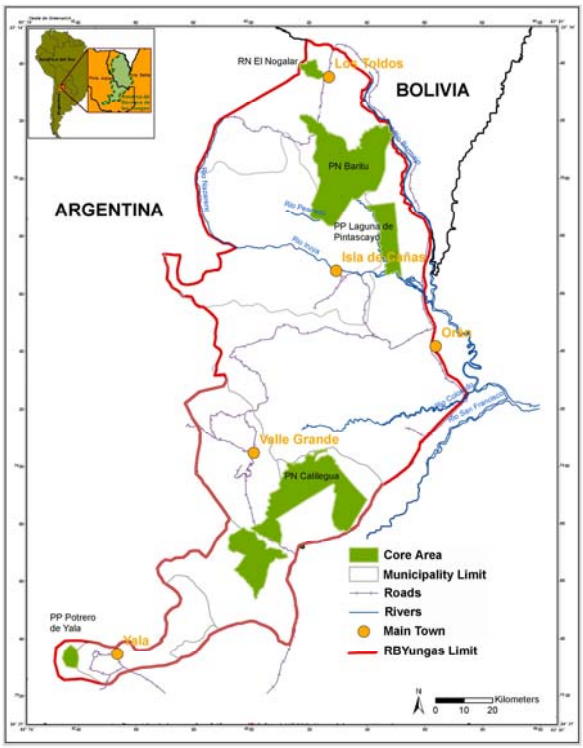

Figure 2. Yungas Biosphere Reserve outline.

The Yungas in this region is classified into three main forest types: Premontane lowland seasonal forests, Montane subtropical forest and upper Temperate montane forest. Two other ecosystems continue further up the altitudinal zones: fog grasslands and highland Andean grassland. This classification is based on

elevation, precipitation, and vegetation type as outlined in Table 1. To date there has been no comprehensive study on the total number of species in the area; it is estimated that more than 230 tree species and 3000 vascular plants are present in the region (Grau & Brown, 2000).

Table 1. Ecological zones of the Yungas forest region of northwestern Argentina (Braun Wilke *et al.*, 2000; Brown et al., 2001; Grau & Brown, 2000)

Forest Zone	Elevation Range (m)	Landscape Position	Annual precipitation (mm)	Vegetation
Premontane lowland seasonal forests (Selva pedemontana)	400 – 700	Base of the Andes; forms transition zone with dry Chaco forest zone to east	700 – 1000	Multi-canopy rainforest with many vines and epiphytes; 70% deciduous trees
Montane subtropical forest (Selva montana)	700 – 1500	Mid- and low-mountain slopes	1000 – 2000	Dense, humid multi-canopy rainforest composed primarily of evergreen species.
Temperate montane forest (Bosque montano)	1500 – 2000/2500	Upper mountain slopes to altitudinal tree line	1000 – 1500; fog present throughout most of year	Open mixed forest of deciduous and evergreen species; dense epiphyte, orchid and fern growth on tree trunks
Fog grasslands (Pastizales de neblina)	2000/2500 – 3500	High mountain slopes above cloud forest zone	~300 – 500; fog main source of moisture	Isolated single-species stands of three deciduous tree species interspersed with pasturelands of graminoids and sedges
Highland Andean grassland (Pastizales altoandinos)	3500+	High-Andean slopes above grasslands	~300 ; fog main source of moisture	Spiny grasslands, herbaceous and subterranean woody plants, and bogs

Of all of the regions in the Yungas, two of them of them stand out as having the greatest ecosystem stability and resilience. The first is the Aconquija mountain range located in the Southern part of the Yungas in the province of Tucuman. The other is the Upper Bermejo River Basin that is located in the northern section of the Argentine Yungas in the provinces of Salta and Jujuy and continues into Bolivia. The Yungas Biosphere Reserve is situated within this last region, as a legal framework to protect this sensitive ecosystem.

The Yungas UNESCO Biosphere reserve (RBYungas) is located on the Tropic of Capricorn in the north western part of the country between the 22° and 24° southern parallel and between the 64° and 65° western longitudinal (Figure 2). The area has a varied and rugged topography ranging between 5000m and 350m. This altitudinal variation occurs within a 100km distance as depicted in Figure 3.

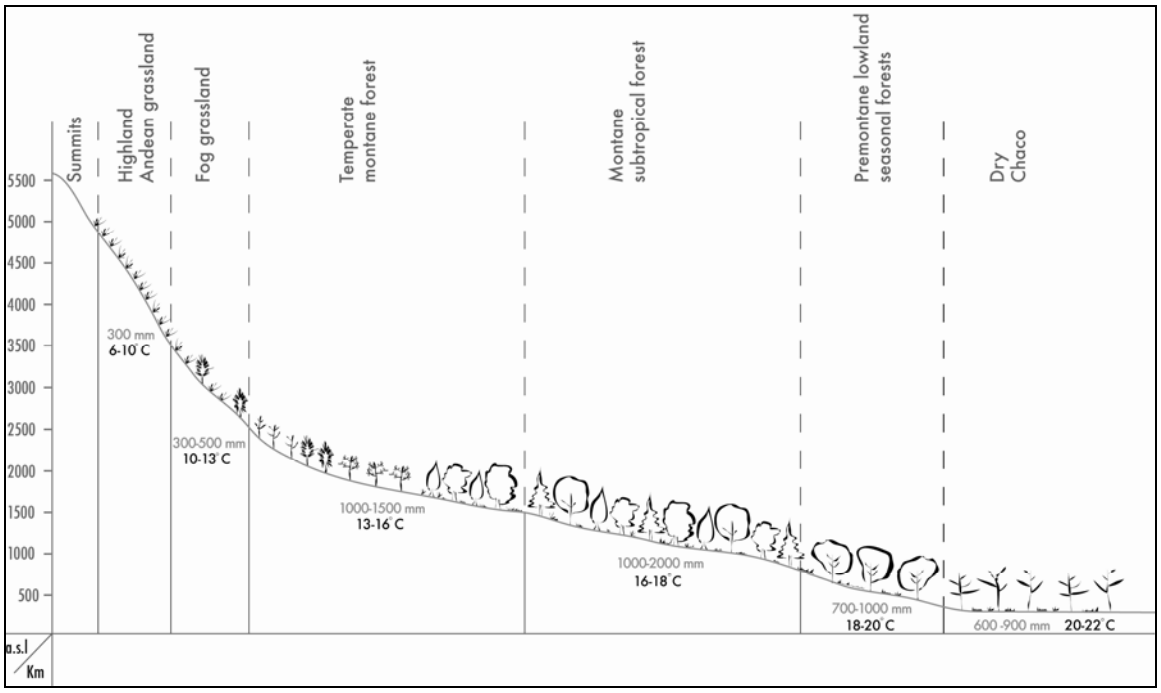

Figure 3. Altitudinal distribution of vegetation in the RBYungas.

The region is characterized by extreme temperatures, dominated by scorching hot summers with temperatures reaching 50°C on one end of the spectrum and winter temperatures below 0°C on the other (Grau & Brown, 2000). On average the region has a subtropical climate with distinct wet and dry seasons. The majority of precipitation (90%) occurs during the November – March summer period (Brown et al., 2001). Annual precipitation varies between 350 and 2300 mm across strong altitudinal gradients, with the highest rainfall occurring between 1000m and 1500m (Grau & Brown, 2000).

The following are the key features that make the RBYungas unique when compared to any other Yungas region within Argentina:

- It is the largest continuous Yungas surface in Argentina, which also continues undisturbed into the Bolivian Yungas which together form a continuously forested area of more than 3 million ha (Grau & Brown, 2000).
- It contains 30% more plant and animal species than any other Yungas region in Argentina. This is due to its larger surface area, a complete altitudinal gradient, a good degree of conservation, a high number of endemic species, a history of stability and isolation, and its geographical location.

- This large pristine landscape creates a safe haven for threatened animals, such as the jaguar (*Panthera onca*), tapir (*Tapirus terrestris*), pecari (*Tayassu albirostris* and *T.pecari*), toucan (*Ramphastos toco*) and others (Grau & Brown, 2000).
- With its abundant forest and non-forest resources and important watersheds the area sustains the economic development of the Pedemonte region. Particularly important in this regard is the water needed to irrigate approximately 200 000 ha of agriculture critical to the region.
- It also has the highest concentration of aboriginal and campesinos[1] communities who live in close contact with the mountain forest and posses a high level of traditional knowledge of the local biodiversity. These communities also harvest a variety of species that are in risk of extinction (Levy *et al.*, 1997).

Approximately 13% of the RBYungas is legally protected in national and provincial parks and constitutes the 'Core area' of the biosphere reserve. The buffer zone consists of 33% of the total area of the RBYungas and the transition zone represents of the remaining 54%. The core area includes two national parks: Calilegua and Baritú; one national reserve: El Nogalar; and two provincial parks: Laguna Pintascayo and Potrero de Yala (Table 2).

Table 2. Protected areas and their diversity in the RBYungas (Brown *et al.*, 2002).

Reserve	Elevation range (m)	Surface area (ha)	Premontane forest	Montane subtropical & Temperate forest	Fog grassland
Nacional Park Calilegua	500 – 3600	77 000	16% 11 803 ha	78% 60 197 ha	6 % 5 000 ha
Nacional Park Baritú	700 - 1600	62 990	0% 0 ha	100% 62 990 ha	0% 0 ha
Nacional Reserve El Nogalar	1600 – 3400	3 240	0% 0 ha	68% 2 190 ha	32% 1 050 ha
Provincial Park Laguna Pintascayo	430 - 820	15 558	79% 12272 ha	21% 3286 ha	0% 0 ha
Provincial Park Potrero de Yala	2800 - 4400	1 990	0% 0 ha	100 % 1 990	0% 0 ha

Section 2 outlines the social, political and environmental histories that lead to the creation of the RBYungas. Section 3 identifies the major threats the region is presently facing and section 4 summarizes what strategies are needed to moderate their effects. Section 5 describes our proposed land use planning process in the region that seeks to overcome

[1] The campesinos are a cultural and genetic mix between the Spaniards and aboriginals

many of the traditional impediments to an effective, transparent and participatory process. We conclude the paper with a brief summary statement in Section 6.

2. History of land use and tenure[2]

To understand the social conflicts in the area we first have to look into how the present land tenure structure came to be. In pre-Hispanic times, before the 16th century, the area was basically inhabited by two ethnic groups. The lowlands, premontane lowland forest (Pedemonte), were under the control of the Chaco indigenous group who were basically hunters and gatherers. The area was later taken over by the ethnic group Chiriguana who are of Guarani origin and subsisted through migratory agriculture. The highlands, temperate montane forest and fog grasslands (Bosque Montano & Pastizales de neblina), were under the influence of the Inca civilization and various ethnic groups that were under there control. The Andean groups had in place an elaborated terracing and irrigation system for agriculture. The lowland and highland groups had a relationship of exchange but did not significantly intermix as they predominately kept to their respective regions.

With the arrival of the Spanish in 1531 also came the Spanish Crown land leasing system. Originally, this system only affected the highlands as Pizarro was only interested in the gold-rich Incan empire. In the 1800's the highlands were mainly used by the immigrants to raise European livestock leaving the lowlands almost unaffected until the early 1900's. The objective of the Spanish Crown land leasing system was to obtain rent and labor from the aboriginal groups in the area. This later evolved into a land tenure system which is widespread through out Latin America called *terratenientes* or large landowners, who were in charge of the *latifundios* (large landowner's properties). The size of the latifundios was at a scale of the river basin or watershed; they included the whole altitudinal range of ecosystems from the highland Andean grassland to the montane subtropical forest. However, most of this land was not used at all; the activity of the latifundios was mainly concentrated in the fog grasslands where most of the aboriginal population lived. This land tenure system is still in place today, with the latifundios now known as *haciendas* or *fincas*. The RBYungas contains primarily four haciendas: Santa Victoria (223 000 ha), San Andrés (125 000 ha), Santiago (125 000 ha), and Los Toldos (70 000 ha).

The initial objective of the terratenientes was to subjugate and control the aboriginal populations and not to exploit the lands. By the 1900's a new system called *constelación latifundio-minifundio* came into place. The minifundio is basically a small property. This system consisted of leasing land to the campesinos as a measure of economic control. When the area started loosing its economic importance within Argentina (1850's – 1920's) the leasing system was kept in place not so much as a measure of economic control but more as a measure of social and political control. At the same time, the haciendas provided a safeguard for the campesinos culture that was being wiped out or strongly modified in the rest of the country due to modernization. The loss of importance

[2] A substantial portion of this section is based on Reboratti, 1995

in the region was due to the growing economy of the Northeastern and Pampean regions, and also to the areas' decreasing relationships with Bolivia. The area started gaining economic importance again in the 1920's with the introduction of the sugar plantations. The sugar plantations were established in the lowlands, premontane forest, where the moist tropical valleys supported the growth of the sugar cane. The *ingenios* or sugar cane plantations acquire all of the temporary labor needed for the harvesting of the sugar cane from the haciendas. This allowed the campesinos to benefit economically from the *ingenios*, while at the same time continuing with their traditional use of the middle and upper forest.

As previously mentioned, in pre-Hispanic times, land use in the Andes region was mainly agricultural, utilizing a terracing and irrigation system. When the Spanish arrived they brought with them two major modifications to the land use management of the area. First, they replaced the camelidaes (llamas and vicuñas) with European commercial species such as bovines, ovines, equines and caprines which consumed much more pastures than the camelidaes. Second, the terracing and irrigation systems were abandoned and replace by migratory agriculture practices on the slopes of the mountain range. These small plots are prepared by removing rocks and weeds and are only cultivated for a short period of time because they become infertile due to erosion. This practice extended through out the altitudinal range of the hacienda, matching the requirements of the crop with the weather at a given altitude. The campesinos also raised and managed the introduced animals as part of their livelihoods. This was done by pasturing in summer in the highlands and then moving the animals into the Montane subtropical forest and temperate montane forest in winter. The subsistence lifestyle of the campesinos depended on the use of the whole altitudinal range of the haciendas and did not have much of a negative impact on the functional structure of the ecosystem. In addition, their livelihoods did not produce many conflicts with the terratenientes nor the ingenios. The terratenientes of the time were not interested in the exploitation of natural resources, but rather on the social and political control they could exercise. The ingenios utilized the lowlands, which the campesinos did not, and gained from the temporary labor the campesinos provided at harvest time.

The major conflicts in the region began when the haciendas started to be seen as a place to profit from the abundant natural resources of the region. By the 1950's some small scale forestry activity in the lowland forests had begun in the area close to the town of Oran. Acutely aware of the economic potential of the area, the terratenientes wanted to gain control of the Yungas forest and leave the fog grasslands to the campesinos. This would have destroyed the diverse campesinos management practices of utilizing the whole haciendas for their livelihoods. Faced with this problem, many campesinos moved out of the highlands and permanently inhabited the Yungas creating new settlements such as Los Naranjos and Isla de Cañas to protect their access to these resources. The use of the land for the campesinos has become even more critical since the 1970's due to a constant reduction in the seasonal labor offered by the ingenios.

Currently the area of the RBYungas, which has the largest diversity of ethnic groups in Argentina, is in crisis. The gradual loss of the historic power of the terratenientes control over the local people has led into a crisis that is more due to who has ownership of the

resources than because of economic reasons. In other words, it is a social and political problem that leads to disputes over land use, not an economic one.

3. Present threats to the functionality and biodiversity of the area

Due to the introduction of the sugar cane plantations, more than 170 000 ha of forest has been converted into cropland. Today, other development projects such as, oil and gas, and agriculture are responsible for the main conversions of forest lands. This is especially true for the recent dramatic expansion of the agriculture frontier that is mainly driven by the soya bean plantations (Grau *et al.*, 2005). Between the years 1986 and 2002 more than 15 000 ha of the RBYungas has been deforested (Montenegro *et al.*, 2003). The surrounding areas of the reserve have also been greatly affected, with more than 194 000 ha deforested in 4 year time frame, from 1998 to 2002 (Gasparri *et al.*, 2004). The main cause of the forest conversion in this area is agricultural expansion, which can lead to serious problems of desertification (Gasparri et al., 2004). Grau and Brown (2000) outline five human activities that currently present a threat to the area, these are: grazing, the timber industry, oil and gas prospecting and extraction, hydroelectric projects, and agricultural development.

As described before, grazing is carried out through out the altitudinal gradient of the area. The fog grasslands have been greatly impacted by the over grazing of cattle and sheep carried out over the past century, and show profound signs of mismanagement (Reboratti, 1995). As Grau and Brown (2000) state: “grazing and trampling remain the most extensive degradation factors in the region, especially at the higher altitudinal levels”.

The first roads to penetrated into the region were built in the 1950’s (Reboratti, 1995). During the 1950s and 1960s forestry activities were carried out in a very aggressive manner with out any regard for the long term management of the resource. These practices were clearly unsustainable and soon left the area with no commercially viable timber (Grau & Brown, 2000). However, on steep slopes and in areas with no road access there still remain large amounts of forest with valuable timber. These areas are not protected from human use and it is only a matter of time until these untouched areas become economically viable for exploitation.

Erosion is another major problem in the Yungas forest. This problem is exacerbated by land cover alterations, degradations and reductions, intense summer precipitation, and thin soils (Braun Wilke et al., 2000). Both grazing and forestry have lead to ecological changes causing increased erosion, which has far reaching hydrological implications. The UNESCO biosphere watershed is part of the upper Bermejo river basin (UBRB), which makes only a minor contribution to the total volume of the Paraná river basin (the largest river system in Argentina). The problem is that the UBRB normally carries approximately 75% of the total sediments reaching the Atlantic Ocean (Grau & Brown, 2000) and is an important water source for the population of the RBYungas and the adjacent regions (40 000 inside the RBYungas and 120 000 in the immediate surroundings). This water is also essential for approximately 200 000 ha of agricultural land located in the surroundings of the reserve. It is evident that any type land

disturbance, such as unsustainable forestry practices and forest clearing for agriculture, in the upper watershed (RBYungas and surroundings) could have widespread regional and national implications.

The RBYungas contains one of the most important oil and gas resources of the country, second only to the Argentina Patagonian oil fields (Urien, 1995; Yrigoyen, 1991). This is evident by the recent construction, within the RBYungas, of two pipelines exporting gas to Chile. Currently, there is a project to construct a new pipeline to Bolivia which will boarder the RBYungas limits. The problem here is not so much the gas and oil prospecting and extraction, but the roads they build into the heart of the Yungas. These roads open access to the logging industry, both the legal and illegal. They also foster hunting and have an overall negative impact on the forest structure and fauna.

Currently no dams exist in the area, but they are a latent threat as three feasible hydroelectric projects exist in the area. The construction of 'Cambai' (a hydroelectric project) in Bolivia would affect the Bolivian Yungas reserve 'Tariquia' and reduce substantially the overall conservation potential of the region. Two other projects located on the border of Argentina and Bolivia would seriously reduce the connectivity of the Yungas between the two countries.

Once a tropical forest, the premontane forest is now a landscaped dominated by modern agriculture. Since the beginning of the 20th century the area has experienced an increase in regional rainfall, which is likely to be a consequences of climate change (Grau *et al.*, 2004). This climatic trend and the favorable international prices for the soya bean have lead to a dramatic expansion of the agricultural frontier into the region. This extends even into areas that were never before considered viable for this use (Villalba *et al.*, 1998). It is predicted that by the end of the decade no more forested flat lowlands will remain (Grau & Brown, 2000). No more than ten years ago the agriculture practices of the region were of an assorted nature. Different crops, fruit trees and vegetables were harvested to create a resilient economy in face of fluctuating individual product prices. While these practices did in fact convert some forest to agricultural land, they also created a diverse landscape, which was beneficial to many animal species (Brown & Malizia, 2004). "The green desert", as the Economist (2004) recently termed the soya plantations in Argentina, has dramatically changed the landscape and has impoverished its diversity.

Due to the combination of all of these human activities outlined above, different regions of the RBYungas have suffered conversion or structural degradation of its forest in conjunction with a loss of biodiversity. Almost 90% of the Yungas ecosystem presents some kind of anthropogenic alteration, both inside and outside of the protected areas. Together these issues define the crisis in this region and, if something is not done soon, it is quite likely that the outcome in this region will not be a favorable one.

4. Strategies of conservation and development

As recent years have demonstrated, Argentina's economy is a fragile one. This fact, when combined with state policies, private activities and social change, yield a high transformation potential for the region (Grau & Brown, 2000). The UNESCO biosphere reserve puts in place a legal framework that allows us to seek a path to a more sustainable future for the region. The strategies described below seek a balance between the social, economic and ecological realities of the region and are in line with the biosphere reserves' conception of land use management.

Biosphere reserves are divided into 3 management areas: core, buffer and transition areas (UNESCO, 2005). The core area is not subjected to human activities, except research, monitoring and traditional extractive uses by local communities. This area falls into the IUCN[3] Category I (nature reserves) and Category II (national parks). There are normally several core areas in a single biosphere reserve to ensure a representative coverage of the biological biodiversity of the region.

The RBYungas has approximately 13% of its land base legally protected (Table 3), falling into categories I and II of the IUCN. We can also observe that the premontane lowland forest is barely represented (5%) in this protected area system, and as pointed out in the previous section, it is under a tremendous anthropogenic pressure to convert all of its forest into agricultural lands. Neither fog nor highland grasslands are represented in the core area of the reserve. To ensure their protection it would be necessary to create a protected area that represents these types of ecosystem. This does not necessarily need to be designated as falling within a type I or II category, but could be type V or VI (Brown, 1995). There is also a need to identify the most sensitive areas outside the present reserves and parks in order to establish new reserves to maintain a core area diverse enough to allow a healthy population of animals to thrive in (Brown et al., 2002).

Table 3. Land distribution according to UNESCO's categories.

	Buffer zone RBYungas	**Transition zone RBYungas**	**Core area RBYungas**
Premontane lowland seasonal forests	14% 19 2282 ha	3% 46 498 ha	5% 59 769 ha
Montane subtropical & Temperate forest	20% 26 8326 ha	27% 36 5704 ha	9% 12 0258 ha
Fog grassland & Highland Andean grassland	1% 13 674 ha	15% 20 3164 ha	0% 0 ha
Agricultural land	3% 36 398 ha	3% 43 492 ha	0% 0 ha

[3] See appendix for more information on IUCN Categories

Under the UNESCO guidelines, the buffer zone is adjacent to the core area and the activities allowed do not hinder the conservation objectives of the core area but rather help to protect it. This area falls into the IUCN Category V (protected landscape) and Category VI (resource management reserve). Some examples of activities that should be carried out in the buffer zone are: experimental research for better management of natural resources, exploring rehabilitation techniques, and direct use of certain natural animal and plant resources with appropriate controls over the season, numbers, methods and sites for harvesting. The area should also accommodate education, training, tourism and recreation facilities.

The buffer zone makes up approximately 33% of the RBYungas land base. This zone falls mainly on private lands, the haciendas, and is compromised mainly by the montane subtropical forest ecosystem (50%) and the premontane forest (40%). The overall degree of conservation of the montane area of this zone is high. Human activities in the montane zone are low intensity, such as: traditional agriculture, migratory livestock, selective logging, and hunting and gathering (Brown, 1995; Ramadori, 1995). Future conservation efforts should be aimed at maintaining the forest matrix between the core areas that this zone presently provides. Sensitive mammals, such as the jaguar, need exceptionally large functional landscapes to maintain a healthy population (Sanderson, 2002). Thus, it is essential to protect these forest corridors that presently maintain a healthy landscape for these animals. Furthermore, the montane subtropical forest ecosystem continues into Bolivian territory, which contains hundreds of thousands of hectares of which 250 000 ha constitute a forest reserve (Tariquia) (Brown, 1995). Efforts should be aimed at creating a protected corridor between the Argentine park Baritú and the Bolivian reserve Tariquía (Grau & Brown, 2000). Other conservation efforts should be directed at two main areas: analyzing what levels of livestock grazing are sustainable within different ecosystems, and studies that improve our knowledge of ecologically sound forestry practices in the region. It is fundamental to involve the community in these types of studies, a technique better known as participatory rural assessment (Chambers, 1997).

Transition zones are “areas of co-operation extending outwards, which may contain a variety of agricultural activities, human settlements and other uses. It is here that the local communities, conservation agencies, scientists, civil associations, cultural groups, private enterprises and other stakeholders must agree to work together to manage and sustainably develop the area's resources for the benefit of the people who live there. Given the role that biosphere reserves should play in promoting the sustainable management of the natural resources of the region in which they lie, the transition area is of great economic and social significance for regional development (UNESCO, 2005).

More than half of the RBYungas is within the transition zone, and it is mainly comprised of private property and some community lands. The ecosystems that make up this zone are predominately, montane subtropical forest, temperate montane forest, and the grasslands. The premontane lowland forests are barely represented since most of it has been converted into agricultural lands. Most of the population of the RBYungas lives on the lower montane subtropical forest and hence most of the pressure on the reserve is

located in this ecosystem. Presently the human activities in the lower montane subtropical forest consist mainly of modern agriculture harvesting soya and sugar cane, and to a lesser degree production of citrus, bananas and vegetables. Forestry activities are also present in this lower part of the Yungas. The main conservation efforts here should first be aimed at limiting any additional forest operations in the lower premontane forest ecosystem. At the same time, incentives need to be created that reinforce the transition of current forestry practices to ones that are sustainable and certified.

The temperate montane forest is the most inhabited area in the montane sections of the Yungas (Brown, 1995). The present management practices are focused on traditional migratory agriculture and livestock grazing. In these areas the management practices should first focus on community forestry and latter on agriculture and livestock (Brown, 1995). Both agriculture and livestock grazing should be done under an agroforestry management plan, while stimulating improvements to agricultural practices to avoid erosion and improve soil conservation. Again, following Chamber's (1997) ideology, these ideas should be analyzed and implemented with the full participation of the local communities. Other areas that need development are: ecotourism, studies of available markets for traditional crafts and harvest, education, fostering traditional knowledge, and reduction of contaminates associated with the modern productive activities and urban areas.

5. Processes and Future Directions

The overall objective of the UNESCO Biosphere reserve concept is to seek a path of development that balances all aspects of sustainability (economic, environmental and social priorities). The typical instantiation of this vision is a land use planning initiative; also know as multi stakeholder process. The concept of land use planning in the United States and Canada differs from a similar term commonly used in most of Latin America called 'ordenamiento territorial' (O.T.). Land use planning has a strong emphasis in developing and applying a zoning system that mainly takes into account the environmental and economical aspects of a region. Ordenamiento territorial also includes these aspects of the landscape while adding a strong emphasis on the social and cultural needs of the population. For example, O.T. typically includes the following aspects of planning:

- Environmental, normally consists of ecological zoning
- Economic development, favors certain sectors of the economy by strategically allocating the land to given them advantages to their production
- Social, aimed at establishing priorities of infrastructural development to meet social needs, such as, roads, schools, hospitals, etc.
- Cultural, zoning system to protect and highlight the diversity of ethnic groups and cultures of the country
- Political and administrative, defines which sectors of government and individuals have control over the land, more commonly know as land tenure.

The central idea is not only to plan the land use in the region, but also the activities that are going to take place in the given location and their balance in terms of both the benefits and opportunities across the region. Most importantly, the O.T. should go

beyond distributing the activities and land, to become part of the process, choosing objectives that address fundamental problems and concentrate on solving development issues that are of prime importance to society. We will use the term O.T. through the rest of this paper because we believe it is more culturally appropriate and because of its more broad meaning surrounding issues that must be addressed if planning efforts are to be successful in the region.

The issues addressed in most planning processes are usually complex and involve multiple stakeholders (Gonzalez & Meitner, 2005). If the planning processes are initiated and fully controlled by government agencies, then the outcomes will most likely depend on the government's vision of development, which often is not in line with the vision of the local population. At the same time, the traditional methods of planning have a series of problems that have not been adequately addressed. Some of these are:

- Issues of access to both relevant information and to the process itself (Kingston, 2002)
- Issues of participation, equity and integrity of the process (Brown, 1996)
- Problems of continuity of a planning process (often these are one time processes, whereas adaptive management necessitates an ongoing process) (Dragićević & Balram, 2004)
- Problems of dissemination of results to the general public

The issue of access revolves around two main axes. The most notorious one is the problem of physically attending the planned meetings because of geographical location and/or time constraints (Kingston, 2002). The second one falls under the category of data access and freedom of information. Often the data necessary to understand the problems a region is faced with are in the control of either government of industry. If these organizations are not willing or able (due to legislation) to share this data then it is unlikely that other parties will be able to operate on a level playing field. Related to this form of access are the issues of dissemination of results from the planning process to the general public. A transparent process is one that openly publicizes its activities in an understandable manner to non-participating stakeholders and to the general public (Hemmati, 2002).

To overcome some of these difficulties in access and dissemination we are implementing two web-based systems of information sharing. An ArcIMS server is being developed in conjunction with Big Sky Conservation Institute[4], a USA based NGO. All of the O.T. processes are centered on the geographical characteristics and capacities of the landscape, hence GIS is one of the best mediums of communication. GIS technology has a number of characteristics and map exploration features that strongly support the spatial representation of the landscape. The added benefit of web-based GIS is the ability to make all the data relevant to the O.T. available before, during and after the planning process (Dragićević & Balram, 2004). Peng (1999) also points out that cost effective access to baseline data is needed for effective planning. The second component of the web-based system is the implementation of 'Phoenix' (NRCAN, 2005). Phoenix is a web

[4] www.bigsky.org

portal that enhances project collaboration through a decision support toolbox. The portal provides the following capabilities:

- User friendly interface to: discover, access, explore, analyze and web publish collections of maps, documents and multi-media sources,
- On-line collaboration tools, such as: announcements, contacts, discussions, email, events, notes, tasks, journals, news.

Phoenix provides us the tools to easily go from the documented planning process to a published informational web page that is available to most citizens. It is clear that not all the citizens have access to a computer and the internet, but at the same time the costs and hierarchical barriers to access are constantly eroding. This approach in itself will not suffice, and therefore builds on other ongoing work in the region[5]. This strategy of modernizing the communication structure of the region will continue to reap benefits into the future, as the local communities will likely adopt the internet as the main medium of communication. These tools help us address the issues of access and transparency outlined before. Even more, Phoenix begins to address the issues of collaboration essential in a successful planning process.

The second objective of our work is to establish an O.T. process that promotes collaboration between the stakeholders. This process, which we refer to as the CCL framework, explicitly deals with the participatory aspect of the O.T. through a collaborative planning mechanism. While a full description of the CCL framework is outside the scope of this paper we provide a detailed explanation of its core principles in a companion paper (Gonzalez & Meitner, 2005). The CCL approach address the issues of participation and continuity outlined before, where participation is defined as the bringing together of the principal actors, while supporting and challenging all stakeholders to be actively engaged (Hemmati, 2002). Through this process stakeholders will be able to co-create a shared meaning of the issues to be dealt with, providing for the equal representation of all views, thus increasing the legitimacy and credibility of the O.T.

Finally we envision a community that is constantly learning and adapting to the changing environment, which requires successive and continuous processes to promote planning over long time scales. The CCL approach, together with the web-based system, strives for these ideals by reducing the barriers to continuous planning. These barriers are normally associated with the cost of the planning process and the resources needed, with the additional individual participants cost of access to the physical location where the planning process is taking place. Other research (Dragićević & Balram, 2004) has shown that the overall cost of an online planning process is usually lower than an equivalent process conducted by more traditional methods, even with computer needs being taken into account. The added benefits are the re-usability of the web-based planning component, which transforms the costs into a long term investment for continuous planning of the region.

This strategy of augmenting traditional planning with a web-based GIS planning and integrative collaboration approach is based on the recognition that a structured method of co-operation is an effective manner of dealing with complex issues (Dragićević &

[5] See Conclusions

Balram, 2004). This strategy helps to generate recommendations that have broad support of the participants, while promoting commitment to the process through participants identifying with the outcome and thus increasing the likelihood of successful implementation. Furthermore, many governments are committed to modernizing their planning processes by improving of their information and communication technologies (McIvor *et al.*, 2002).

The RBYungas was declared a reserve in 2002 due to the anthropogenic pressures and conservation potentials outlined before, but has yet to develop goals, objectives and strategies to guide its management. Presently the management in the region continues as usual, the core areas (previously existing parks and reserves) is under the control and management of the National Parks board. All the rest of the areas inside the RBYungas continue to be managed independently by their municipalities, overseen by the provincial governments. The unique biophysical characteristics of the threatened premontane forest, the persistent degradation of the montane subtropical and temperate forest, and the susceptible livelihoods of traditional people urge us to define a strategy for the O.T. in the region. A strategic management plan for the RBYungas is urgently needed. For a prosperous future, this plan must be co-created by the active participation of all the affected stakeholders, with the objective of defining an O.T. that strives for a sustainable use of the landscape and the well-being of its inhabitants well into the next century.

6. Conclusions

The establishment of a UNESCO Biosphere Reserve creates an enormous challenge for the individuals tasked with the management and planning of the region, but also represents a great opportunity to promote a new style of management that links local communities and society as a whole. The biosphere reserve calls for new forms of institutional co-operation and increased integration between levels of economic and political decision making (UNESCO, 2000). The concept builds on the idea that humans and nature are intrinsically linked and the only way to conserve and protect our remaining natural places is to work closely with the people living there. This approach seeks to find innovative management methods that support local ecosystems, thus allowing for the conservation of ecological diversity and for change in the way societies use and manage their natural resources. This means that local administrative systems must be capable of integrating multiple values held by the population and be representative of the needs of the community, while striving to use its natural resources in a sustainable manner.

This approach would not be possible if not for all the ongoing work in the region. ProYungas has been working in the area for many years on projects related to biodiversity, wildlife, traditional knowledge and local communities, forest management and certification, and other work related to conservation. The GIS division is currently working on a number of projects: establishing GIS standards and integrating with other GIS working groups of the region, creating management plans for private lands, support for the RBYungas committee, and as a GIS support to research undertaken in the Ecological research laboratory of the Yungas (LIEY.)

We believe that by implementing the outlined strategy we will enhance the democratic governance of the region and begin a process of participatory deliberation of the much needed strategies of O.T. in the reserve. This is a long term strategy that will permit all of the actors to be better prepared for the ever-changing economic, environmental, political, and social pressures that must be adapted to if the region it to thrive.

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Appendix

The IUCN system of protected area categories. Type of protected areas management objective(s).

I Strict nature reserve / Science or Wilderness area wilderness protection
II National park ecosystem protection and recreation
III National monument conservation of specific natural features
IV Habitat / Species conservation through management area intervention
V Protected landscape/ Conservation and recreation Seascape
VI Managed resource / Sustainable use of natural protected area ecosystems

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