Executive Summary

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Executive summary

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THE RAP PROGRAM

The Rapid Assessment of Program (RAP) was created in 1990 by Conservation International (CI) with the objective of rapidly collecting the biological information necessary to accelerate conservation actions and protection of biodiversity. In Venezuela, the RAP program has been modified and expanded to involve multi-disciplinary and multi-institutional teams to study terrestrial and freshwater ecosystems. National investigators, along with invited international experts, apply their taxonomic expertise to study specially selected habitats over a 15 day period. To this information is added additional data previously collected from the area by other authors; together they make conservation recommendations based on the biological diversity of the area, level of endemism, the uniqueness of the ecosystems and their threats, both actual and potential, as well as the risk of extinction for some species at national to global scales.

The RAP scientists evaluate and analyze in the field the diversity of groups of organisms selected as indicators. By combining their field data with social, environmental and other data sources, they can make realistic and practical conservation recommendations to governments, institutions, funding agencies, and others responsible for taking decisions related to biodiversity conservation.

The results of RAP have served as scientific support for the establishment of national parks in Bolivia, Peru, Madagascar and Guyana, providing the biological baseline information for poorly explored tropical ecosystems. The RAP program also identified threats and proposed recommendations for the conservation of these areas. The results of RAP surveys are made immediately available to all parties interested in conservation planning.

SPECIFIC OBJECTIVES OF THE 2008 RAMAL DE CALDERAS RAP SURVEY

- Inventory species of mammals, birds, reptiles, amphibians, fishes, and aquatic invertebrates associated with the different ecosystems of the Ramal de Calderas in the Venezuelan Andes.
- Describe the vegetation types present in the sampling areas in the Ramal de Calderas.
- Determine the most important physicochemical parameters of the different ecosystems in the area of study.
- Produce a list of endemic species and/or species with restricted distribution in the area of study.
- Determine the most important species for conservation plans (threatened, endangered, etc.) and/or sustainable use.

- Identify the habitats or areas of special interest (high diversity, high endemic species density, etc.) present in the area of study.
- Identify present and potential threats in the area.
- Generate baseline information to establish protection and integrated conservation for the Ramal de Calderas.

BACKGROUND

Venezuela is among the top ten countries with the highest biological diversity on the planet. Preliminary estimates highlight the existence of 4,500 to 5,000 vascular plant species, approximately 250 fish species, 84 amphibian and 97 reptile species, 741 bird species, and 212 mammal species in the Venezuelan Andes. The level of species endemism (species found no where else) is one of the highest in Venezuela: flora (33 species), fishes (45 species), amphibians (53 species), reptiles (22 species), birds (21 species) and mammals (7 species). The extraordinary richness and endemism of the local flora and fauna are also the most threatened in Venezuela. According to local red books (Rodriguez y Rojas 2008), 22 species are classified as Critically Endangered (8 amphibians, 3 birds and 11 plants); 29 as Endangered (6 fishes, 5 birds, 4 mammals and 14 plants); 126 as Vulnerable (10 fishes, 15 amphibians, 3 reptiles, 11 birds, 11 mammals and 76 plants), and 46 species as Near Threatened (5 fishes, 8 amphibians, 1 reptile, 26 birds and 6 mammals). Moreover, 77 species are poorly known and could disappear before they are thoroughly studied. This biodiversity represents essential resources for local communities, such as in the case of fishes, of which 46% are important as a subsistence resource and 64% are used as ornamental species by local people. Some species need to be protected from extinction, such as large mammals (e.g. felines) and plants like the Espeletias, Orchids, and Droseras. On the other hand, forests as a whole are also important for soil coverage and protection of water sources.

The Ramal de Calderas constitutes a natural biological corridor between Sierra Nevada and General Cruz Carrillo (Guaramacal) National Parks, Teta de Niquitao-Güirigay Natural Monument, and the Protective Zone of the Guanare, Boconó, Tucupido, La Yuca and Masparro hydrological watersheds. The flora and fauna of this area possess significant value not only for their high diversity, richness and potential use of natural resources, but also because they constitute the exclusive habitat of plants and animals of this Andean region. Furthermore, these great blocks of remnant vegetation still harbor populations of a for a dozen of recently discovered species known to science. We must evaluate the status of this region when developing effective use and conservation plans. In addition, five important rivers (Burate, Aracay, Masparro, Calderas and Boconó rivers) arise within the Ramal de Calderas and replenish water reservoirs located in the low lands of the llanos foothills. On the northern slope of the Ramal, the lower zones are heavily disturbed. Habitat alteration has accelerated in recent years, converting into a real threat to the natural equilibrium of the area and coexistence between humans with their natural environment.

Based on the absence of integral biological information on the Ramal de Calderas, as well as the importance in defining areas that can connect forests of global importance, Conservation International Venezuela carried out a rapid biodiversity and social evaluation in April 2008 in three focal areas, with the participation of 14 Venezuelan scientific-academic institutions, with a team of 20 researchers and the assistance of 10 members of local cooperative projects.

Given the importance of the Andes within the global context and the threats from increasing population density and higher demands on natural resources, it is essential to understand the structure and composition of coffee forests, as a traditional cultivated crop in the Andes, often viewed as a permanent alternative to maintaining the natural equilibrium between humans and its surrounding sustainable environment. Conservation efforts involving local people have allowed Conservation International Venezuela to establish alliances with institutions and local groups to work together on a strategy to protect the natural heritage as a means to achieving human wellbeing in the long term.

The results obtained from this RAP survey have significantly increase knowledge of the diversity and biogeography of this area, and the country in general. It also contributes essential information for designing and implementing strategies for the conservation and sustainable use of species and ecosystems.

A rapid biodiversity assessment in the Ramal de Calderas took place between March 26th and April 5th, 2008. Studies were carried out in three focal areas representing the productive Venezuelan Andean landscape. Terrestrial and aquatic ecosystems of pristine forests and disturbed areas within an altitudinal gradient between 800 and 2,000 m.a.s.l., were studied, giving special consideration to shade-grown coffee agroesystems as an intermediate ecosystem of great importance to human communities in the area, and as an alternative to biodiversity conservation against the advance of the agricultural and cattle ranching frontier.

Focal Area 1 (FA1): Cerro Gobernador – Valle Encantado (San Ramón Sector) includes natural forests with different degrees of alteration on smooth hills, between La Bellaca stream (1,100 m) and the base of Cerro El Gobernador (1,500 m), classified as semi- deciduous forest with natural forests and low shrubs on steep slopes between 1,500 and 2,000 m, as well as grazing pastures (potreros) and shade-grown coffee plantations.

Focal Area 2 (FA2): Aguas Blancas – Los Alcaravanes (Aguas Blancas Sector) from cloud forest at 1,700 m to paramo at 3200 m, including high altitude grazing pastures for cattle at the base of this focal area.

Focal Area 3 (FA3): Bosque de Café – Pozo Azul (Sector Pozo Azul – La Volcanera) which includes shade-grown coffee plantations that have replaced natural forests within semi-deciduous forest, from 800 to 1,200 m elevation, along La Volcanera stream.

RESULTS RELATED TO CONSERVATION

Criteria for conservation
Primary criteria

Heterogeneity and habitat uniqueness

Ramal de Calderas is a mosaic of terrestrial and aquatic ecosystems that range from the paramo at 2,000 m.a.s.l. to semideciduous forests which have been transformed into agro-ecosystems for shade-grown coffee cultivation and grazing pastures between 800 and 1,200 m.a.s.l. The highest zones are dominated by cloud forest ecosystems, followed by "Chirivitales" (high Andean shrubs) and paramos, while the lower area of the southern slope have sub-mountainous forests that are highly fragmented as the result of human intervention. The northern slope, in the surroundings areas of Boconó and Niquitao, has persisting mountainous deciduous forest. Their presence in lower altitudes makes them favorable for shade-grown coffee cultivation. These semi deciduous forests are of special ecological interest for the biodiversity they harbor and the threats they face facing from land use changes.

The hydrological network within Ramal de Calderas drains to the Orinoco River. Very steep slopes and accentuated drops between summits and valleys allow water runoff to accelerate, creating torrents and promoting high sediment dragging capacity. The area contains the headwaters of the Calderas or Azul River, Burate, Aracay, Masparro and Boconó rivers, as well as other important streams. The aquatic ecosystems of this region are varied and include bogs, streams, and rivers that constitute particular habitats for the remarkable fauna of vertebrates and invertebrates in this Andean foothill.

Actual level of threat

While the Ramal de Calderas geographic area pertains to two National Parks, a Natural Monument and a Protective Zone, it is not protected in its entirety and each of the preceding protected areas have different objectives and degrees of protection. On the other hand, its association with National Parks (NP) is not direct, and in both cases, Ramal de Calderas is separated from these two protected areas by a riverbed. Towards the west it is separated from the Sierra Nevada NP by the Santo Domingo River and the national road Merida-Barinas; to the east it is separated from the General Cruz Carrillo (Guacaramacal) by the Boconó riverbed.

In general, about 26% of the Ramal de Calderas is protected by Teta de Niquitao-Güirigay Natural Monument (Polygon B – Güirigay) and 55% of this geographic unit is located within the Protective Zone for Hydrological Watersheds of the Guanare, Boconó, Tucupido, La Yuca and Masparro rivers. Both protected areas cover, almost in its entirety, the surface of the paramo located in this zone.

The Protective Zone of the hydrological watersheds mentioned above was decreed for conservation and recovery of hydrological resources. This area was declared a Natural Protected Area (ANAPRO, in Spanish) according to the National Decree No. 2.236, published in the Extraordinary Official Gazette No. 4.464 on August 8th, 1982, which contains the Land Use Ordinance and Regulations for the referred Protective Zone. For its part, the Teta de Niquitao – Güirigay Natural Monument presents unique and outstanding landscapes of local and national importance that merit conservation measures. This area was declared a monument by National Decree No. 1.473 according to the Official Gazette No. 36.063 signed in October 11th, 1996 to protect these landscapes.

Excluding the areas located within the decreed ANAPROs, 19% of the Ramal de Calderas is not protected. We refer to the area mainly covered with pristine forests. This unprotected zone consists of a forested area along an important altitudinal gradient ranging from 1,600 m.a.s.l to 3,400 m.a.s.l.

Potential opportunities for conservation

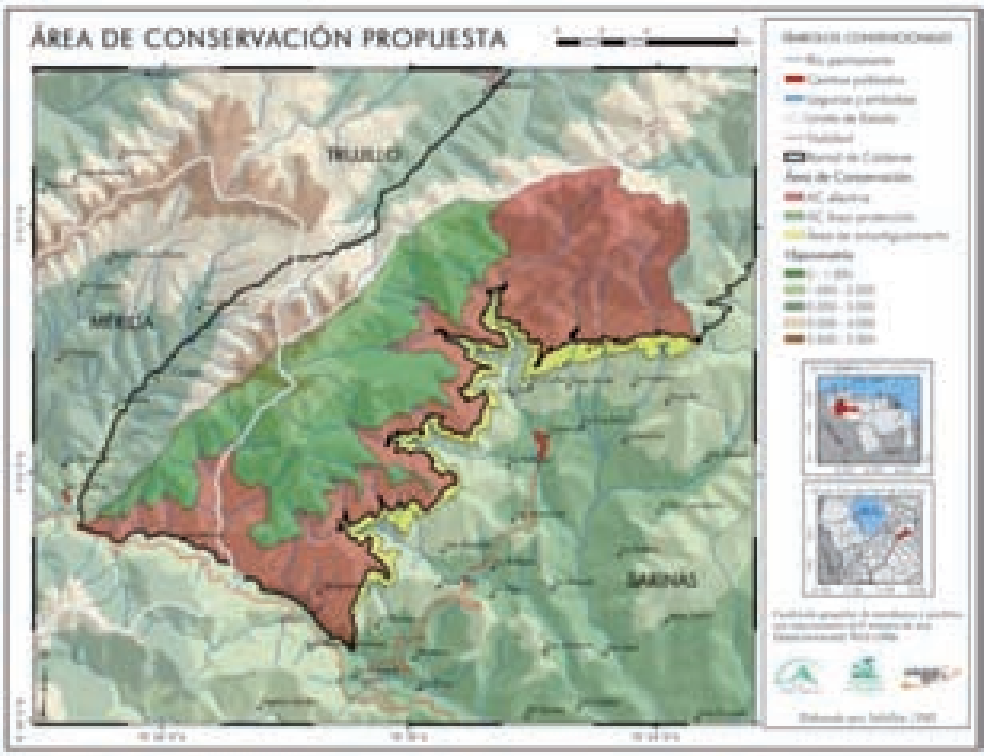
Ramal de Calderas represents a geographic area of great global importance. Locally it serves to connect two important National Parks in the Merida mountain range; it is an area of high biodiversity and levels of endemism, as well as its hydrological resources, which are also very threatened due to human pressure. These reasons justify the creation of a "conservation area" in this region.

Proposal for a conservation area for the Ramal de Calderas

Based on land cover information generated from satellite imagery, analysis of susceptibility to change, and the presence of protected areas in the region, a preliminary conservation area for the Ramal de Calderas was delineated with an extension of 12,000 ha, including the headwaters of the La Volcanera, del Medio and El Molino streams, and the Azul River (Conservation International Venezuela 2007). Seventy percent (70%) of the area is covered by forests and 2% by paramo. Lastly, 7% of the surface has been altered by humans, and as a result, it has been highlighted as a priority for recovery. The proposed conservation area is located on the western slope the Ramal, along the left bank and northeastern end of the Santo Domingo River, and near the headwaters of the Calderas River.

Level of fragility

Excluding the areas within the National Protected areas, 19% of the Ramal de Calderas is under no protection and is mainly covered by pristine forests. This unprotected area is represented by a strip of land with an important altitudinal gradient ranging between 1,400 m.a.s.l. and 3,400 m.a.s.l. This area is in high danger of alteration itself, since it is located next to shade-grown coffee forests located near the Calderas community, and on the right bankof the Santo Domino and Aracay rivers, which are areas that have undergone significant changes in the last 20 years.



Secundary criteria

Diversity and Endemism

Flora and fauna richness documented in the Ramal de Calderas is an important representation of biological diversity found in the Venezuelan Andes, from which its notable and high level of diversity and exclusiveness, distinguishes it as one of the highest in the country.

Human significance

The population of Calderas located in the Municipality of Bolívar is sensitive to the value of nature and are generous towards other people. Their economy is based primarily on shade-grown coffee cultivation. Their fondness of the forest, their appreciation for water sources, and their respect towards animals endow them with a distinctive behavior compared to other communities in the region. These character traits have allowed plenty of habitants to associate and adopt new ideas and productive ventures which are based on harvesting nature without causing further damage and degradation. Examples of this are activities like rural community tourism, harvesting of medicinal plants, and training of nature guides. A set of projects and cooperatives (Aromas de Calderas and Boca e'Monte) have been the axis of Conservation International Venezuela's strategy with local partners (Programa de Andes Tropicales, Fundatadi, ULA, and coordination of the GEF Terrandina Program). Conservation International Venezuela's five-year effort in this area has demonstrated the existence of great human capital for the sustainable use and conservation of natural resources in the Ramal de Calderas, which provides great opportunities to promote good use of forests, water and air resources, and regional Andean biodiversity.

Level of integrity

In general this region has a medium degree of integrity, with a progressive tendency towards a higher degree of integrity in areas that are free from human disruption. Subsistence agriculture covers most of the lower area of the Ramal de Calderas. Mid elevation zones are occupied by shade grown coffee plantations, notably affecting important and scarce semideciduous Andean forests. Higher zones are the least affected, conserving good areas of cloud forest and paramo.

Tertiary criteria

Ability or capacity to generalize

This study complements information available on natural and altered environments in the Merida mountain range in the Venezuelan Andes. Explorations carried out in three established focal areas in this study allowed us to have approximate figures on the terrestrial and aquatic biota, taking into account that our knowledge is more complete for some groups like fishes (given their modest richness and restrictive habitat) or birds (due to previous inventories); while others are less well known (amphibians and reptiles). In this sense, results obtained in this study can be used as a foundation to predict the potential biological diversity in Ramal de Calderas and the Andes in the studied altitudes, but without neglecting the possible existence of unique species in particular habitats like the paramo and river headwaters, especially for animal groups with low dispersion rates like amphibians and fishes.

Level of knowledge

Prior to this study there was limited to no information on the biological diversity of the Ramal de Calderas, most of which was available in isolated and scarce records. After this study, there is a satisfactory amount of knowledge, even though further research is needed in the area during different seasons, and in those environments that were scarcely studied during this RAP survey. Further research is especially needed to document species that may undergo migration, displacement or seasonal movement between habitats, etc.

SUMMARY OF RESULTS OF THE 2008 CALDERAS RAP SURVEY

Description of the Study Area

Ramal de Calderas is located in the northeastern portion of the Merida mountain range, above the sloped llanos plains, in Barinas State of the Venezuela Andes. This region is formed by the succession of sedimentary outcrops, granitic and metamorphic units from the mid Eocene period; it presents great environmental variability where altitudinal gradients with different climatic factors are combined, resulting in the presence of different ecological units (sub-montane forests, semi-deciduos forests, cloud forests and páramo) which, in conjunction, exhibit great beta biodiversity as the result of rapid species turnover along the altitudinal gradient and the existence of high endemism. These characteristics provide the area with high strategic value for conservation, in addition to its potential as a natural biological corridor integrating a group of natural protected areas such as the Sierra Nevada, La Culata and Guaramacal National Parks, Teta de Niquitao-Güirigay Natural Monument, and the Protective Zone of the Guanare, Boconó, Tucupido, La Yuca and Masparro hydrological watersheds.

Flora and vegetation

Data on the composition and structure of the vegetation was collected in three forested zones in the Ramal de Calderas within Bolivar Municipality in Barinas State. These areas where located at 1,100; 1,700 and 2,300 m.a.s.l., respectively corresponding to lower montane semi-deciduous humid forest, montane semi-deciduous humid forest, and upper montane semi-deciduous humid forest (cloud forest). From 720 samples collected, 579 species of pteridophytes (ferms) and angiosperms of the classes Liliopsida and Magnoliopsida, distributed in 125 families and 274 genera. Given that the Ramal de Calderas has not been studied broadly from a floristic point of view, more that 40% of the species recorded are new records for Barinas State, and four species are new to science. The RAP team classified and described the different types of vegetation between 1,100 m.a.s.l. and the páramo at 3,400 m.a.s.l, including altered environments, particularly coffee plantations.

Water geochemistry

In general, water bodies studied in the Ramal de Calderas presented low conductivity values (4 – 86 µs), concentration of dissolved solids (3,2 -57,8 ppm) and low temperatures (15,5 - 21 ºC), which represent typical conditions of Andean foothill rivers. Discharge values ranged between 0,172 m3/s, in the lower sector of El Molino stream, and 0,545 m3/s in the La Bellaca stream.

Aquatic macroinvertebrates

Before this RAP survey, no studies of the macroinvertebrate fauna had been conducted in this area. An inventory of aquatic macroinveterbrate groups was conducted in the most representative water bodies of Ramal de Calderas (Barinas State) in the Venezuelan Andes. In the first habitats sampled –areas with rapids and wells, zones with leaf accumulation, rocky and sandy substrates, and aquatic vegetation (macrophytes and pteryphyton) – the macroinvertebrate community was represented primarily by aquatic insects, from 54 families belonging to 11 orders: Diptera, Coleoptera, Collembola, Ephemeroptera, Heteroptera, Lepidoptera, Megaloptera, Odonata, Orthoptera, Plecoptera and Trichoptera. In addition, representatives of other groups were collected, including gastropod mollusks, decapod crustaceans, copepods, ostracods, nematodes and platyhelmiths. Diversity and richness decreased from FA1 to FA3, corresponding to increasing levels of human alteration. The biotic index analyses indicate good water quality in most of the bodies of water evaluated.

Fishes

This RAP survey is the first inventory of fishes to be conducted in this area. Between March 26th - April 5th, 2008, a rapid biological assessment of the ichthiyofauna was carried out in the Ramal de Calderas, studying 16 bodies of water (streams and ponds) pertaining to the Orinoco hydrological watershed (Andean foothills), through the Calderas, Santo Domingo and Apure river systems, with sampling stations located between 933 and 1,590 m.a.s.l. Nine (9) species were identified, of which six (67% of the total) where present in San Ramón Sector (FA1), six (67% of the total) in Aguas Blancas Sector (FA2) and five (55% of the total) in Pozo Azul – La Volcanera Sector (FA3). The Siluriformes order was the dominant group with 5 species (56%), followed by Characiformes with 4 species (44%). Of the six families identified, Trichomycteridae presented highest species richness with three species (33%), followed by Characidae with two species (22%), and Crenuchidae, Lebiasinidae, Astroblepidae and Loricariidae with one species each (11% each). At least two species, one assigned to the genus Astroblepus, and another to the genus Trichomycterus, are new to science. The main threats to the conservation of fishes in the region are degradation and habitat loss as the result of poor agricultural practices, such as slash and burn to expand current grazing pastures, as well as overgrazing in areas near river headwaters. Pollution was also observed in some of the water bodies studied.

Amphibians and Reptiles

Before this RAP survey, no studies of the macroinvertebrate fauna had been conducted in this area. During the RAP survey, herpetofauna was studied over a period of 20 edays -10 days between March 25th and April 5th, 2008, and ten additional days between September 3-12th, 2008. Over both periods, a total of 33 species were recorded: 17 amphibians (Anura), 5 reptiles (Sauria) and 11 snakes (Serpentes) belonging to two orders, 14 families and 26 genera. This relatively low biodiversity seems to be the consequence of an intense drought during the first period of sampling in the field. Four Anura amphibian species fall have a threat status of Data Deficient (Señaris 2008). Three potential new species to science belonging to the Adenomera, Aromobates and Pristimantis genera were recorded; as well as five geographic range extensions, specifically for the Anura Allobates humilis, Mannophryne cordilleriana and Dendropsophus luteoocellatus; Riama inanis (reptile) and Siphlophis compressus (snake). The main threat to the herpetofauna in the Ramal de Calderas is the loss and habitat fragmentation as the result of deforestation for agricultural and cattle.

Birds

During the 2008 Calderas RAP, 274 bird species were recorded in cloud and semi-deciduos forests, altered areas and shade-grown coffee plantations located between 1,250 and 2,500 m.a.s.l. in three focal areas defined for this study. One hundred and seventy eight (178) bird species were recorded in the San Ramón Sector, 147 bird species in the Aguas Blancas Sector and 96 bird species in the Pozo Azul Sector. New distribution data was collected for seven bird species and there may be three (3) subspecies new to science. Forty-four percent (44%) of known species for the region were documented in shade-grown coffee forests, but species found in the forest understory were scarce and other species usually abundant in natural forests seemed to have have disappeared (for example species of Formicaridae, Pipridae, and some Tiranidadae). These differences are due to the practice of clearing plants from the understory of coffee plantations and planting trees that provide little shade. Given these circumstances, to favor bird diversity it is recommended that a higher diversity of shade trees are planted, and that understory plants are maintained to the extent possible, if they do not interfere with the coffee. Ramal de Calderas continues to be an area with unknown ornithological information since inventories have only taken place in the lower part of cloud forests, disregarding bird species in paramos habitats and higher cloud forests, which are habitats were the majority of endangered species for the Andean region are located. Seven (7) species documented are considered of global importance for BirdLife and 2 species are considered under some category of threat by IUCN, which makes Ramal de Calderas an area of great importance for birds. Primary threats to birds are deforestation for agricultural purposes and hunting pressure. The Tropical Andes region has a high potential for bird watching-based tourism.

Mammals

Based on sampling carried out over a period of 18 days, as well as information from interviews with local people, direct observations, searches for tracks and footprints in the Ramal de Calderas (Barinas State) in the Venezuelan Andes, seventy-four (74) mammal species were recorded from 7 orders, 21 families and 58 genera. Nonetheless, species accumulation curves indicate that the total richness for the sampling and overall study area is still unknown. With information from this assessment, the known distribution of Chrotopterus auritus and Oecomus flavicans is increased in the flatland (llanos) slope of the Venezuelan Andes. Likewise, 18 species represent new records for Barinas State. The study area harbors an endemic species for the Venezuelan Andes (Nephelomys meridensis), a species considered under threat (Tremarctos ornatus), and three species considered vulnerable (Lontra longicaudis, Leopardus sp. And sphiggurus pruinosus). The absence of primates, low representation of bats from the Phyllostominae subfamily, and high number abundance of fruit-eating bats (Carolliinae and Stenodermatinae subfamilies) indicate that the natural areas studied have suffered considerable human disturbance. Nonetheless, these areas still seem to harbor elevated species richness that plays an important role in ecosystem functionality. Thus it becomes a priority to recuperate and conserve these ecosystems due to the strategic value of the Ramal de Calderas as a corridor between Guaramacal and Sierra Nevada National Parks, to conserve Andean lowland foothills and specially the Spectacled Bear.

SOCIAL AND CULTURAL ASPECTS

Calderas represents an area of opportunities for conservation and a clear example of what can be accomplished in terms of local community development tied to recognition, valuation and protection of the environment. Their set of moral values has fostered a source of human and social capital that can be a key to success.

Cattle and shade-grown coffee zones in the Venezuelan Andes

The cattle and shade-grown coffee zones in the Venezuela Andes are mainly located on humid slopes of the Merida mountain range between 800 and 2,000 m.a.s.l. Coffee plantations and cattle grazing pastures own their success to historical, economic and social activities that occurred in these mountains in the early and mid nineteen century. Contrary to what has happened in other mountain ranges in Venezuela, coffee production and cattle raising in this area was based on small to medium family properties, characterized by an ample amount of agricultural products, much of which allowed for subsistence in harsh times and improved family diets during better harvesting periods, maintaining up to three commercial products in which coffee has the most importance. Moreover, these productive units usually handle small to medium size bovine cattle, which does not necessarily occupy the same space as coffee plantations, thus occupying

ample extensions of the cloud forest. The expansion of areas destined for coffee and cattle has had environmental consequences like changes in water flow, soil erosion and biodiversity loss. Unfortunately, these consequences have not been studied thoroughly and there is lack of information that can allow better understanding on the true impact of changes in the landscape. However, these sustainable productive systems, and the economic and social well-being of local communities will depend on further information on these environmental changes, and on how well this knowledge is applied to regional development plans.

THREATS

In the areas studied in the Ramal de Calderas, current threats to biological diversity were detected and are detailed below.

- The main threats to the flora and fauna in Calderas are deforestation and fragmentation of original vegetation formations for agriculture and cattle use. Expansion of areas destined for extensive agriculture and cattle ranching have had environmental consequences that are evident in water flow changes, soil erosion, as well as local biodiversity loss.

- Within the coffee agro-ecosystems, the species of native canopy trees from the semi-deciduous forest are being replaced by a few species of introduced shade trees which simplify the composition of these new "coffee forests", negatively affecting the biodiversity and making them more susceptible to pests and diseases.

- Wood harvesting and burning practices constitute threats to local flora and fauna, not only in terrestrial environments but also in water bodies in the region.

- Water contamination as the result of inadequate agrochemicals used or disposal of domestic litter affect water quality and the surrounding landscape, and have consequences over human populations that inhabit this area.

- Even though the existing "shade-grown coffee culture" within local communities in Calderas, their traditional and friendly use of natural resources is in peril. Decline of coffee prices, limited real economic stimulus and the expansion of agricultural and cattle raising activities by outsiders constitute a threat to this tradition, with effects on people and their surrounding environment.

- Visitation by tourists with low cultural appreciation for the environment, limited awareness of the importance of these ecosystems, and inadequate guidance, may put the biological diversity in the area at risk, as well as disrupt the harmonic relationship between local inhabitants of Calderas. Deterioration of social and natural spaces, as well as fires that occur frequently during the drought season, are the result of inappropriate behavior from many visitors. The potential threat from illegal extraction of flora and fauna species from this area should also be monitored.

- While infrastructure at a large scale in all the focal areas studied represents an improvement in communication between local populations, it often also facilitates landscape disturbance in mountainous sectors. This merits attention from local authorities. A case in example is the road that connects Aguas Blancas with La Volcanera – Masparrito.

CONSERVATION RECOMMENDATIONS

Based on results and observations made during this RAP survey, the following recommendations are proposed for ecosystem and biodiversity conservation in the area:

- Establish Ramal de Calderas as a conservation area to create a biological corridor between Sierra Nevada and Guaramacal National Parks, Teta de Niquitao Güirigay Natural Monument, and the Protective Zones of the Guanara, Boconó, Tuycupido, La Yuca and Masparro rivers. Promotion of this conservation area should be a joint strategy between governmental and non-governmental institutions, and local communities.

- Urgently protect the remnant medium size forests (5-10 ha) to ensure conservation of pre-montane and lower montane vegetation formations, and the biological diversity associated with them.

- Promote shade-grown coffee cultivation that includes conservation criteria as well as fair economic incentives for local producers that procure higher quality products, and which maintain the Andean region's natural heritage. Shade-grown coffee forests can be valuable allies for biodiversity conservation in environments subject to habitat loss and fragmentation. If these agro-ecosystems are managed adequately, they can act as biological corridors that connect native forests and offer refuge to numerous birds, mammals, amphibians, reptiles and insects.

- Continue to support and provide incentive to activities that develop innovative sustainable use of natural resources in the area, and that promote improvements to the quality of life of local communities. Conservation International Venezuela, Programa Andes Tropicales and Fundatadi ULA began a joint strategy that has resulted in a network of rural community based tourism activities, including training nature and bird-watching guides and forming two well-established cooperatives (Aromas de

Calderas and Boca e'Monte) to carry out plans at a larger scale.

- Further promote and disseminate information on the importance of the biological diversity of the Ramal de Calderas in maintaining natural equilibrium in the Andean ecosystems. Highlight not only the presence of endemic and threatened species that inhabit the area, but also vital environmental services to humankind like seed dispersal and pollination, among others.

- Continue to improve local capacity in monitoring key species – endemic, threatened, rare, etc – as begun by Conservation International Venezuela, for implementation of more extensive programs for the integral conservation of natural ecosystems in the area, and for the improvement of the quality of living for local communities.

- Conduct studies during additional seasons, and in unexplored environments.

- Develop a program to consolidate knowledge on biological diversity in this interesting sector of the Venezuelan Andes. Local communities should actively cooperate in increasing local knowledge, in monitoring, and in conservation efforts.

- Establish official surveillance and protection for the forests in this region. Wood harvesting and extraction of fauna decreases, directly or indirectly, the quality of life of the local communities, and it is a crime against our natural heritage.

- Protect water bodies, river headwaters, and their associated forests.

- Develop alternatives to overharvesting of local natural resources by local communities, which may negatively impact hydrological resources; Study the economic alternatives that procure fair use and maintenance of natural resources for future generations.

This RAP survey was complemented with additional studies on coffee forest biodiversity. For the first time in Venezuela, and with support from CIARA Foundation, Conservation International Venezuela, La Salle Foundation on Natural Sciences, Fundatadi ULA, Phelps Collection, UNELLEZ and the Universidad de los Andes have contributed information on the importance of these agro-ecosystems in productive Andean landscapes. It is recommended that these results are published and developed into a program to monitor the status of biodiversity and coffee productivity within shade coffee plantations in Calderas.