ECORREGIONAL ASSESSMENT: EASTERN CORDILLERA REAL ORIENTAL PARAMOS AND MONTANE FORESTS

The Nature Conservancy, EcoCiencia y Fundación AGUA. 2005. Evaluación Ecorregional de los Páramos y Bosques Montanos de la Cordillera Real Oriental. Quito-Ecuador.

The ecoregional assessment of Eastern Cordillera Real Paramos and Montane Forests was implemented to design a network of conservation areas that can maintain successfully in the long-term characteristic biodiversity of the region, as well as ecological processes.

The Tropical Andes region located in northern South America is gifted with an impressive array of biodiversity. The Nature Conservancy (TNC) has worked for several years in collaboration with local organizations implementing conservation actions on this region. Within the Tropical Andes the Eastern Cordillera Real Paramos and Montane Forests are found, which have been identified as strategic areas for directing conservation efforts.The Nothern Andes Program of the World Fund for Nature (WWF), in the biodiversity vision for the Northern Andes, identified 65 priority areas for conservation on this region that groups several ecoregions. This process identified the Eastern Cordillera Real Montane Forests ecoregion as a priority within the ecoregional complex.

With this background, the former Ecuador Program (now Northern Tropical Andes Conservation Program) in collaboration with EcoCiencia and Fundación AGUA, decided to develop an ecoregionall assessement on this ecoregion to refine the results and data produced by WWF.

The objective of this assessment is to propose a common vision of biodiversity success in the Eastern Cordillera Real Paramos and Montane Forests, through the following:

- Identification of priority sites that represent biodiversity of the ecoregion
- Create an innovative methodology that can be used in future exercises with similar purposes
- Engagement of stakeholders to ensure that results will be used in the future
- Develop a scientific baseline to be used on strategy development that can ensure conservation of priority areas
- Support national planning processes (for example the Gap Analysis under the Convention on Biological Diversity)
- Strengthen organizations involved in the process
- Create a biodiversity information system that can unify information of the region and make it available to the public
- Establish a baseline to measure biodiversity conservation success in the future

Data and results generate by this project constitute a decision support tool that can be used by all those interested in conservation of this region.

¿What is an ecorregion?

Ecoregions are relatively large geographic areas of land and water defined by common climate, vegetation, geology and other ecological patterns. Ecoregions proposed by WWF are used as planning units in regional analysis.

Ecoregional assessment

Ecoregional assessments are suites of ecological and socio-political analysis that prioritize and inspire conservation actions with partners through the development of a lasting vision for conservation success

Conservation results are the aim of all who care for the Earth and its rich and varied biological diversity. Ecoregional Assessments lay the foundation for conservation of this biological diversity. They are the first step in The Nature Conservancy´s framework for mission success – Conservation by Design – in that they set the biodiversity priorities for which strategies are developed, action is taken and success is measured in every ecoregion in the world where the Conservancy and its partners work.

The main steps of this methodology are:

- Identify focal biodiversity: Plants and animal species, natural communities and ecological systems are identified to represent the ecoregion´s biodiversity.
- Assess ecological condition: The ecological health of focal biodiversity is assessed to determine current conservation status and to focus conservation on viable examples.
- Set conservation goals: Numeric goals are set for the desired number of populations or occurrences of each biodiversity element across the ecoregion.
- Design a network of conservation areas (portfolio): Networks or portfolios of conservation areas are developed based upon the best science available and in consultation with stakeholders. Effective conservation of these areas should guarantee persistence of the biodiversity of the region in the long-term

Study area

This ecoregional assessment had a terrestrial and a freshwater component that ensures adequate representation of biodiversity of the region. The study area included 9`236.067 hectares, of which 68% are in Ecuador, 21% in Peru and 12% in Colombia.

In the region 13 protected areas are found in Colombia, Ecuador and Peru, they represent a surface of 26% of the total surface of the area. In addition to this, there are private protected areas that complement the National system and that represent an additional 6%.

The paramos and montane forests of the Eastern Cordillera Real are not only important because of their biodiversity, they play a very important role as water sources for human populations. Inside the study area, more than 500,000 people live, in addition to this population outside the area depend upon its resources. For example the city of Quito, with 2 million people, depends on water sources coming from this region. This emphasizes the importance of ensuring that conservation activities are implemented in this area, in order to guarantee availability of resources in the future.

Intensive colonization processes without adequate planning, and natural resources extraction without environmental considerations are putting in danger the ecological integrity of this region. It is urgent that stakeholders of the region work under the same vision that can ensure maintenance of resources in the future.

Study area: terrestrial component

The study area includes a terrestrial ecorregion: Eastern Cordillera Real Montane Forests, and portions of other two ecoregions: Northern Andean Paramo, and Central Andean Paramo.

Eastern Cordillera Real Montane Forests
Tropical montane forests of this ecoregion are distributed in the eastern slope of the Andes, from the Colombian “macizo”, through Ecuador, to the northern slope of the Marañon river in Peru. It has a total extension of 102.500 $km^{2,}$ and an altitude range of 500 to 3500 m. These forests receive between 1.500 and 4500 mm of rain. Dominant vegetation varies dramatically with altitudinal variation, finding forests with strong Amazon influence, cloud forests and elfin forests in the higher parts. These forests have a very high biodiversity richness and importance due to its great altitudinal variation and its geological history. In addition to this, the ecoregion has species that originated in the Amazon basin, the dry inter-andean valleys and the tropical forests of the pacific.

Northern Andean Paramo

This ecoregion has a patchy distribution in areas above 3,500m. It covers areas from southern Venezuela to the central paramo of Ecuador. The study area includes from the Macizo Colombiano to Cuenca-Girón in Ecuador.

The paramo ecosystems in these ecoregions are humid and very humid, with the vegetation dominated by grasslands and plants adapted to cold weather. A lot of species are restricted to these habitats, so endemism is high in several taxa as vascular plants and amphibians.

Central Andean Paramo

The paramos of this ecoregion are found from southern Ecuador to Northern Peru, as a series of islands located in the higher parts of the mountains (over 3,000 m). The weather is cold and less humid than the Northern Andean Paramos. The ecoregion covers a surface of 1`220.000 $km^{2.}$ Due to their isolation, they have high levels of endemism and present important differences of biotic composition with the Northern Andes. This can be explained because of the influence that this ecoregion has from the dry tropical forests found in the Equatorial Pacific, as well as the desert areas of Peru.

Study area: freshwater component

Information on composition and biological dynamics of the aquatic ecosystems in the region is very limited. Few studies done on this area, show the importance of this region in terms of freshwater resources. This ecoregional assessment constitutes a very important contribution to increase scientific knowledge on freshwater biodiversity. To develop this assessment, Ecological Drainage Units (EDUs) were defined. These are macro-units structured by a group of basins that share similar environmental characteristics, as temperature, precipitation, connectivity and biogeographic patterns. Six EDUs were defined for the study area: Putumayo, Napo, Pastaza, Santiago, Zamora-Cenepa y Marañón.

Analysis and results

Selection of focal conservation targets

To represent the biodiversity of the ecoregion conservation targets were selected, these are the features for which a conservation plan is attempting to ensure long-term persistence. Conservation targets were selected to capture different geographical scales as well as scales of biological organization. Ecosystems targets were selected first, with the assumption that these capture the majority of the biodiversity. Species that are not well represented by ecosystems were selected later.

In the terrestrial component, the ecosystem map was done based upon the classification proposed by NatureServe. The map was done using existent vegetation maps, satellite images, field work and expert workshops. 27 terrestrial ecosystems were identified and mapped.

For the freshwater component, ecosystems were defined using a cartographic model, where information on geomorphology, watershed size, altitude, vegetation cover, meteorological data and biogeographical data was used. 180 systems were defined, and in addition to this all wetlands were included.

In addition to ecosystems, species and guilds (groups of species) that require special attention were selected. Criteria for selecting species for the terrestrial component were: threatened status, endemism, and landscape species. For the freshwater component the criteria were: threatened status, endemism, habitat specialist, bio-indicators, and commercial species. Focal conservation targets were selected from the following groups: mammals, birds, amphibians, orchids, araceaes, ericaceaes, trees, fish, aquatic plants and macro-invertebrates.

Viability and ecological integrity assesment

This step had the objective of assessing the capacity of focal conservation targets to persist in time, and identify those areas that have the better examples of viable occurrences that should be included in the network of conservation areas. This analysis was done for ecosystems, as well as for species. In the case of species, predictive distribution models were generated using occurrence data from museums, herbariums and experts. These models enable the possibility of doing viability analysis of the species based upon their habitat.

The terrestrial component identified the areas with the highest integrity for ecosystems through a landscape analysis using the following variables: habitat remnants, patch connectivity, patch size and number, and core area. For species viability, distribution models were used to compare potential and current distribution. Fragmentation, connectivity, core area, habitat remnant was measured; and areas with higher viability were identified.

The freshwater component analyzed ecosystem integrity for micro-basins by using information on bio-indicators (aquatic plants and macro-invertebrates), water quality, percentage of natural vegetation cover, distribution of species conservation targets, and habitat diversity. Threats were also analyzed and ranked for aquatic systems, the following threats were considered: industries, roads, degraded areas, dams, towns, tourism, irrigation channels, oil industry and exotic species. In addition to this natural risks that can affect aquatic ecosystems were analyzed: landslides, volcanic activity and seismic activity.

Establish conservation goals

Define quantitative goals for the conservation targets allow us to answer to the key question of: how much area of each target should be conserved for long term persistence? Goals were established as a percentage of the conservation target distribution. This percentage represents the amount of habitat that should be captured in the network of conservation areas for each target. Conservation targets that are more threatened, or are rare or endemic, had higher conservation goals, so a higher percentage of their distribution was captured in the network.

On the terrestrial component, conservation goals for species were set based on the following: (1) Distribution range within the ecoregion, (2) Degree of rareness, (3) Percentage of habitat loss, and (4) Fragmentation index. For ecological systems conservation goals were based on (1) the distribution pattern within the ecoregion (2) Degree of rareness (3) Percentage of habitat loss, and (4) Fragmentation index.

For the freshwater component, the goals for species and systems were defined considering the total area of the EDU, equivalent to 100% and were set with the 20% minimum area required to conserve each system within the EDU. This procedure ensures the conservation of at least 20% of the total area of each system within the EDU.

Design a network or portfolio of conservation areas

This final step integrates all the information produced in the previous steps by selecting a network of priority sites for biodiversity conservation (portfolio). The rationale behind the portfolio is to ensure that all the biodiversity components of the ecoregion, represented in the conservation targets, are adequate included in the selected sites.

For the terrestrial component, the portfolio was designed using a computer-based algorithm to prioritize areas for conservation. The primary advantage of using this type of algorithms is that they allow planners to delineate explicit “rules” to identify a set of conservation areas and to assess alternative portfolios of conservation areas by making changes in these rules.

For this component, different portfolios were produced; one for the total extension of the ecoregion, which considered the criteria of biodiversity, ecological integrity and species viability. Three additional scenarios were produced just for the Ecuadorian part, which took into account socio-economical information, in addition to biodiversity data. Unfortunately, this was not produced for Colombia and Peru, due to lack of socio-economical information. The socio-economic information included data on demography, accessibility, extractive activities (oil, mining) and land use.

The first scenario that included the whole study area recognized 48 areas all over the cordillera with special emphasis on the paramo and the Andean foothills ecosystems. The areas incorporated on the portfolio represent 42% (3´916.800 ha) of the ecoregion´s surface, of which only 28% is under the national protected area systems. The remaining 72% belong to private land owners, indigenous communities or national forestry reserves.

The three scenarios developed for just the Ecuadorian part were created based on slightly different criteria. The first scenario was created using the same conservation goals as for the whole ecoregion, and including socio-economic variables. The second one ensures accomplishment of conservation goals for species. The third scenario was built focusing on the conservation targets that needs a conservation goal higher than 35% of its original distribution. The generation of different scenarios offers a flexible tool that can be used based upon the needs of decision makers.

For the scenarios created just for the Ecuadorian part, the first scenario includes 3´824.400 ha divided in 21 areas that accounts for the 50% of the study area. The second version of this portfolio includes 23 areas with a high overlap with the areas included on the first scenario. The third case is made up of 23 areas with a slightly different setting. This scenario covers 44% of the Ecuadorian portion of the ecoregion. As a result of combining the three scenarios a portfolio of 26 priority areas was produced. A high proportion of these 26 areas are redundant for the three scenarios. However, important areas are defined for only one or two of the scenarios.

For the freshwater component once the goals for the conservation targets were defined, a portfolio of sites was developed, which allows the identification conservation areas, ensuring adequate representation of conservation targets. The portfolio design resulted from a selection of high viability areas, areas of high species richness, important areas for ecological services, wetlands with high ecological value, and protected areas.

As a result of this process a network of 156 areas was defined. This includes wetlands represented according to the conservation goals established. This assessment identified that most of the priority areas for conservation are within the EDU's Putumayo and Zamora – Cenepa, but there are also important areas in the EDU's Santiago and Marañón, in the southern part of the Ecoregion. In summary, the portfolio comprises a surface equal to 20% of the total surface of the Ecoregion, which fulfilled the conservation goals proposed at the beginning of this process.

Conclusions and recommendations

Biodiversity conservation under this planning scheme should be based on three cornerstones: identification of conservation areas (portfolio), design and implementation of conservation strategies and measuring the impacts of our work under an adaptive management model. It can be said that the first and the third cornerstone, are based in technical and scientific information, but the second one which can be understand as the one that gives coherence and sense to the whole process, is highly dependant on social and political issues. Long-term conservation of the portfolio depends on several factors, based upon which the following recommendations are presented:

- The information generated on this process should be used as a planning tool to guide environmental work of government, NGOs, as well as private and communal conservation initiatives. Also it should help to build partnerships and opportunities for collaboration to affect positive change in the region.

- The resulting network of conservation areas can serve as a principle component of the country's desired vision for its biodiversity, as a tool that can support the National Strategy of Biodiversity.

- The information generated by this process can assist the countries with their commitments with the Convention on Biological Diversity, in particular through the Protected Areas Workplan by linking the information and analysis produced with the development of the Gap Assessment.

- Regional visions should consider local visions. It is important to emphasize that local actions are critical to ensure conservation impact, and also provide a social sense to conservation activities

- The results and data of this ecoregional assessment should be widely known and validated by key stakeholders of the region, like local governments, social organizations, academic institutions, etc., so they can use it as a decision making tool.

- This ecoregional assessment has created a decision support system for conservation and should be used by conservationists to ensure the smartest, most efficient and most scientifically defensible decisions. Data should be regularly updated and conservation measures established to evaluate the impacts of our actions on biodiversity conservation on the future.