ECORREGIONAL ASSESSMENT EASTERN CORDILLERA REAL ORIENTAL PARAMOS AND MONTANE FORESTS: FRESHWATER COMPONENT EXECUTIVE SUMMARY

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The Ecoregion of the Eastern Cordillera Real Oriental montane forests extends from the southern part of the Colombian Range, specifically from the Putumayo basin, through all the Cordillera Oriental of the Ecuadorian Andes and the north part of the Cordillera Oriental of the Peruvian Andes. Its altitudinal range extends from 500 m of altitude to the permanent snowcaps in the higher mountaintops. The study site has a total surface area of 91,871 Km^2, which includes large extensions of mountain landscapes of the Andean paramo, cloud forests and Amazonian mountain ridges localized in the eastern area of the Cordillera Real of the Andes. This area is considered as one of the ten places with highest biodiversity in the world. The freshwater systems within this area have a total surface of 78,248 Km^2; and extend from 1.83º N to 6.05º S and 76.18ºE to 79.47ºW. Therefore, it includes, to the North, the watersheds of the Eastern Colombian Range, including the areas of Caquetá and Putumayo; and in the southern extreme Abra de Porculla in Perú; to the West the study area starts in the higher limits of the watershed going to the East up to 500 meters of altitude.

Due to its recent geological history, the Cordillera Real Oriental contains mostly high-altitude Andean areas, with some flanks draining to the Amazonian watersheds. These areas have a very heterogeneous topography which produces ideal microhabitats that embrace high levels of biodiversity and endemism. For example, approximately 2,900 out of 16,000 species of vascular plants are endemic for the Ecuadorian Andes (Jorgensen & León 1999), 75% of the endemic flora has been registered for Ecuador in the last five years (Valencia *et al.* 2000). But very little is known about the dynamics and biological composition of freshwater ecosystems in this region. Nevertheless, there are some studies about diversity and distribution of freshwater macrofauna that indicate that the macro invertebrate composition is about 27,8% in the high Andean area and 40,3% in the Amazonian flanks compared to all benthonic composition registered in Ecuador until now (Jacobsen *et al.* 1997). Likewise, studies about the composition of the aquatic flora suggest that the Andean region has very high species richness of aquatic plants (55 species), which constitutes one third of the 147 species of aquatic plants that have been registered for Ecuador (Terneus 2002a; Terneus 2002b; Jacobsen & Terneus 2001). These studies show the enormous importance that the Cordillera Real Oriental represents in terms of biodiversity and natural resources.

During the last decades, this ecoregion has become a focus of attraction for productive and development activities and for the establishment of new human settlements. These activities have resulted in a large-scale exploitation of natural resources which is threatening its own sustainability. Apparently, the major attractive of this region is concentrated in the Andean paramo areas, because they are considered as a permanent source of water for the human populations settled along the inter-Andean valleys. It is important to mention that this ecoregion contains 13 protected areas which belong to the protected areas systems of Ecuador, Peru and Colombia, and protect an area equivalent to 26% of the study area. There are also many private protected areas which complement the protected area systems with an area equivalent to 6% of the total surface of the ecoregion (UICN-UNEP 2003). Despite the management status of these areas, several productive activities are developed within them, especially those related to cattle-raising, agriculture, and natural resource exploitation. These activities are seriously threatening the long-term integrity of these areas, a situation that is aggravated by the intense colonization processes taking place in the region, which are mainly concentrated along the main road systems that traverse this landscape.

In this context, The Nature Conservancy together with Fundación AGUA and EcoCiencia, recognized the need of developing and strengthening conservation activities in order to ensure the subsistence of this vast ecoregion which harbors a great potential in terms of biodiversity and natural resources. With that objective, these institutions initiated a process of Ecoregional Assessment with the objective of developing a lasting vision of conservation success in the region. Ecoregional Assessments are suites of ecological and socio-political analyses that prioritize and inspire conservation action with partners through the development of a long-term vision for biodiversity conservation.

Ecoregional Assessment

A process of Ecoregional Assessment requires important efforts in terms of compilation, organization and interpretation of secondary and primary information. The process also requires permanent contributions from an interdisciplinary team, whose objectives are to identify priority conservation areas, based on the scientific and biological knowledge about the dynamic of the study system, and about its socio-economic characteristics. The convergence of these different elements will determine the success or failure of the process of Ecoregional Assessment; therefore, the level of knowledge and compromise of the actors and the quality of available information will determine the credibility of the final results.

The process followed for the Ecoregional Assessment of Eastern Cordillera Real Oriental paramo and montane forests included several steps. The first one was the identification of macro-units of analysis that, for freshwater ecosystems, were be represented by Ecological Drainage Units (EDUs). These units are structured by a group of micro basins that form smaller units of analysis called ecological systems. The second step was the selection of conservation targets or focal biodiversity, which are species, natural communities and ecological systems that are identified to represent the ecoregion´s biodiversity. Conservation targets are defined at two levels: coarse filter conservation objects (ecological systems) and fine filter conservation objects (freshwater species). The third step was assessment of the ecological condition or viability of the conservation targets previously selected. The ecological health of focal biodiversity is assessed to determine current conservation status and to focus conservation on viable examples. This process considers a detailed analysis of threats and the consequences that each threat generates to the conservation target. Another step is setting conservation goals, which are numeric goals set for the desired number of populations or occurrences of each biodiversity element across the ecoregion. The final step on this assessment was to design a network of conservation areas, known as the portfolio. This portfolio represents the group of areas that are needed to maintain in order to conserver the biodiversity of the ecorregion. This portfolio maintains a structure based on connectivity criteria, with the purpose of allowing the continuity of intrinsic ecological processes within the dynamics of freshwater ecosystems.

Methodology and Results

Conservation targets/ focal biodiversity: Coarse filter conservation targets (freshwater systems) were defined on the basis of large scale cartographic criteria, where information about topography, micro-basin size, altitude, natural vegetation cover, meteorological data and biogeographic distribution patterns of some fish species was used to define a model of freshwater systems for the study area. Fine filter conservation targets (freshwater species), were selected on the following criteria: endemic species, endangered species, bioindicator species and some species of commercial use. This data was used to build models of potential species distribution and identify those optimal areas for the development and establishment of these species. At the end of the process we selected 180 freshwater systems and 131 species, including one mammal species, nine bird species, 64 amphibian species, 15 aquatic plant species and 21 families of aquatic macro invertebrates.

The analysis of ecological condition or viability was developed in two phases. The first one corresponds to a general analysis about the health status of the sub-basins and micro-basins in terms of species, systems, and natural phenomena (intrinsic evaluation), and the presence of threats to surrounding areas (extrinsic evaluation). The second phase corresponds to an assessment of conservation areas based on the establishment of a hierarchical scale of viability, based on a cartographic model. For the viability analysis, the occurrences of species, their distribution and the health status of the species and systems within the study area was taken into account. Threats were ranked according to their impact on freshwater biodiversity. As a result of this analysis the percentage of viable area for each EDU was determined, and the results were as following: Putumayo EDU presented a viable area of 57%; the Napo EDU 57%; the Pastaza EDU 46%; the Santiago EDU 56%, the Zamora- Cenepa 50% and finally the Marañon EDU 36%.

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.

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.

The EDU Putumayo has 15 areas of high and very high priority, which are localized in Ecuador within the Cayambe-Coca and Antisana Ecological Reserves. These areas comprise a surface of 432,747 hectares which belong to 5.5% of the total surface for protected areas within this Ecoregion.

The EDU Zamora – Cenepa exhibits nine areas of high and very high priority, which are localized in the Gualaquiza and Bomboiza sectors and also in the Podocarpus National Park, in southern Ecuador. These areas have surface of 76,515 hectares.

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.

Information Gaps

Information gaps were identified in the southern section of the EDU Putumayo region, potentially caused by limited access to the area due to the ongoing Colombian conflict in this region. In the other hand, there are also information gaps in the northern section of the EDU Marañón, due to limited sources of information from Perú. Therefore, future efforts should be supplemented by additional information from Colombia and Perú.

Recommendations for the Future

It is important to start a process of field validation, especially in those areas that have been selected as part of the portfolio.

The results of this study should be considered as a decision support system for improving conservation in the region. The information generated on this assessment is aimed towards helping conservationists to make the smartest, most efficient and more scientifically defensible choices regarding biodiversity conservation. We hope that this study will help to build a common vision for the future, with a common vision of success and priorities for the region.

It is also important to keep improving the understanding of freshwater ecosystems types that are within the Ecoregion. This will allow higher accuracy in the results and canalize conservation strategies and activities.

Finally, it is important to promote and stimulate the establishment of monitoring plans and programs that will allow permanent evaluation of the impacts of our actions on biodiversity conservation.