

BIODIVERSITY VISION OF THE SOUTHWESTERN AMAZONIAN MOIST FORESTS GLOBAL 200 ECOREGION



Acknowledgements

This document incorporates the ideas, concerns, goals and expertise of people from Brazil, Bolivia, Peru, and the USA in an attempt to make a comprehensive assessment of the potential for conservation of the extensive and uncharted biodiversity harbored by the Southwestern Amazonian Moist Forests Global 200 Ecoregion (SWA G200). It is a unique endeavor in ecoregional planning in that individuals from different WWF focal units and partner organizations, pulled together to function as a unit – as an Ecoregion – and work as a team to plan the future for the Southwestern Amazonian Moist Forests.

The goals stated as fundamental to Ecoregion Conservation (ERC) as a WWF initiative are the foundation of this Vision. Modifications in the ERC workbook proposed methodology occurred where data is lacking to define and nominate areas for conservation. The Southwestern Amazonian Moist Forests presented challenges that were not necessarily anticipated but which were overcome by pertinacity and a desire to develop a conservation program that would function, that could be used as a tool for planning, that can guide our efforts for the next 50 years and provide a yard stick by which we can measure achievement, accomplishments, and even impacts.

The WWF ecoregional core team consisted of Dra. Rosa Lemos de Sá (WWF-Brazil), Dr. Leandro Ferreira (WWF-Brazil), Luiz Carlos Pinagé (WWF-Brazil), Dr. Eduardo Venticinque (INPA-Brazil), Juan Carlos Riveros (WWF Peru), Henry Campero (WWF Bolivia), Chelsea Specht (WWF Bolivia and former SWA Ecoregional Coordinator), Dr. George Powell (Conservation Science Department, WWF US), and initially Dr. John Butler (WWF US) as Senior Program Officer (SPO) in charge of the SWA G200 Ecoregion for WWF US. John was responsible for initial attempts at developing the ecoregional Vision and coordinating tri-national collaboration and should be acknowledged for his pertinacity in developing a working ecoregional team and initial attempts at an ecoregional Vision. Dr. Jaime Cavelier replaced John Butler as SPO for the SWA ecoregion in March of 2000. Maria Elena Godbey, WWF-US desk officer responsible for SWA, was incredibly important in coordinating technical as well as financial ecoregional details and her efforts were crucial for holding the ecoregion together as a unit in the absence of an ecoregional SPO. Nancy De Moraes replaced Maria Elena at the end of the process and was instrumental in finishing this product. Ing. Pedro Vasquez R., Director of the CDC-Peru and on the Faculty of Forestry Sciences at the Universidad Nacional Agraria La Molina was essentially a full-time member of the ecoregional team and his assistance at the technical and conceptual levels was important to defining ERC strategies for SWA and developing the various documents and draft visions that were reworked, revised, and even rejected during the composition of this Vision. His team of colleagues and staff at the Centro de Datos para la Conservacion (CDC), also facilitated many technical issues during the development of the Vision, especially Fernando Regal Gastelumendi who provided extensive GIS support and technical advice during the various Vision workshops and in the development of the final document. Fernando Rodriquez from the Instituto de Investigaciones de la Amazonía Peruana (IIAP) formed part of the initial team which developed the Peruvian portion of the preliminary socioeconomic assessment - the socioeconomic data collected, compiled and analyzed by IIAP was important in designing the ecoregional Vision and will form an important database for future investigations and refinement of the Vision. In a similar form, the Fundación Amigos de la Naturaleza (Bolivian NGO), was responsible for developing the methodology used for the preliminary biological and socioeconomic assessment for Bolivia and developed a database that includes a Geographic Information System and site-based biodiversity. Tom Allnutt's expertise in conservation science and GIS was essential for developing the model for sub-ecoregion design. Meghan Mcknight from the Conservation Science Program of World Wildlife Fund – US provided skillful insight for the final design of the maps of this document.

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Chelsea D. Specht, Jaime Cavelier, and Leandro Ferreira

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Chapter 2: Biological Assessment and Data Collection

I. Biological assessment of the SWA Global 200 Ecoregion

In the early stages of development of the Biodiversity Vision, each country was going to prepare a biological and socioeconomic assessment. These assessments and country-based visions for the Ecoregion, were going to be assembled to come up with an ecoregional Biodiversity Vision. Although some of these assessments were carried out and completed, final compilation and standardization of assessments turned out to be difficult due to differences in methodology used for the assessment and different quality and quantity of data that exist for each of the three countries. In addition, basic maps required to develop ecoregional maps of biological elements, such as hydrology, vegetation, and geomorphology, were not easily integrated due to different scales and themes of the basic thematic maps. While the actual assessments were not incorporated per se into this Vision, the data collected to make those assessments were invaluable and the assessments considered as ecoregional goals were defined and conservation criteria were established.

One of the results provided by the biological assessments was that one of the foremost barriers to the development of this Biodiversity Vision was precisely the lack of data on the distribution of species. With no comparable inventories or field studies across the Ecoregion, it was impossible to nominate areas based on special or unique biological characteristics. This conclusion helped design a methodology that used proxies of biodiversity distribution rather than maps of individual species. By designing future studies to complement the existing database and fill the holes in biological information required for logical conservation planning, we can further refine this Vision to ensure representation of ecoregional biodiversity.

II. Assessment by Country

a. Bolivia

The biological and socio-economic assessment for the Bolivian portion of the Ecoregion, was carried out by Fundación Amigos de la Naturaleza (FAN), a local Bolivian conservation NGO based in Santa Cruz. In addition to the socioeconomic and biological diversity assessments, FAN developed a methodology to arrive at a Biodiversity Vision and a Conservation Action Plan based on ecoregional and landscape conservation techniques, but it included only the Bolivian portion of the Southwestern Amazonian Moist Forests Ecoregion.

FAN's initial work was presented at a workshop with the participation of local and international experts and institutional representatives who work in the Bolivian portion of the Southwestern Amazonian Moist Forests in October 1998. The details of this workshop are outlined in the document "Conservación Basada en Ecorregiones en el Sudoeste de la Amazonía, Subdivisión Bolivia". While intended to be a vision workshop, and in fact the resulting document was a Biodiversity Vision for the Bolivia section of the SWA, the ultimate product was primarily a biological assessment. The biological and socioeconomic data that was accumulated and analyzed to arrive at the conservation assessments and "vision statements" were ultimately very useful in the development of the Ecoregional Biodiversity Vision. Maps collected during FAN's biological and socioeconomic assessment form a foundation for the Vision and the Monitoring and Evaluation plan that will develop from the Vision Goals.

b. Peru

The biological assessment for the Peruvian portion of the SWA Ecoregion was carried out by the Center for Conservation Data (CDC- Peru), and the socioeconomic assessment by the Instituto de Investigaciones de la Amazonía Peruana (IIAP). Both organizations were contracted by WWF Peru to develop the assessments and both organizations were in contact with FAN of Bolivia which was developing the methodology for the assessments and the Vision as the Peruvian teams were getting started. The assessments were similar to those done by the Bolivian team, but differed in the treatment of areas lacking biological data. The socioeconomic assessment was eventually combined with the biological assessment, and both of these documents have been very useful in providing an extensive conservation-oriented database for developing the current Vision for the Southwestern Amazonian Moist Forests Ecoregion. In addition, participating members of the CDC who developed this regional assessment continued to work with the Ecoregional Team while developing the final Biodiversity Vision.

c. Brazil

The biological assessment for the Brazilian portion of the SWA G200 Ecoregion was carried out by the Brazilian WWF team, who did not have the opportunity to participate in early ecoregional meetings and workshops and was not present as the "vision" methodology was being developed by FAN and implemented by CDC and IIAP. After participating in meetings in Iquitos (March 1999) and Puerto Maldonado (April - May 1999), the Brazilian team performed the biological and socioeconomic assessments and the results were presented in a meeting in Brasilia in August of 1999 for the SWA Moist Forest Ecoregion (sensu strictu) and in Lima (2001) and Santa Cruz (2001) for the other three ecoregions of the SWA Global 200.

III. Integration of Data

a. Management of Data: Computerized Mapping and Analysis (GIS)

Much of the work for this Vision has been accomplished with the aid of Geographic Information System (GIS) technology. The maps and analyses were primarily performed using ArcView, Arc Info, and ERDAS. If the Vision is to be a working document, with a system designed to monitor its progress and evaluate its conservation impacts, an ecoregional based GIS system must be established and maintained. Through the process of developing this Vision, GIS laboratories and trained personal have been established in each of the participating WWF offices via the WWF Network and local associations. The full database used for developing this Vision will be housed in each WWF office, as well as the central ecoregional coordination location. Yearly updates, required for proper monitoring and evaluation, will require communication among the three local WWF offices and/or the establishment of an ecoregional central office that maintains the updated database.

b. Development of an Ecoregional Database

In addition to GIS, much biological and socioeconomic data has been produced during the development of this Vision. Much of the site-specific biological and socioeconomic data can be found in the Bolivia and Peru documents as well as the database created by WWF-Brazil for its ten-percent Amazonian conservation program. An effort is being made to consolidate these databases and create a working baseline of data that can be used to develop and maintain a monitoring and evaluation plan for the Vision and ultimately for ecoregional conservation. The information contained in this database will also help to define scientific activities that increase the knowledge of the biological diversity, its extent, and its patterns of distribution, throughout the Ecoregion.

Chapter 3: Summary of Approach: outlining the goals

The goals for ecoregional conservation of the Southwestern Amazonian Moist Forests Ecoregion take into consideration the defining characteristics of this particular Ecoregion, such as high species alpha-diversity, and dependency of ecological and climatic processes on closed canopy forests. In order to maintain ecoregional diversity and promote protection of ecoregional integrity, the following goals were established to define the Biodiversity Vision :

- 1) Representation of biodiversity
- 2) Maintenance of large blocks of closed canopy forest, capable of maintaining:
 - viable populations of focal species
 - climatological processes
 - ecological processes that create and sustain biodiversity
 - resilience and responsiveness of habitats to large-scale disturbances and long-term changes.
- Continuity of the closed canopy for the maintenance of corridors suitable for seasonal migrations and flow of genetic information (metapopulation vitality).

A basic outline of the process used to create the Vision is presented in the flowchart (Box 3.1). Each of the processes and contributing data sets is described in detail in this and the subsequent chapter. The goals (representation, large habitat blocks and connectivity) directed the development of the process and define the resulting Vision.

I. Goal 1: Representation

Representation of biodiversity within the Ecoregion is the most basic goal of ecoregional planning. All unique biological elements and their unique combinations are to be protected in order to conserve the current level of biological diversity at the ecoregional level. Because we did not have taxonomic data available to directly determine patterns and extent of ecoregional biodiversity, and thus, a proposal for creating a network of areas for protection and management of resources, reaching the goal of representation required the development of proxies that predicted these patterns (Margules and Pressey, 2000). Environmental units (derived from climatic, edaphic, and vegetation maps) were used as proxies for biodiversity distribution.

By using this approach, we are assuming that there is a significant correlation between environmental units and species distribution, a hypothesis that needs to be tested, especially in light of the current debate of the levels of Alpha and Beta diversity of tropical rainforests in general, and in Amazonian forests in particular (Pitman *et al*, 1999). The environmental units defined for the purpose of approaching the distribution of species, were developed by subdividing the ecoregions into "sub-ecoregions" on the basis of climatic data and then dividing these subecoregions on the basis of units defined by unique combinations of vegetation and soils. The first division into climatic sub-ecoregions,



was necessary because vegetation maps at the ecoregional levels did not have the sufficient level of resolution to capture eventual differences in species composition under the same forest type. Thus, the intention of using climate as the first discriminating variable was to allow the model to accommodate species turnover within the same forest type according to large-scale vegetation maps.

a. Delineating Sub-ecoregions

Heterogeneity Model and Justification

The biodiversity contained within the humid forests of the Neotropics is relatively unknown at a small or local scale; that is to say that ecological variation within the tropical forests remains largely unmapped. Some say that the forests are relatively homogeneous and therefore can be treated as a single conservation unit (Hubbell, 1998, Pitman *et al*, 1999, Murray *et al*, 1999). However recent results are providing information that suggests the opposite: that microhabitats and species adapted to microhabitats actually exist and that these must be considered when developing conservation plans (Gentry, 1988, Tuomisto *et al*, 1995, Tuomisto and Poulsen, 1996, Svenning, 1999). Because of the ongoing debate over high or low Beta biodiversity (i.e. species turnover from one to another environmental unit) and because data distribution is very poor for most taxa, relatively large environmental units were used as proxies of species distribution.

The division of an ecoregion into subecoregions effectively increases the ability of planners to represent heterogeneity within the ecoregion by defining areas with different climatic conditions that are presumed to support different assemblages of species (Strittholt *et al*, 1999). In order to delimit sub-ecoregional boundaries for the Southwestern Amazonian Moist Forests Global 200 Ecoregion, a model was developed that took into account climatic information and clustered them based upon overall statistical similarity, thereby forming units defined by natural variability (Terborgh and Andersen, 1998)

The basic design of the model was to input climatic data into a grid system, such that each square of the grid was given a value for each of the climatic parameters. The grids were then subjected to a multi-variate cluster analysis that formed groups of highest similarity. The program was designed to output the number of clusters desired (28 in the last run). The model was constrained to consider only grid squares of proximity to be available for clustering with one another.

Selection of Parameters

The parameters entered into the analysis consisted of four variable classes: temperature, precipitation, evapotranspiration, and elevation. Data were selected based on availability at the ecoregional level and apparent effect on biological diversity. The variables available within each parameter were as follows:

Precipitation:

Annual mean

Range (annual monthly maximum minus annual monthly minimum) Number of wet months (months with >100mm rainfall) Number of dry months (months with <60 mm rainfall) **Temperature:** Annual mean Low (average monthly minimum) Range (annual monthly maximum minus annual monthly minimum) Variance (standard statistical variance) **Evapotranspiration:** Annual mean Annual minimum Annual maximum Range (annual monthly maximum minus annual monthly minimum) Variance (standard statistical variance) **Elevation:** Meters above sea level

Due to the likely interdependence (auto-correlation) of some of the variables within each of the parameters, an analysis of principal components (PCA) was run on each class to determine which of the variables in each parameter contributed most to the variation found across the Ecoregion. In each case, the contribution of two variables could explain at least 95% of the first principal component. These two variables were selected from each parameter and these seven variables together with elevation were entered as the components for grid identity and clustering.

Several versions of the model were run to test sensitivity to data inclusion/exclusion and variation of components (at the variable and parameter levels). Statistical analysis showed best clustering parameters when precipitation and temperature variables were used independently of the evapotranspiration and elevation, likely due to the interdependence of these classes that was noted in a PCA analysis run with all classes and their component variables. Ultimately, two variables of precipitation (number of wet months and range) and two variables of the temperature class (range and mean) were used for the clustering analysis to define sub-ecoregional boundaries (see Figures 3.1a and b; and 3.2 a and b).

Clusters of the climatic variation within the Ecoregion were generated with ERDAS software. This program defines clusters with a standard "Isocluster" algorithm then assigns each grid cell to one of the clusters according to a Maximum Likelihood routine. The 28 major clusters were used to define sub-ecoregions (Figure 3.3). The number of clusters selected was determined to maximize divisions within the Ecoregion without compromising the integrity of habitat clusters. The approximate distribution of the habitat clusters was delineated through the knowledge of the experts.

b. Landscape Units

Landscape units, the second element used to develop the representation units, were created by the intersection of a map of soil (FAO 1977, Fig-



Figure 3.1a. Number of wet months in the SWA G200 ecoregion



Figure 3.1b. Annual precipitation range(mm) in the SWA G200 ecoregion



Figure 3.2a. Annual mean temperature(°C) in the SWA G200 ecoregion



Figure 3.2b. Annual temperature range(°C) in the SWA G200 ecoregion



Figure 3.3. Southwestern Amazonian Moist Forests G200 subecoregions

ure 3.4) and a coarse scale map of vegetation (CIAT 1975, Figure 3.5) that were available at the ecoregional level. The resulting layer contained 140 landscape units (Figure 3.6). These data sources, while relatively coarse (scale -1:5,000,000), were the most detailed data available for the entire Ecoregion. Vegetation and/or soil or other abiotic or biotic maps existed for each country; however each country's map used different criteria to define vegetation types that are not compatible at the ecoregional level. For subecoregions that are completely within one of the three countries, more precise abiotic or biotic maps can be used to further define zoning and activities in the nominated areas. However, for purposes of the representation analysis at the ecoregional level, the coarse level data sets provided standard and sufficient detail.

c. Representation Units and Ecoregion Conservation Criteria

Because the scales of both soil and vegetation are so coarse, a single landscape unit (combination of vegetation and soil types) may be found in various sub-ecoregions. For example, a nonflooded forest in the Rio Javarí basin in Brazil may be classified in the same landscape unit as terra firme vegetation type with the same soil as a non-flooded forest in the basin of the Rio Mamoré in Bolivia. Because the two areas are widely separated, they will most likely have different species compositions. This is due, among other things, to disparate climatic conditions that were used to identify the sub-ecoregions. Thus, the landscape units within each sub-ecoregion were considered to be distinct in terms of species and/or species aggregations. Crossing the landscape unit layer with the sub-ecoregion layer produced a map of



Figure 3.4. Soil map (FAO) for the SWA G200 ecoregion



Figure 3.5. Vegetation map (CIAT) for the SWA G200 ecoregion





460 representation units that could be used as the basis for developing representation goals across the Ecoregion (Figure 3.7).

d. Setting the Level of Representation

While the concept of conserving a sample of each representation unit is simple, there is little information on what actually constitutes adequate representation to ensure long-term survival of the species and assemblages of species that are unique to each environmental unit. Scientists still do not agree on what level of representation is adequate to guarantee the viability of all species and natural communities in the area over the long term. Representation of 10% of the historic distribution of each habitat type is often proposed as a politically "realistic" objective (Soulé and Sanjayan, 1998), but that value is widely considered to be insufficient (Soulé and Sanjayan, 1998; Margules and Pressey, 2000) and levels of 50% and higher are suggested by studies that have attempted to quantify adequate representation on the basis of ecological parameters such as ecological structure, diversity, and resilience (Soulé and Terborgh, 1999) or to represent and protect "most elements" of its biodiversity (Soule and Sanjayan, 1998; also see review by Noss and Cooperrider, 1994). These amounts are assumed to vary in response to different factors in a region or habitat type, including connectivity, natural disturbances, and human resource uses.

In the absence of specific data on how much area is required to conserve all species and ecological processes, Strittholt et al (1999) proposed using a range of habitat representation targets (10%, 25%, and 50%) with 25% of each habitat's original (pre-European intervention) distribution being the recommended representation goal. In



Figure 3.7. Unique landscape units in the SWA G200 ecoregion

recognition of this uncertainty, for the analysis of representation of biodiversity in the SWA G200, the technical group decided to use a minimum representation goal of 10% of each major landscape unit, with the stipulation that the 10% goal was coupled with the requirement that all proposed areas also must be large enough to fulfill the minimum area requirements of area-sensitive "focal" species that were selected to represent the Ecoregion. The group concluded that it was necessary to impose a minimum area requirement in conjunction with the 10% representation requirement to ensure that all areas that were established for Level I (strict-use) protection would be large enough to support the complex Amazonian ecosystems and their ecological processes over the long term even if they became isolated.

II. Goal 2: Maintenance of large forest blocks

a. Use of Focal Species for Estimating Minimum Area Requirements

As with the procedure of setting minimum representation goals, determining what constitutes a large block of Amazonian forest habitat presents a challenge for conservation planners. For most ecoregions, scientists have little information on the area requirements of the vast majority of resident species. In the absence of information on the spatial requirements for long-term viability of each and every species, one strategy for developing minimum area objectives is to apply the needs of species that are believed to be most sensitive to restrictions in habitat availability, so-called area-sensitive focal species, to establishing the criteria (size, location, habitat types and/or diversity, degree of connectivity) for habitat blocks in conservation landscapes (Miller et al, 1998).

The habitat needs of area-sensitive focal species guided our selection of "intact" habitat blocks. A block was considered intact if its size was greater than the minimum required to sustain a viable sub-population, defined as 50 breeding groups (Shaffer, 1981) of the focal species, and that the block was adequately linked to other habitat blocks if the combined blocks were large enough to sustain metapopulations, defined as at least 500 breeding groups (Shaffer, 1981), including the protection of any local seasonal migration areas.

b. Selection of Focal Species

Species that are selected as focal species are generally wide-ranging (area-sensitive) species, that, by virtue of their large size or certain lifehistory traits like specialized diets or breeding requirements, require large interconnected areas to maintain viable populations (Lambeck, 1997). These species were selected on the assumption that establishing sufficiently large areas and connectivity to fulfill their habitat requirements will likely satisfy the requirements of most (ideally all) other species native to the region. A major restriction on the selection of focal species is the requirement that there must be enough known about a species' natural history to allow planners to quantify one or more attributes of their habitat requirements. For example, information must exist on specific habitat type and area requirements for focal species that are specialists, or total area requirements for focal species that are habitat generalists (Dinerstein et al, 2000).

For the Southwestern Amazonian Moist Forests, two species were identified as area-sensitive focal species: the jaguar (*Panthera onca*) and the Harpy eagle (*Harpia harpija*). A number of studies have quantified home range sizes of the jaguar in different habitats throughout its wide range. One study, Emmons and Terborgh (unpubl.), which was based on free-ranging radio-tagged

individuals in the Southwestern Amazon, concluded that female jaguars used about 25 km² for their home ranges with about 30% overlap among neighboring females. Males used an area about 3 times that of females, but these home ranges were widely overlapping. The figure of 2,500 ha for 50 females adjusted for 30% overlap yields an area requirement of 87,500 ha. This assumes that the jaguars utilize all of the habitat within that area. Evidence from Emmons and Terborgh (unpubl.) suggests that the females are concentrated in low lying areas where there tends to be more prey. Thus, the figure of 87,500 ha for a subpopulation of jaguars is undoubtedly conservative. In accordance with Shaffer's (1981) conclusion that 500 breeding units would be required to maintain a meta-population, sustaining a population of 500 female jaguars would require about 900,000 ha.

For the other focal species, the Harpy eagle, we could find only a single reference to habitat requirements for this species. Terborgh (1999) cites a study using satellite telemetry that quantified habitat requirements of breeding Harpy eagles. According to that study, each pair requires about 5,000 ha or about double that of the jaguar. According to that figure, a sub-population of Harpy eagles would require about 250,000 ha, which again is likely to be a conservative figure since it assumes that the Harpy eagles would fully saturate the area. The space required to support a meta-population of Harpy eagles would be on the order of 2,500,000 ha.

c. Establishing a minimum block size

To fulfill the objective of maintaining large blocks of closed canopy forest, the technical group proposed that a block size of 500,000 ha be adopted as the goal for identifying priority areas. Blocks of this size would be large enough to secure sub-populations of the most area-sensitive species such as the jaguar and the harpy eagle even with the likely situation of human hunting pressures reaching in from the edges of the block.

III. Goal 3: Continuity of the Closed Canopy

In addition to representing all habitats (as indicated by the representation units of the proxy) and in large blocks, the third goal was to propose a landscape for the SWA G200 that would ensure the ecological continuity or connectivity throughout the Ecoregion. That is, a design that maintains an unbroken forest canopy, at least via amply wide corridors, throughout the entire Ecoregion. Achieving this high level of interconnection across the Ecoregion will require strategic engagement of other stakeholders such as indigenous groups and even some of the more forward-looking logging concerns.

Considering the goal of representation and the criteria for ecoregional conservation and prioritization of areas (connectivity and closed canopy), analyses were performed for each subecoregion on an individual basis, considering connectivity with other sub-ecoregions in order to increase block size of intact and protected areas. The following chapter describes this process of defining the Vision landscape.

Chapter 4: Designing the Vision landscape (nominating priority areas and designing connectivity)

The conservation landscape described in the Biodiversity Vision is an overall view of how natural habitats should be maintained in the long term if the full compliment of biodiversity and biological processes are to be conserved in perpetuity. In the Southwestern Amazonian Moist Forests, deforestation is the ultimate ecoregional threat, as a forest converted to grassland has little chance to be restored to its former level of diversity. Currently, deforestation is mainly concentrated and normally follows the accessibility provided by road and main rivers to traditional models of development and colonization projects. Therefore, restoration of habitat was not considered essential to achieving the Vision. Rather, efforts were focused on creating large conservation areas that are protected or managed for resource use in ways that eliminate or decrease deforestation and maintain large blocks of intact forest canopy as required for focal species' survival and for the maintenance of ecological and evolutionary processes.

The conservation landscape was created with four basic types of units:

- 1. Level I: Areas limited to strict protection (i.e. national parks).
- 2. Level II: Managed areas for resource use and extraction of non-timber forest products.

- 3. Level III: Commercially managed areas for resource extraction (including timber).
- 4. Corridor Zone: An area that consists of a mosaic of sustainable uses that do not destroy the integrity of the forest canopy.

Level I areas consist of existing protected areas that are designated for strict-use protection (IUCN categories I to III) and the priority areas delineated during this exercise to fulfill representation goals. The Level II and III "managed areas" form a part of the Vision landscape that is more difficult for conservation-oriented groups to control unilaterally. Increased interactions with biodiversity lawmakers and the commercial sectors involved in natural resources would ensure that areas marked for resource management are indeed being managed in ways consistent with conservation goals.

The final type of unit "Corridor Zones", was designated to complete the connectivity of conservation and management areas at the ecoregional level. No specific management is defined for these areas as more detailed socioeconomic information and analysis is required. However, these areas should be maintained with minimal deforestation and developmental impacts if the core areas are to function as resource sources for the entire Ecoregion.

I. Priority Areas

"Priority areas" are those that will function as the core protected areas within the Southwestern Amazonian Moist Forests conservation landscape. Priority areas were delineated in areas with high conservation potential, according to the model (conservation model), such that they would raise representation above 10% and form blocks of at least 500,000 hectares. Box 4.1 outlines the procedure used to select these areas.

The priority areas, together with existing protected areas, would form the conservation core of the Ecoregion, and therefore play an important role not only in representation, but also in connectivity and maintaining blocks of closed forest canopy that are large enough to maintain populations of focal species and sustain ecological and evolutionary processes.

a. Conservation Potential Model

With the entire Ecoregion as a reference, and only 18% (83 of 460) of unique landscape units adequately represented (at least a minimum of 10% coverage) in the current system of protected areas, planners were faced the challenge of systematically identifying the most effective locations for priority areas. The methodology needed to consider not only the biological goals but also existing social and political issues that ultimately affect the success of any conservation plan.

To help identify sites for priority areas, a "conservation potential" model was developed for the Ecoregion. The purpose of the model was to evaluate each square kilometer of the Ecoregion with respect to a list of parameters that were considered by the technical team to influence the probability, or likely difficulty, of attaining Level I conservation status (strict protection) in that area. The first step was to define the parameters that were considered likely determinants of conservation opportunity or impediment (deforestation, existing roads, and human settlements). These parameters were identified as either positive (connectivity model) or negative (vulnerability) factors affecting the likelihood that an area would become a conservation area. The application of these factors would not compromise the overall goal of presenting at least 10% of each of the unique landscape units.

Box 4.1 Analysis to capture 10% of each representation unit

- 1. Calculate existing representation of **representation units** by protected areas in each subecoregion (Level I areas).
- 2. For representation units that have less than 10% representation in current protected areas, draft areas to achieve adequate representation. Criteria for selection are:
 - Coverage of representation units within the sub-ecoregion
 - High Potential for Level I conservation (based on conservation vulnerability and connectivity models)
 - Adequate size for conservation of focal species and population dynamics (500,000 ha) or less when the area included small patches of unique landscape units.
- 3. Analyze total coverage of representation units and determine which units still lack representation.

- Distance from protected areas and indigenous lands: Proximity to existing protected areas was considered as positive for nominating areas in that (1) it is politically much easier to expand limits of an already existing protected area than it is to create an entirely new administrative area, (2) the new area would benefit from connectivity with a larger area already under protection, effectively increasing the size of a large conservation block, and (3) the new area will not be isolated in a landscape of potential future development.
- Proximity to major roads and rivers. Areas with roads or within the range of navigable rivers suggest existing access and deforestation as well as potential advance in colonization with concomitant deforestation. This exercise is similar to the use of "roadless areas" for nominating sites in other ecoregions (Northern Andes, Klamath-Siskiyou).
- ٠ Deforested Areas. Areas already deforested were automatically excluded from the category of potential nominated areas. Proximity to deforested areas was also considered negative, as the impacts of deforestation extend into the surrounding forest and increase the difficulty of maintaining Level I protection and biodiversity conservation in these areas. Deforestation for Bolivia and Peru was determined using Pathfinder data (1990) with revisions in the areas that show up as deforested but are considered to be either natural non-forest habitats (savannas, meandering river effects) or cloud interference. The map was hand-revised by the ecoregional team. For Brazil, we used other sources of data that gave a better indication of the current situation of deforestation in the Brazilian Amazon that had occurred from 1971 to 1999 (IBAMA, 2000).
- Proximity to human settlements. Areas around human settlements that are designated for

human use such as agriculture and cattle have great potential for colonization with accompanying deforestation. The model assumes that these areas are negative to conservation of biodiversity.

The vulnerability model was developed combining empirical logistic regressions representing the behavior of parameters that potentially affect biodiversity conservation. Logistic regression is a variation of ordinary regression, useful when the observed outcome is restricted to two values, which usually represent the occurrence or nonoccurrence of some outcome event, (usually coded as 1 or 0, respectively). It produces a formula that predicts the probability of the occurrence as a function of the independent variables (Hosmer and Lemeshow, 1995).

The calculation of spatial probabilities was based on the application of the following model of logistic regression:

 $y = \frac{e^{(ax+b)}}{1+e^{(ax+b)}}$ $y = \frac{e^{(ax+b)}}{1+e^{(ax+b)}}$ $y = \frac{e^{(ax+b)}}{1+e^{(ax+b)}}$ y = dependent variable<math display="block">e = 2.718 (constant)a = first coefficient ofadjustment (constant)b = second coefficient ofadjustment(interception)

The methodology steps are outlined in Box 4.2.

Vulnerability map

As expected, the buffer distance applied to roads resulted in very high values near the roads and decreasing exponentially with the distance (Figure 4.1). Similar patterns have been observed in other studies in the Amazon biome (Laurance, 2001; Nepstad, 2001). The distance for rivers buffers (500 km) was obtained from studies of logging activities in the Amazon floodplain forests (Uhl *et al*, 1997). In this case, only the deforesta-

Box 4.2 Development of the vulnerability and connectivity models

Variable	Buffer distance	Buffer interval	Figure	Model contribution
Roads	120 km	4 km	4.1a	Negative
Major Rivers	500 km	2 km	4.1b	Negative
Protected Areas –	120 km	4 km	4.3	Positive
Level I				
Level II	120 km	4 km	4.3	Positive
Level III	120 km	4 km	4.3	Positive
Human settlements	120 km	4 km	4.3	Negative

1. Development of buffer zones for each variable.

- 2. Overlay of the generated buffer zones with available deforestation data: (0 = deforestation, 1 = forest cover).
- 3. Identification of the fitted logistic regression functions using SYSTAT statistical software.

Roads	$y = (e^{(-0.057 \text{ X}) + (-0.679)})/1 + (e^{(-0.057 \text{ X}) + (-0.679)})$
Rivers	$y = (e^{(-0.045 X) + (-3.323)})/1 + (e^{(-0.044 X) + (-3.323)})$
Level I Areas	$y = (e^{(-0,148 X) + (6,690)})/1 + (e^{(-0,148 X) + (6,690)})$
Level II Areas	$y = (e^{(-0,061 X) + (2,351)})/1 + (e^{(-0,061 X) + (2,351)})$
Level III Areas	$y = (e^{(-0.089 X) + (2.603)})/1 + (e^{(-0.089 X) + (2.603)})$
Human Settlements	$y = (e^{(0,128 X) + (-6,690)}) / 1 + (e^{(0,128 X) + (-6,690)})$

- 4. Generation of the logistic regression buffer areas in ArcView in order to calculate deforestation probabilities as a function of distance (figure 4.4).
- 5. Overlay of buffer areas to obtain the vulnerability map (effects of deforestation along roads; effects of deforestation along rivers and human settlements) and the connectivity map (Level I, II and III areas) (figure 4.5 and 4.7).

tion areas outside a road's influence was used to avoid double counting. The vulnerability model did not use the population center information because the negative influence of this layer was already included in the regression analysis performed for the deforestation in relation to roads and rivers. The resulting regression equation and curve fit are shown in figures 4.2 and 4.3. The potential areas for creation of the new protected areas are those with low level of vulnerability taken in conjunction with the areas already identified in the representation analysis.

Connectivity map

The logistic regression derived from the protected areas, indigenous lands, and human settlement layers was used to prioritize the potential connectivity between the existing protected areas and indigenous lands while avoiding conflicts with the existing human settlements (Figure 4.6).

While strict-use protected areas (Level I) are created specifically to protect natural biodiversity (Brunner et al 2001), indigenous lands have been reported as an efficient way to protect biodiversity, avoiding the advance of land occupation and destruction of the natural resource base (Nelson and Oliveira, 1999, Ferreira et al, in press). The managed areas defined here as Level II included extractive reserves (i.e. Resex in Brazil) and sustainable development areas (i.e. national forest and forestry concessions). These management areas, while not providing the best conservation opportunities for biodiversity, have been shown to be far better than other land uses, including pastures for cattle ranching and agribusiness. The potential areas for creation of the new corridor are those



Figure 4.1. Deforestation as a function of distance to roads

 $y=(2.718^{(-0.057 \times)+(-0.679)}) / 1 + (2.718^{(-0.057 \times)+(-0.679)})$



Figure 4.2. Regression equation and curve fit for Distance to Existing Roads (km)



Figure 4.3. Regression equation and curve fit for Distance to Rivers (km)



Figure 4.4. Probabilities of deforestation as a function of distance to existing roads



Figure 4.5. Deforestation probabilities for the SWA G200 ecoregion

with high level of connectivity. The resulting map of connectivity is presented in Figure 4.7.

b. Delineating Priority Areas

The 29 Level I protected areas that currently exist in the four ecoregions of the SWA Global 200 Ecoregion (Figure 1.3 and Table 1), are not sufficient to ensure the landscape heterogeneity of the Ecoregion. Only 18% of the environmental units to be covered by Level I protected areas are under full protection. In order to complete the representation of all environmental units within the system of fully protected areas (Level I), the technical group delineated eighty priority areas (Figure 4.8, see Appendix I for description of nominated areas). The location of the new areas presented three main characteristics:

- 1. the areas were located in places with a low level of vulnerability (or conversely a high conservation potential);
- 2. the areas contributed to scale down landscape representation gaps; and
- 3. the areas were situated in locations of the landscape that had conservation potential for connectivity.

Figures 4.9a and 4.9b show the vulnerability model with all the unique landscapes units in the SWA Global 200 Ecoregion. The dark areas indicate low potential for conservation of biodiversity. This procedure was repeated in each of the 28 sub-ecoregions of the SWA Global 200 Ecoregion (Figure 4.9b)



Figure 4.6. Connectivity potential between different types of managed areas



Figure 4.7.Connectivity map for the SWA Global 200 ecoregion



Figure 4.8. Delineated Priority Areas for the SWA Global 200 ecoregion

The resulting eighty (80) nominated priority areas fulfilled the representation objective for 377 additional units currently lacking 10% representation. However, in some sub-ecoregions the representation objective was not met. In those cases, the model units were either:

- (a) small and marginal, indicating that they were likely part of a larger landscape unit in an adjacent ecoregion,
- (b) contained within an indigenous area or forestry concession, which meant, according to the Biodiversity Vision procedure, that they could not be considered for nomination as protected areas, or
- (c) located in areas with high disturbance (for example, along a major access route or near a cluster of population centers or human

settlements). In this case, more detailed studies will be necessary to determine if the habitat represented by the model unit is truly degraded by the disturbance patterns or if representation could be considered.

Appendix II shows the representation of the landscape units with less than 10% coverage following the delineation of new priority areas. In a few cases, full representation of a model unit will require developing strict conservation zones within areas of extractive resource use. In several cases, the units were not fully represented because they fall almost entirely within Level II or III protected areas such as on indigenous lands. These areas will need to be considered with a large degree of flexibility as to precisely where and how they can be incorporated into a regime of strict conservation.



Figure 4.9a. Vulnerability model for the SWA Global 200 ecoregion

II. Establishing continuity throughout the ecoregion

As one of the primary ecoregional goals is maintaining continuity throughout the Ecoregion, corridor zones were identified to interconnect the proposed and existing protected areas, extractive reserves and forestry operations. The precise type of management that these areas require was not specified and will vary based on the current use and tenure of the land in these areas. The habitat will, however, need to be maintained and closed canopy forest must predominate in these areas in order to ensure the success of the Vision in conserving the biodiversity of the Southwestern Amazonian Moist Forests (Figure 4.10).

In order to help determine where connectivity zones were most feasible, a connectivity model

was created to analyze the Ecoregion with respect to the potential barriers to connectivity. The model assessed the "cost of migration" between the proposed and existing protected areas, using the connectivity model. Just as with the vulnerability model, negative values were assigned to landscape features such as roads, deforested areas, and human settlements that make migration difficult. Positive values were assigned to features such as protected areas that helped to maintain continuity.

A total of 17 connectivity zones were identified in the Vision. While several zones directly link protected areas, others interconnect via indigenous areas or extractive reserves (Level II and Level III) (Figure 4.10). In some cases, these Level II and Level III areas are also highlighted as "important for connectivity," indicating their role in creating and maintaining the Vision landscape (Figure 4.11). Loss of connectivity through these managed areas would result in biological and ecological isolation of one or more protected areas



Figure 4.9b. Landscape Units of Subecoregion with Vulnerability Model values









and disrupt the continuity of the landscape. As with the nominated areas, more detailed studies on the current situation of land use and land tenure within the connectivity zones will be necessary to develop plans of action for maintaining habitat integrity within the connectivity zones.

While connectivity was mainly considered within the Ecoregion (the model only takes into account intra-ecoregional associations and movements), it is unrealistic to treat the Ecoregion as an island of conservation. Protected areas of Level I and Level II types located outside of the ecoregional boundaries, but close enough to influence species migrations and habitat intactness (Figure 4.12), were also considered when analyzing the placement and ecological validity of the nominated areas located on the margins of the Ecoregion.



Figure 4.12. Protected areas outside of the ecoregional boundaries of the SWA G200

Chapter 5: Setting Priorities for Conservation Action

I. Prioritizing proposed protected areas

Areas were prioritized based on their contribution to the ecoregional goals of representation, connectivity, and the maintenance of large blocks of closed canopy forest. The exact parameters used to prioritize were: size of the proposed area, number of representation units that would be protected, diversity of representation units that would be protected (Shannon's diversity index), and importance of the area for ecoregional connectivity. Box 5.1 gives the values for deriving the priority scores (1 [low] to 4 [very high]) for each nominated area. Figures 5.1 to 5.4 show the individual nominated areas with their respective priority rankings for each parameter. Figure 5.5 shows the composite for all parameters. Appendix Ia contains a table of the nominated areas with their priority scores.



Figure 5.1. Nominated Areas classified by Size in the SWA Global 200 ecoregion

Box 5.1: Priority Criteria for Nominated Areas

Parameter	Measure	Score
Total size of nominated	> 1,000,000 hectares	4 (very
area (Figure 5.1)	500,000 – 1,000,000 hectares	high)
-	100,000 – 500,000 hectares	3 (high)
	< 100,000 hectares	2 (medium)
		1 (low)
Number of representation	13 – 16 units	4 (very
units (Figure 5.2)	9 – 12 units	high)
	5-8 units	3 (high)
	1 - 4 units	2 (medium)
		1 (low)
Diversity of landscape	Shannon Diversity Index Score	- (
units within nominated	>3.0	4 (verv
area (Figure 5 3)	20 - 299	high)
	10 - 199	3 (high)
	0 - 0.99	$2 \pmod{2}$
	0-0.99	1 (low)
Contribution to	Values assigned based upon:	4 (high)
ecoregional connectivity	Is there an alternative route? If no then	$\frac{1}{3}$ (medium)
(Figure 5.4)	HIGH	1 (low)
(Figure 5.4)	Doos it directly connect Protected Areas?	1 (IOW)
	If yes, then HIGH	
	Is it part of according a connectivity? If	
	not, LOW	
	Is it involved with connecting other areas	
	(extractive and managed resource areas)?	
	If yes, then HIGH or MEDIUM, depending	
	on how many.	
Overall priority value	13 - 16	VERY HIGH
(Figure 5.5)	10 – 12	HIGH
	7 – 9	MEDIUM
	4 - 6	
		LOW

A final analysis for the priority-setting procedure took into consideration the biogeographic diversity of the Ecoregion. As was shown by the climate model that was used to delineate the subecoregions, there is substantial climatic variation from north to south across the Ecoregion. To ensure that this variation was factored into the prioritization of proposed protected areas, the Ecoregion was divided roughly into thirds (Northern, Central, and Southern sections) and the top two to three proposed areas from each sector were identified as first priority (Figure 5.5 blue circles).

Table 5.1. Top Priority Areas of the Southwestern AmazonianMoist Forests Biodiversity Vision

ID	Name	Extension	Priority Score	Country
1.1	Supra Javari	802456,2	11	Brazil
3.1	Rio Jurua oeste	582280,6	6	Brazil
3.2	Norte da Serra do Divisor	324012,9	11	Brazil
3.3	Abujao-Tamaya	1571769,9	15	Peru
3.5	Sierra de Contamana	592179,1	11	Peru
5.2	Vale do Purus	967264,9	13	Brazil
6.1	Alto Purus	1304853,9	14	Peru
8.1	Rio Iaco	1003382,7	15	Brazil
10.2	Toromonas-Madre de Dios	249648,1	11	Bolivia
12.1	Beni Sur	201609,4	11	Bolivia
18	Lago Mamia	723143,56	12	Brazil
20	Alto Rio Abacaxis	515082,06	8	Brazil
22	Rio Juruema	603915,97	13	Brazil
30	Baixo Madeira	726920,73	8	Brazil
31	Bolivia 1	899609,08	15	Bolivia
34	Alto Rio Aripuana	988236,95	12	Brazil
36	Sao Joao da Barra	1085357,14	13	Brazil
38	Rio Camaca	1223737,60	11	Brazil
39	Rio Sucunduri	1581413,01	14	Brazil
40	Baixo Rio Ituxi	2457419,66	14	Brazil
41.1	Alto Mutum-Jutai	1360551,41	12	Brazil
53	Baixo Rio Roosevelt	508772,91	9	Brazil



Figure 5.2. Nominated Areas classified by Number of Landscape Units in the SWA G200



Figure 5.3. Nominated Areas classified by Landscape Diversity in the SWA G200



Figure 5.4. Nominated Areas classified by Connectivity Value in the SWA G200



Figure 5.5. Nominated Areas with overall priority values in the SWA G200

Chapter 6: Turning the Vision into Action

The Biodiversity Vision

Existing protected areas, nominated areas, connectivity zones and defined Level II and Level III management areas are the substance of the Biodiversity Vision, creating a landscape that represents ecoregional biodiversity while considering connectivity among diverse habitats and the maintenance of large expanses of closed-canopy forest required for focal species viability and maintenance of ecological and evolutionary processes.

The remaining areas within the Ecoregion will be considered as converted habitat for ranching and farming, population centers, and roadways. It is the goal of the Biological Vision to confine the negative environmental impacts of these areas to buffer zones surrounding roadways and population centers, eliminating extensive farming and cattle ranching in areas that are prioritized for conservation by replacing them with low impact activities.

Legally managed and certified forestry practices in the Ecoregion do maintain canopy cover and therefore can be consistent with conservation goals if the activities are managed to reduce human impact and monitor effects on diversity at the habitat, species, and even genetic levels.

With a large extent (67% total coverage) of the Ecoregion managed for conservation and protection of biodiversity, we create "conservation landscapes" that are large enough to support wideranging as well as endemic species populations and maintain important ecological processes. Wide-ranging species of specific concern are jaguar (*Panthera onca*), white lipped peccary and collared peccary (*Tayassu tajacu* and *T. pecari*), Harpy eagle (*Harpia harpija*), red howler monkey (*Alouatta seniculus*) and black spider monkey (*Ateles belzebuth*), all requiring significant blocks of intact habitat. The giant otter also is considered as a focal species and contributed to the inclusion of watershed issues in the Biodiversity Vision.

Connectivity of conservation landscapes via a network of protected and managed forests is essential to create potential for migrations and increase suitable territory for home ranges and population expansion, and are included in the Biodiversity Vision under the "continuity of the closed canopy" goal.

For conservation to succeed at the ecoregional level, international threats identified in this and other assessments much be considered when developing conservation action plans. Coordination with local and international stakeholders is essential to achieving the goals outlined in the Vision. Political actions must be taken to alter existing laws and create new ones that permit the protection of the environment as a national resource, and such actions must be coordinated across political boundaries such that an action on one side does not negatively influence conservation efforts across the borders. Ecoregion Conservation (ERC) involves such actions, uniting conservation action groups, local NGOs, educators, politicians, and local leaders as stakeholders in the conservation of the biological diversity found in the Southwestern Amazonian Moist Forests Global 200 Ecoregion.

Long-term Objective

The Conservation Landscape for the next 50 years

The Biodiversity Vision of the Southwestern Amazonian Moist Forests Global 200 Ecoregion (ca. 73,000,000 ha), has set the following targets for the conservation and sustainable use of its biological resources:

- The creation of 34 new protected areas (ca. 15,000,000 ha) and the protection of the 12 legally established Protected Areas (3,500,000 ha) in the Ecoregion (Fig. E.1). In all, 25% of the ecoregion should be covered by areas for strict protection of biodiversity.
- The development of conservation programs for two types of connectivity (corridor) areas: a) indigenous territories and other areas for traditional extractive uses (i.e. non-timber products), and b) sustainable forestry concessions that maintain largely closed canopy. The current cover by these managed areas is 27% (19,800,000 ha) and 10% (7,300,00 ha), respectively.
- Support policies and launch campaigns on overarching threats through communication, education and training, forest certification of wood and non-timber forest products, and addressing transboundary issues such as roads, hydrocarbons projects, and dams. These policy campaigns should aim for the long-term maintenance of protected and managed areas.

The Action Plan

Turn nominated areas into Protected Areas (National Parks, Indirect Use, IUCN I-III)

- Address political issues at the at the national and regional levels for implementation of national and private protected areas
- Analyze land tenure issues in priority nominated areas
- Identify and target overarching threats in and around nominated areas
- Conduct socioeconomic analyses, including:
 - Roads (existing, proposed, and improvements)
 - Logging and hunting
 - Mining, oil exploration and extraction (present and future concessions)
- Coordinate and support biodiversity surveys in nominated areas

Consolidate conservation in existing protected areas

- Promote the preparation or update of Management Plans
- Promote implementation and monitoring of Management Plans
- Monitor and evaluate the impacts of conservation actions on biodiversity

Develop conservation programs for connectivity blocks (conservation and resource management)

- Promote legal recognition of conservation and management areas
- Promote local participation in identification and analysis of threats and in the actions and mitigation of conservation and managed areas
- Promote the drafting of laws that define land tenure and legal resource use in conservation and management areas as well as connectivity zones

• Creation and implementation of connectivity zones identified by the Biodiversity Vision and connectivity areas (i.e. Amboro-Madidi)

Address policy issues at the international, and national levels on overarching threats and opportunities

- Support policies and launch campaigns at the international and national levels on overarching threats and opportunities:
 - Roads (ie. Avança Brasil)
 - Logging (export of tropical hardwoods, the wood pulp industry)
 - Cattle ranching and barraqueros (private resource extraction)

- Oil and gas exploration and extraction (pipelines, social impacts, transport)
- Mining (gold)
- Hydroelectric power (dams, transport, social impacts)
- Indigenous reserve policies (potential for conservation initiatives)
- Illegal plantations (coca) and social impacts

ERC development in SWA Global 200

- Verification of the underlying principles of biodiversity representation
- Presentation and adoption of the Vision by WWF and local stakeholders.
- Monitoring and evaluation of the Vision implementation



Taking Action – The SWA Global 200 Ecoregional Targets

FOREST TDP 1: The establishment and maintenance of a viable, representative network of protected areas in the world's threatened and most biologically significant forest regions, by 2010.

SWA Strategic Objective I: Create new protected areas (IUCN I to III) and attain effective management of existing ones in priority areas as a means to ensure conservation of core areas critical for long-term conservation of the SWA Global 200 Ecoregion.

Targets:

- Twenty-five (25) million ha of SWA G200 in National Parks. Expected contributions: Peru: 6.5; Bolivia: 6.0; Brazil: 12.5.
- 2 Nearly ten (10) million ha of newly created protected areas. Expected contributions: Peru: 3.0; Bolivia: 2.2; Brazil: 4.5.
- 3 Ten (10) million ha under effective management (area delineated; infrastructure, management plan, and adequate personnel in place).
 Expected contributions: Peru: 4; Bolivia: 3.8; Brazil: 2.2.

FOREST TDP 2: One hundred (100) million ha of certified forests by 2005, distributed in a balanced manner among regions, forest types, and tenure regimes.

SWA Strategic Objective II: Promote sustainable natural resource management.

Targets:

- Six (6) million ha of FSC certified forest (timber). Expected contributions: Peru: 1; Bolivia: 1; Brazil: 4.
- 2 One (1) million ha of FSC certified forest for non-timber forest products. Expected contributions: Peru: 0.3 ; Bolivia: 0.5; Brazil: 0.2.

- 3 National protocols for all 3 countries for the application of "Principle 9" of FSC in high conservation value forest developed and implemented.
- 4 One (1) million ha of community managed forests with natural resource management plans developed and financially viable, but not necessarily FSC certified. Expected contributions: Peru: 0,5; Bolivia: 0,2; Brazil: 0.3.

SWA Strategic Objective III: Support policies and launch campaigns on overarching threats.

Targets:

1. Transboundary issues:

Updated GIS database with information on transportation (i.e roads in the Avança Brasil Program) and energy sectors (i.e. hydrocarbons, dams, mining) to monitor developments and to take action at the ecoregional or national levels as appropriate.

SWA Strategic Objective IV: The adoption of a scientifically rigorous Biodiversity Vision and its implementation by all relevant stakeholders

Targets:

- 1. Updated and validated Vision.
- 2. Outreach and communication strategies for the scientific community, funding agencies, conservation partners, governments and private sector.
- 3. Monitoring and Evaluation System to follow the implementation of the Action Plan and monitor the status of the Ecoregion.
- 4. Fundraising/financial sustainability strategy in place.

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E-Data sources:

Precipitation and Temperature:

http://www.pik-potsdam.de/~cramer/ climate.htm

This database is a major update of the Leemans & Cramer database (Leemans & Cramer 1991). It currently contains long-term monthly averages, for the period 1931-60, of mean temperature, temperature range, precipitation, rain days and sunshine hours for the terrestrial surface of the globe, gridded at 0.5 degree longitude/ latitude resolution. It was generated from a large data base, using the partial thin-plate splining algorithm developed by Michael F. Hutchinson, Canberra (Hutchinson and Bischof 1983). A documentation is currently in preparation - for the time being the most essential technical information is contained in a readme.file. The data is available through anonymous ftp from <ftp.pik-potsdam.de>, in the directory /pub/CLIMATE.

Evapotranspiration:

http://www-cger.nies.go.jp/grid-e/gridtxt/ tateishi.html

This data set is produced by AHN and Tateishi (Remote Sensing and Image Research Center, Chiba University, Japan). It consists of estimated monthly global potential

evapotranspriration (PET),

evapotranspiration(ET), water balance on 30minute latitute-longtitude grid. Estimation was based on the Priestley-Taylor method using global data sets including air temperature, albedo, cloudiness, elevation, which are parts of Global Ecosystems Database supplied by NOAA-EPA. Then further calculation was conducted on Thornthwaite method to estimate evapotranspiration using precipitation (supplied by NOAA-EPA) and soil water holding capacity (supplied by GRID-Geneva) data. Almost of all source data were those of approximately 1920 through 1980. The comparison of the latitudinal distribution shows that the larger amount of water surplus in 45N-75N and deficit in 10S-30S rather than those of Legates and Mather. On the other hand, the latitudinal distribution of annual evapotranspiration shows very similar, except in middle-high latitudes region. Further investigation was conducted to evaluate regional existing water resources using each countries' statistics. Details of it was given in the original documents. The data set is available as an 'Binary' format file. The monthly and annual 'Evapotranspiration Data', 'Potential Evapotranspiration Data' and 'Water Balance Data' consist of a total of 39 binary format files. All files are in a raster form (360 lines and 720 pixels).

Elevation:

http://gcmd.gsfc.nasa.gov/cgi-bin/md/ getdif.pl?format=sgml&morph_dic=dif_to_fgdcedc-html.dic&entry_ids=GTOPO30

USGS GTOP30 global elevation dataset, 30second resolution (approx 1km)