## Creating Mosaic-Based Conservation Corridors to Respond to Major Threats in the Amazon Headwaters

*Amy Rosenthal (Conservation Science Program, World Wildlife Fund US, 1250 24th Street NW, Washington, DC 20037) Hannah Stutzman (corresponding author, Amazon Conservation Association, 1822 R Street NW, Fl 4, Washington, DC 20009, hstutzman@amazonconservation.org) Adrian Forsyth (blue moon fund, 222 W South Street, Charlottesville, VA 22902)*

Completion of the Interoceanic Highway through southeastern Peru threatens to ecologically sever the southwestern Amazon and eastern Andes, which contains one of the richest concentrations of terrestrial and freshwater biodiversity on the planet (Myers et al. 2000). Road and other infrastructure development characterized by limited planning and governance allow access to previously remote forests where the Andean highlands meet lowland forests, driving unprecedented land clearing and habitat degradation through illegal timber harvest, secondary road-building, hunting, expansion of agriculture and ranching, and rapid growth of informal gold mining. Planned development of large petroleum and gas reserves and hydropower-related dams also threaten the region.

Developing habitat corridors is considered one of the few effective methods for responding to the risk of large-scale land conversion (Powell and Bjork 1995, Beier and Noss 1998, Haddad et al. 2003). In North America, the Yellowstone to Yukon (Y2Y) initiative is an emblematic example (Raimer and Ford 2005, Locke and Francis, this volume). In Europe, Natura 2000 directives establish a foundation to develop and protect bird migration corridors and habitats. Around the world, a number of international "mega-corridors" aim to tie together large protected areas, such as the Vilcabamba-Amboró Corridor (Bennett and Mulongoy 2006), Mesoamerican Biological Corridor (Kaiser 2001), and proposed Selous-Niassa Corridor in Africa (Rovero and Jones, this volume). However, it remains unclear how successful regional conservation corridors can be in many areas of the developing world, where there is little legislative support, poor implementation of environmental policies, and, in many places, fast-paced and poorly planned development (e.g., Johnsingh and Williams 1999).

The Amazon Conservation Association (ACA), a partnership of Peruvian, Bolivian, and U.S. conservation organizations (www.amazonconservation.org), designed a suite of 3 interrelated conservation corridors in one such development frontier in the western Amazon-Andes in collaboration with a broad set of stakeholders. The Manu-Tambopata, Castaña, and Andean Cloud Forest Corridors attempt to mitigate major emerging threats to biodiversity and sustainable livelihoods (Table 1). While each area tends to be characterized by a primary, destabilizing force, these threats often overlap spatially and interact, exacerbating their effects.

Where human communities and high biodiversity must coexist, conservation strategies should maintain landscape connectivity while allowing for human use. In response to this challenge, ACA designed 3 corridors based on a land-use mosaic, which includes an array of rights-holders and land tenures in addition to conservation areas. Supported by both science and community engagement, each corridor design considers social and political dynamics as well as ecosystem processes. Anchored by large protected areas, these conservation corridors consist of a patchwork of land uses, which permit economic development while allowing for gene flow and species migration (Figure 1).

The Manu-Tambopata Corridor connects Manu National Park with Tambopata National Reserve via ACA's Los Amigos Conservation Concession. This last unprotected stretch of the Vilcabamba-Amboró Mega Corridor was split by the recently paved Interoceanic Highway, a cross-continental highway that stretches from Rio de Janeiro on the Atlantic to the pacific ports of Peru. Highway construction has transformed access to the region whose capital city was previously only accessible by river, air, or a difficult overland journey on an unpaved road. Since 2008, ACA has worked with local landowners, forest users, and regional government to create a conservation mosaic across 210,000 ha of tropical forest. The Castaña Corridor incorporates ACA's longstanding conservation efforts to develop Peru's first Brazil nut (*Bertholletia excelsa*) harvest concessions. We provide technical support and training to more than 400 families in eastern Madre de Dios to maintain standing forests and secure sustainable economic practices. These concessions and indigenous territories cover 354,500 ha of primary forest along the Interoceanic Highway.

The Andean Cloud Forest Corridor protects an unbroken stretch of forest from lowland valleys to Andean highlands between Manu and Bahuaja-Sonene National Parks. It aims to enhance connectivity in critical upper elevation zones, which are the least protected areas within Manu National Park. Climate change is expected to force species to migrate to higher elevations (Feeley and Silman 2010, Peres et al. 2010), and this corridor is designed to provide a refuge for a genetically diverse population of plants and animals by maintaining and amplifying migration pathways across an altitudinal gradient.

Each corridor is important in itself, but it is their combination that makes this conservation strategy effective. Instead of a single, linear connection between 2 nodes, these 3 corridors establish a radiating web of linkages between major protected areas in the western Amazon. In the view of ACA and its partners, we are "building the ark" for future generations to know and benefit from rich biodiversity at risk of extirpation or extinction from emerging threats.

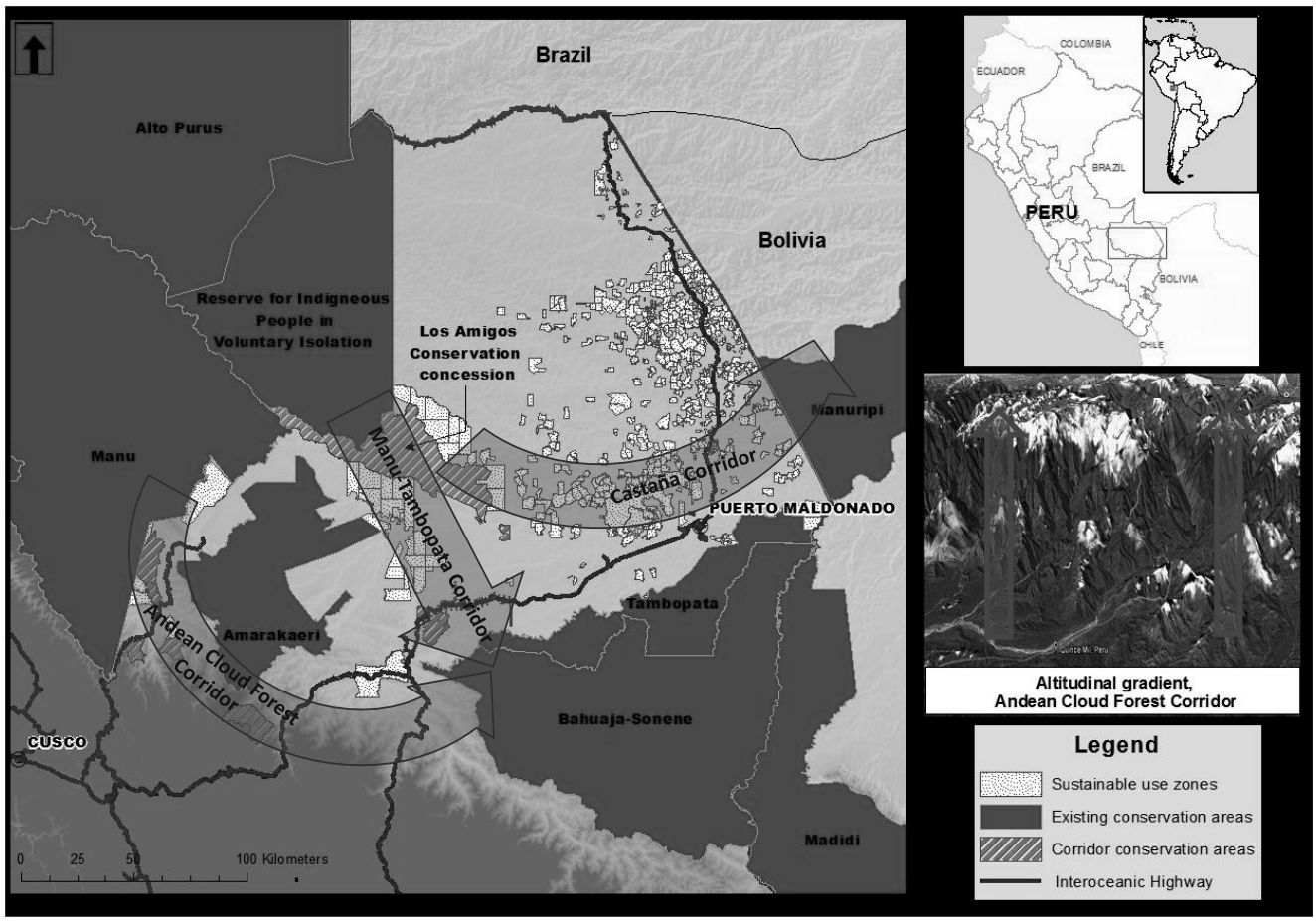


**Figure 1. The 3 Amazon Conservation Association (ACA) conservation corridors in the departments of Cusco and Madre de Dios, Peru. The corridor mosaics are indicated by directional arrows and the set of sustainable use zones (dotted areas) and conservation areas (hash marks) under development. Anchoring protected areas are indicated by name and shapes with solid fill. The sidebar maps show the area in regional context and the steep altitudinal gradient that is a key feature of the Andean Cloud Forest Corridor.**

In addition to mitigating threats to habitat, the initiative has 3 interlinked goals. The first is to incorporate both strong scientific input and broad stakeholder participation. We base corridor design on 2 principal information sources: 1) biological inventories and studies that indicate use of the area by key species (Table 1, Feeley and Silman 2010, Laínez et al. 2012); and 2) a comprehensive engagement process with local governments, communities, and civil society both to ensure the feasibility of particular routes and conservation methods, as well as address local needs. With limited resources and a challenging social and political environment, we have chosen to be explicit about accomplishing what is feasible and defensible, not what is ideal. Biological and socioeconomic baseline studies for each corridor build scientific knowledge about the region and help establish priorities and core strategies, which can be monitored and evaluated (e.g., Laínez et al. 2012). Ongoing research programs within each corridor initiative answer strategic questions. For example, in the Andean Cloud Forest Corridor, researchers assessed the impacts of semi-wild cattle on tree regrowth under different conditions (Mamani, unpublished data). For the Manu-Tambopata Corridor, Pitman and colleagues (2011) designed and reported the results of a biodiversity monitoring program. Additionally, due to concern regarding contamination of water and fish populations across the corridor, Fernandez (2012) evaluated mercury levels in commonly consumed fish species, and study results were used in a public education campaign and to develop local aquaculture enterprises that provide a mercury-free alternative. Results from such studies are integrated into the implementation process to improve habitat connectivity and more effectively direct limited funding (e.g., Botanical Research Institute of Texas 2012).

The second goal is to build on existing conservation strategies and long-term relationships with stakeholders. The corridor initiatives grew organically from ACA's long-term field presence. Longstanding programs, such as Conserving Brazil Nut Forests and Families, and the construction and operation of ACA's 3 regional biological stations anchor corridor development. Early successes of these corridor initiatives have depended in great part on those relationships, knowledge, and experience.

The third goal is to depart from "fortress conservation" by embracing sustainable use areas and integrating human-dominated habitats. ACA's mosaic design creates a patchwork of excellent to good habitat options for a number of species, from jaguars (*Panthera onca onca*) to scarlet macaws (*Ara macao*) to spectacled bears (*Tremarctos ornatus*). Simultaneously, we promote alternative livelihood options for resident communities that typically live in poverty and are dependent on marginal agriculture and dwindling resources. As a result, the corridors contain designated private conservation areas and state parks, as well as areas of private or concessioned land dedicated to sustainable forestry, ecotourism, agroforestry and reforestation, and payment for environmental service projects, such as Reducing Emissions from Deforestation and Forest Degradation (REDD+).

To create and consolidate this mosaic, ACA is implementing a broad range of conservation areas, which now make up a significant portion of the corridors. These areas include many private conservation areas (>19,000 ha), 1 indigenous conservation concession (6,975 ha), and the Los Amigos Conservation Concession (145,000 ha), which buffers Manu National Park and a state reserve for uncontacted indigenous peoples. The corridor initiative fills gaps between conservation areas with sustainable use zones, including over 195,000 native and commercially-important trees (207 ha) planted in the Andean highlands and 38,000 trees for agroforestry systems for 80 families in the Amazonian lowlands. Nine timber concessionaires have joined ACA in a consortium, and they have agreed to shift to sustainable harvesting practices and patrol against illegal harvest and invasions on more than 138,800 ha.

ACA is fostering eco-enterprises as an alternative to existing economic activities that encroach on habitat, including aquaculture with Amazonian river fish, sale of regional fruits, such as copoazu (*Theobroma grandiflorum*), and ecotourism enterprises such as a community project along the Interoceanic Highway that benefits 14 families (86 people) and covers 6,880 ha. ACA also provides technical support to 509 Brazil nut concessions (over 600,000 ha), managed by 420 families, to reduce human-wildlife conflict, improve environmental management, avoid land invasions, and move toward financial sustainability. This effort includes technical training and ongoing field support, basic financial literacy and management skills, and development of market linkages for harvesters.

Building and maintaining these corridors is a long-term endeavor. Existing conservation areas and sustainable use zones will be complemented by future activities in remaining priority areas for each corridor. ACA plans to help establish 3 new regional conservation areas (263,000 ha), create several new conservation concessions (15,300 ha), and support the design of sustainable management and financing plans for new protected areas. Likewise we intend to double planting of new agroforestry systems and reforestation areas and develop sustainable management options for 100 additional forest landholders. A new initiative will restore forested areas degraded by gold mining. The portfolio of sustainable development activities in the corridor is compatible with REDD+, and ACA is seeking to develop and certify REDD+ projects where possible to secure a long-term funding stream.

Although the absolute success of these approaches remains to be seen, early conservation achievements demonstrate that this approach is practical and workable on the ground. Many places confronting analogous threats to biodiversity could benefit from mosaic-based conservation corridors. For example, based on these initial successes ACA is expanding its conservation corridor approach to neighboring Bolivia, in the proposed Pampas-Yungas Corridor, which will connect Manuripi National Reserve to Madidi National Park along a tropical forest and grassland gradient where habitat and resident indigenous communities face similar pressures.

Nevertheless, a series of significant challenges jeopardize the ultimate success of this effort and others like it. The scale and pace of the forces driving change and resource conflicts are alarmingly disproportionate to the capacity and power of resource-poor non-profits and politically weak, impoverished stakeholders promoting mitigation and adaptation. Rarely do efforts like these obtain financing at the scale and duration necessary to make them viable. Also, many governments fail to account for nature as a globally valuable reservoir of biodiversity, carbon storage, and other ecosystem services, and instead view it as an obstacle to development. In Peru (as in many other countries), there is no legal status for biological corridors, which leaves each piece of the mosaic vulnerable to shifting political winds and legal claims. Surmounting these challenges to address threats at the appropriate scale will take more political will, clearly demonstrated benefits, and coordinated efforts by non-profit organizations, funders, governments, and affected communities. Failing this, we risk losing some of the most biodiverse places on the planet.



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