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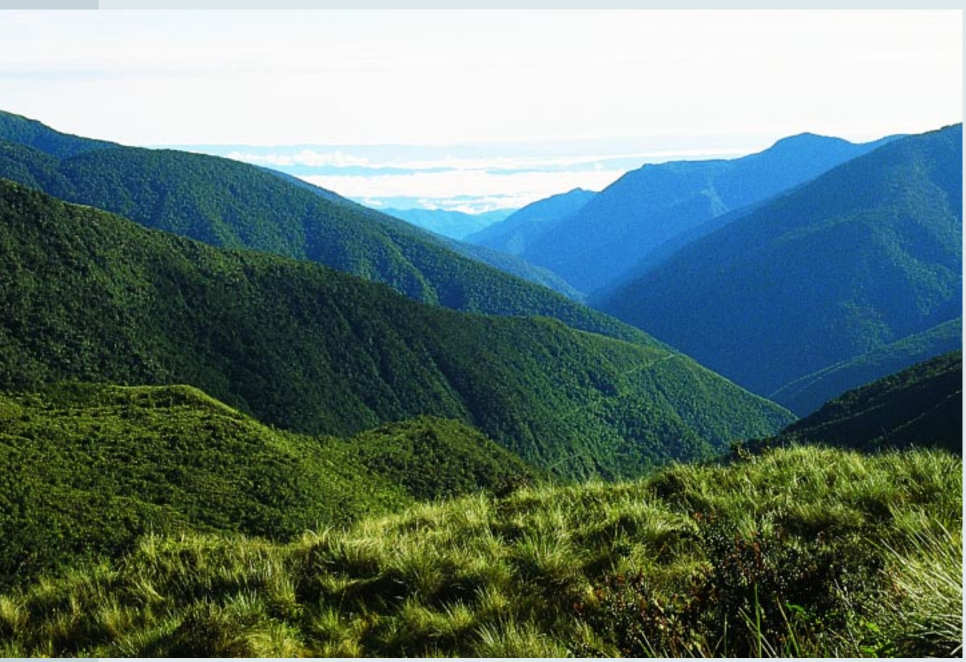
Biodiversity Conservation in Peru's Eastern Montane Forests

Sometimes the most appropriate form of economic development consists of retaining native forests on steep slopes where other land uses are environmentally destructive and where economic or humanitarian considerations do not override these limitations. This is especially the case when native plant and animal species are diverse and special, as, for example, in many of the forested areas found on the humid eastern slopes of Peru's Andes Mountains. The authors recently evaluated the biological diversity there. They provide a brief outline of their findings and conclusions.

Peru's eastern slopes

The Andes split Peru in a north–south direction, providing a complex geographical setting with multiple differences in topography, altitude, and geological characteristics. The easternmost-facing slopes look out over the Amazon basin, forming the upper watersheds of the western Amazon (Figure 1). Because trade winds push humid air upslope most of the year, extensive humid and perhumid forests are maintained. Many, in fact, are true cloud forests, often immersed in fog and exposed to heavy rainfall. These eastern montane forests constitute part of a long but narrow corridor that runs from southwestern Venezuela to northern Argentina. In eastern Peru, humid to very humid montane forests occupy a narrow band, roughly between 1500 and 3500 m (Figure 2). While the upper limit of 3500 m is often where the timberline occurs, the lower elevational limit of 1500 m corresponds to a biotic changeover between typically Andean (montane) species and species found mostly in the Amazon lowlands and foothills. The forest belts are typically subdivided into upper montane (2500 m to timberline) and lower montane (1500 to 2500 m).

FIGURE 1 Timberline zone in southern Peru showing tropical alpine grasslands, upper montane forests, and a view to the east, toward the Amazon lowlands. (Photo by Kenneth R. Young, 1991)



Upper montane forests include numerous species of trees, shrubs, lianas, epiphytes (Figure 3), and herbs. Often the canopy reaches 10–25 m in height, although some locales have taller emergent trees. Most of the plants are pollinated by insects, hummingbirds, and bats. Seed dispersal typically depends on fruits eaten by birds and bats. This area is not appealing for long-term human habitation due to steep relief, shallow soils, and frequent slope instability causing landslides and erosion.

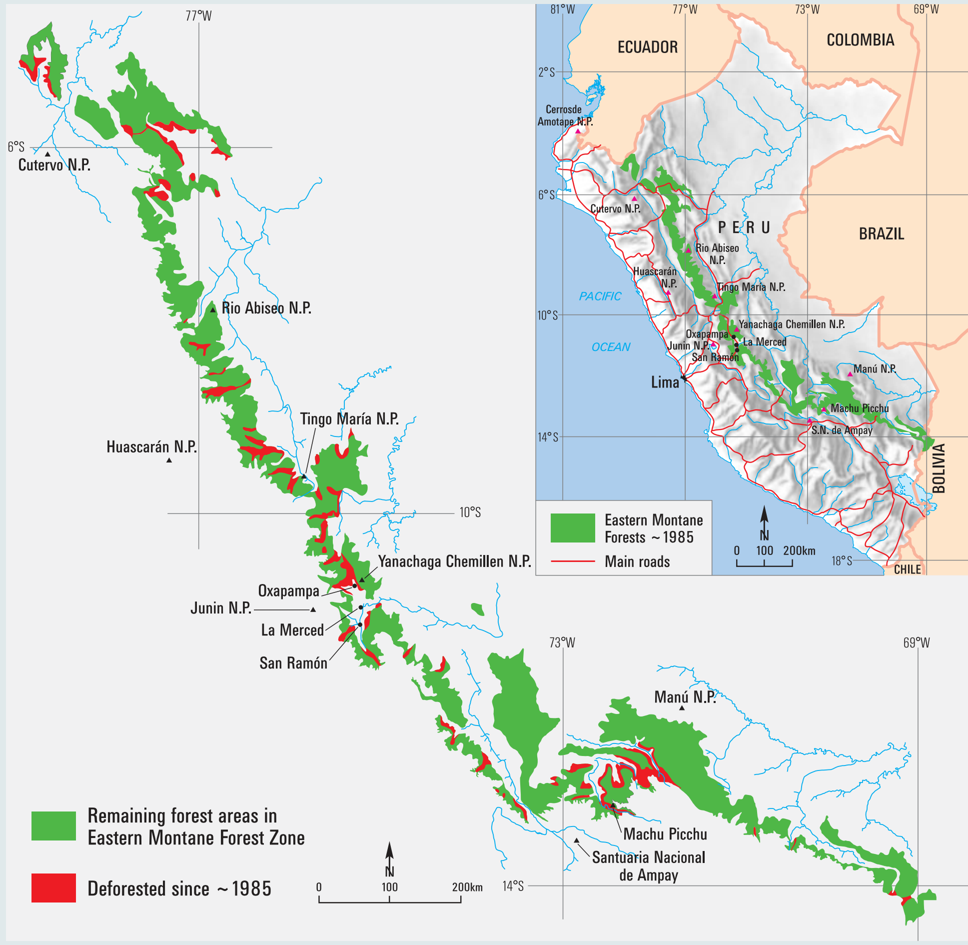
Tropical lower montane forests grade into the forests that occupy the Andean foothills. The topography is often steep and rugged, overlain by forests 10–30 m high, almost always with dense understories. Forests may even be taller on gentler slopes, with trees up to 40 m. The native biota includes numerous species of restricted distribution that are specialized in terms of a particular elevation or vegetation type. Also, species appear that are otherwise typical of tropical lowland rain forest to the east. Biologically, this is a mixture of habitat specialists with both lowland and highland species, creating natural environments for many hundreds of plant species and dozens of species of bats, rodents, frogs, and birds. These areas can be attractive for timber extraction and for the establishment of unimproved pastures, both of which endanger the local biodiversity. Temperatures are milder, and recent human settlements accessible by road can be found.

Biological diversity and endemism

Humid to very humid montane forests are probably the most biologically diverse natural environments found in the tropical Andean region. In Peru, the eastern montane forests include almost 3500 plant species, accompanied by about 120 mammal species and probably more than 400 of birds, perhaps 100 of frogs, and thousands of invertebrates, especially spiders, butterflies, and moths, and land snails. Biological differences in terms of the richness and composition of these forests are associated with altitudinal differences. Although there are many exceptions, overall diversity typically decreases with an increase in elevation, while uniqueness (endemism) of the plants and animals increases (Figure 4). In addition, unique assemblages of species exist, particularly in the transition zones such as those at timberline and in the foothills. The majority of the species in the eastern montane forests are terrestrial organisms, but aquatic species, especially invertebrates and small vertebrates, such as frogs, also contribute significantly to the total diversity of the area.

Rough topography and a dynamic geologic history may have contributed to speciation in these forests. Many plant and animal species have distributions restricted to single watersheds or limited to narrow altitudinal belts. For example, in the case of the spiders examined by biologist Diana Silva, few species were common to the several forested sites studied and many were scientifically undescribed. The constant dynamism of these forests matches that of the physical setting. Forest composition and structure, as well as accompanying fauna, are reshaped with physical changes, such as those caused by a landslide or the fall of a tree. This is especially apparent during the long rainy season when strong winds buffet the trees and slope failures are common.

FIGURE 2 Montane forests of the eastern slopes of the Peruvian Andes around the mid-1980s, as recorded in Landsat imagery, and the areas deforested since then. Contours in altitudinal zones between 1500 and 3500 m were studied on these slopes and biodiversity evaluated in this demarcated region. (Map by authors and Andreas Brodbeck)



Efforts to conserve biological resources in Peru's eastern montane areas are typified by the official recognition of endangered and threatened species and the establishment of protected areas. Unfortunately, with some exceptions such as the rare Andean bear (*Tremarctos ornatus*) and the endangered yellow-tailed woolly monkey (*Lagothrix flavicauda*), most montane species are not overly photogenic, being relatively small and inconspicuous despite their uniqueness. They are rarely considered in international conservation appeals, and their basic biology and biogeography are poorly known. It is obvious, however, that accelerating changes in Peru's eastern Andes, driven by economics and technology, do not bode well for species with small ranges, a dependence on intact forests, or mutual interdependencies with other species.

FIGURE 3 Cloud forest with abundant epiphytes in the high elevations of Manú National Park, southern Peru. (Photo by Kenneth R. Young, 1991)

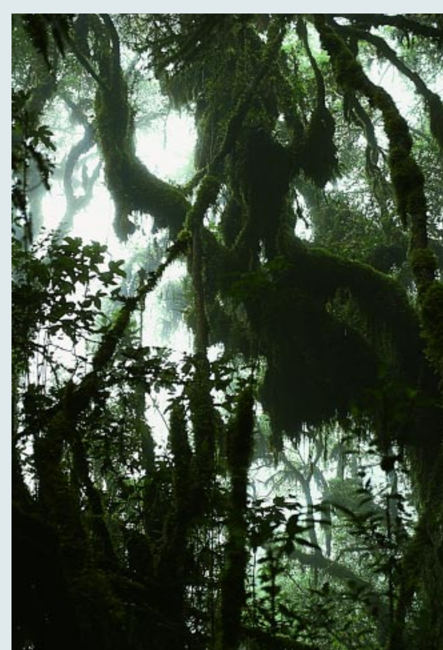


FIGURE 4 This Inca marsupial mouse (*Lestoros inca*) is only found in wet montane forests of southern Peru. (Photo by Kenneth R. Young, 1991)

FIGURE 5 This view is at 1800 m in Oxapampa, central Peru, and clearly shows the deforestation affecting the hills near town. (Photo by Kenneth R. Young, 1988)

Humans and change

The history of human occupancy in Peru varies, depending on location. On the eastern slopes, the majority of extant human settlements have been inhabited for less than 300 years and are frequently quite new. Unlike in other tropical forests, there is little resource use or permanent settlement by indigenous groups within the eastern montane forest zone in Peru. Only a few urbanized areas of more than 5000 inhabitants are to be found, including Oxapampa and La Merced-San Ramón. Roads were built to connect the upper Amazon with the Andes and coastal Peru beginning in the 1940s and at a more rapid pace in the 1960s and 1970s. Each road has become associated with deforestation and massive slope failures in a land-use cycle of timber extraction, followed by the clearing and burning of forests for agriculture or range and often by abandonment as soils erode and weeds proliferate (Figure 5). Few montane species of interest for conservation persist in these altered landscapes. This would be less of a loss if the land could be used sustainably, but that appears to be a naively optimistic hope given the lack of information, incentives, and feasible renewable extractive systems.

Colonization of Amazonian Peru has played an important role in the transformation of the landscapes involved. Most colonists came from areas with little forest cover, often anciently deforested. Regional and national governments have promoted colonization with the intention of relocating landless and jobless people or encouraging extractive activities such as mining or forestry. With few exceptions, these colonization programs have failed to resolve land tenure issues, leaving newcomers without legal titles to land and usually occupying sites considered by planners to be unsuitable for human occupancy because of their steepness. Numerous social actors play a conspicuous role in the status of the eastern montane forests of Peru. They include both institutions and unorganized sectors of the human communities. However, there has been no systematic attempt to evaluate the processes and levels of impact of these actors in relation to differences in the variable landscapes of the montane forests.

For the forest-dependent plant and animal species, four national parks (Abiseo, Cutervo, Yanachaga-Chemillen, Manú), and two sanctuaries (Ampay and Machu Picchu) include intact forests. However, only several dozen people are charged with protecting the biodiversity of this vast area, in contrast to the hundreds of thousands of recently arrived settlers living in the Andean foothills or moving along the roads. Recognition of the importance of natural processes as a key to maintaining the biota of these dynamic forests should be an important focal point for the discussion of the role of humans in protecting the eastern montane forests. Solutions to encroachment and destruction of these forests must include

1. More parks and reserves.
2. The expansion of small reserves or their interconnection by conservation corridors.
3. More active protection efforts to control poaching and arson.

Is sustainability possible?

Growing human requirements for natural resources can overwhelm biological processes in the eastern montane forests. Resource use in the eastern montane forests has been and remains extractive in nature. Because tree growth is relatively slow at these elevations, there are limited opportunities for using native species as commercially valuable timber in planted forests. At most sites in the eastern montane forests of Peru, slopes are so steep that cable logging would be required for environmentally appropriate harvesting. Some wild relatives of crops are found in these forests. However, few field crops prosper here, and those that are commercially valuable face many logistic and economic barriers. Only coca (*Erythroxylon coca*) cultivation for the production of illicit narcotics earns a substantial profit in deforested lower montane areas.

Our protectionist viewpoint can be characterized as being at odds with current conservation trends of searching for ways to harmonize the needs of local people with the continued existence of tropical biodiversity. We suggest that the solution to this dilemma consists of not attempting to do everything on the same tracts of land. Strictly protected nature reserves need to be maintained in the uninhabited watersheds that still exist while the technical and legal tools are developed to make extraction and agriculture possible in already deforested areas and along roads. This would help slow the advance of deforestation and also improve livelihoods.

Lessons from the past

Ironically, there is evidence of precolonial sustainable use of humid montane forests in northern Peru where the Chachapoyas ethnic groups once lived. Their land use was associated with careful design: houses were built on ridges and terraces were used for agriculture. All that is left today are archaeological sites (Figure 6), abandoned shortly after the arrival of the Spaniards and still incompletely studied. In the meantime, it is important that the cultural resources represented by these sites and their associated artifacts be protected. Both they and the natural ecosystems are testimony to what is possible in the cool, wet upper watersheds of the western Amazon.

Modern colonization that requires mechanization and ignores the real limitations imposed by topography and climate will be unsuccessful. Many challenges lie ahead, especially in the evaluation of the suitability of land use in those areas where colonization is occurring. Also, it will be necessary to promote the restoration of degraded lands.

The legal framework and policies concerning the use of natural resources could be better harmonized with the realities found in the study area. Overall, we believe that the appropriate use and conservation of these forests should be implemented considering spatial and historical variables. In uninhabited but biologically diverse areas, the correct strategies will differ from those used in areas long occupied and others recently populated.

FIGURE 6 The Gran Pajaten archaeological site is located at 2800 m elevation within Rio Abiseo National Park, northern Peru. View of stone wall found on the site. (Photo by Kenneth R. Young, 1985)

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