The Highlands

of Colombia's Cauca Valley Department

CVC
CORPORACION AUTONOMA REGIONAL DEL VALLE DEL CAUCA
45 años
1954 1999
LIDERES EN DESARROLLO SOSTENIBLE

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The Highlands

of Colombia's Cauca Valley Department

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The Collection of Strategic Ecosystems of the Department of the Cauca Valley

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Contents

Front cover. In its natural state, the páramo is a rich mixture of dense grasses and shrubs, interspersed with clumps of elfin forest whose stunted trees are wreathed with ferns, mosses and epiphytes. Páramo del Duende, Departments of the Cauca Valley and Chocó.

Back cover. The grasses of the páramo are now predominantly of the grazing variety. The colorful flowers one finds throughout the region (such as this Iridaceae), are a beacon in a sea of green, beckoning both bird and insect, as if saying "Here I am."

Preceding page. This large gentiana (Gentiana sedifolia) *- hardly more than five centimeters in height, usually inhabits the more humid spots, sometimes carpeting entire areas of fragmented rock.*

Foreword

Environmental education lies at the very heart of the changes the CVC wishes to inspire among the inhabitants of the Cauca Valley. We are but temporary custodians of the natural resources at our command. A sound environment – both today and tomorrow – means a higher standard of living for all the inhabitants of this department. The second book of the "Strategic Ecosystems" series, which we are today presenting to the Cauca Valley and to the world as a whole, ratifies this vision. May it be a token of our commitment to environmental education, as well as a practical guide to the basic aspects of our diverse ecosystems. The reader may wish to consult the first book of this series, "The Coastal Rain Forest of Colombia's Cauca Valley Department". In 1999 we celebrate our 45th anniversary – fully forty-five years of inspiring change and promoting the environmental welfare of the Cauca Valley. We have chosen this special occasion to present this book to all the inhabitants of the department, in hopes that many of them will gain a new-found appreciation of our priceless environmental legacy and rise to the challenge of protecting this most delicate of ecosystems -the páramo.

OSCAR LIBARDO CAMPO VELASCO
Director General

Preceding page. The large blackbird (Turdus fuscater), *is one of the more common birds of the páramo, especially in pastures and open fields. Thanks to the bright color of its feet and beak, and to its repertoire of shrill calls, it can hardly go unnoticed. It feeds on fruit – principally that of the local "mortiño", "nigüito" and "uvo de monte" – although it does not eschew the occasional worm or "cecilia".*

Prologue

The Sub-Directorate of Environmental Resources of the Autonomous Regional Corporation of the Cauca Valley, CVC, takes pride in the publication of "Highlands of Colombia's Cauca Valley Department" , the second volume of the "Strategic Ecosystems of the Department of the Cauca Valley" collection – also available in Spanish. This work, beautifully illustrated, summarizes the research carried out by the CVC, together with a long list of scientists from a host of national and international institutions. It is hoped that this work, intended for the general public but especially for those whose home is the Cauca Valley, will create a heightened awareness of this unique region and perhaps sway many more individuals to rise to its defense and conservation. The best legacy we can leave our children is a respect for our wildlife and an appreciation of the need to conserve our natural resources for the benefit and enjoyment of generations yet unborn. This work, intended to be accessible to the vast majority of the Cauca Valley's populace, is a small contribution towards the achievement of the daunting task that lies before us.

EDUARDO VELASCO ABAD
Subdirector Patrimonio Ambiental

Preceding page. The "frailejón" is without doubt the Andean highland's most abundant shrub. There are fully 54 species distributed throughout Ecuador, Venezuela and Colombia. The Department of the Cauca Valley, however, is home to only two: Espeletia hartwegiana *in the central cordillera, and* E. Frontinoensis *in the western cordillera. Serrania de Merida, Venezuela.*

Generalities

Los páramos. Thus are Colombia's highlands known. Located at altitudes above tree line, the páramos form a separate and distinct ecosystem all their own. Derived from the latin paramus, meaning deserted plain, devoid of inhabitants or crops, there are only about five regions in the entire world to which the word can be properly ascribed.

One such area is the highland of central Africa, another is in Malaysia. The central Andes and their northernmost extension – located in Colombia – also qualify. Perhaps the only other area with similar characteristics is the highland of Costa Rica.

The páramos of the Andes owe their name to the first conquistadors to arrive from Spain, some five hundred years ago. To them, the arid highlands of the Andes resembled the dry, windswept wastes of their native Castile.

Though the páramos extend across four countries – Peru, Ecuador, Venezuela and Colombia – it is in the latter that one finds the world's largest highland area – some 11,500 square kilometers covering all three Andean cordilleras. This book shall afford us a glimpse into the exotic world of the Colombian páramos. In particular, it shall acquaint us with the páramos of

The "superpáramo" of the Huila snowcap, Colombia.

the Central and Western cordilleras of Colombia´s Cauca Valley Department. In general terms, one can say that the páramos begin at an altitude of 3,000 meters and extend to the region of perpetual snow, which starts at 4,500 to 4,800 meters. Of course, these altitudes are only an approximation. Just where the páramos begin and end, also depends on the temperature, the precipitation, the prevailing winds – even the steepness of the slopes. It is customary to classify the páramos into three zones, according to their altitude. The sub-páramo, or lower fringe, is located at altitudes of 3,000 to 3,500 meters. This fringe is characterized by dense brush and grasses, including species of Poaceae, Asteraceae, Ericaceae, Melastomataceae and others. As one makes one's way to higher altitudes, say between 3,500 and 4,500 meters, the real páramo begins. The bushes become smaller and less frequent, till only the grasses remain (Poaceae). Yet farther up, above 4,500 meters, we find the superpáramo – a grim region of sparse and discontinuous vegetation – mostly lichens and the hardier species of the Asteraceae, such as *Senecio*. The extension of the páramo is also a function of temperature, and a difference of five degrees results in an entirely different ecosystem. Below seven degrees Celsius the forest gives way to the sub-páramo. Below two degrees Celsius one enters the domain of the super-páramo. The degree of moisture also plays a role. Moist soils retain heat, thereby allowing low-altitude vegetation to thrive at higher altitudes than normal. Dry soils, in turn, allow the sparse vegetation of the páramo to appear at lower altitudes. Deep valleys, sheltered from the warming rays of the sun, also serve to extend páramo vegetation to lower altitudes. Such is the case in the La Cocha Lagoon of Nariño Department in southwestern Colombia, where páramo vegetation can be found at a mere 2,700 meters above sea level.

The Páramo de la Culata, Serranía Mérida, Venezuela

Climate

As in all tropical latitudes, the temperature of the páramo is relatively constant throughout the year. In fact, the temperature variation between daytime and nighttime is greater than any seasonal variation. In Colombia's páramo, daytime temperatures hover around 10 degrees Celsius, dropping to 0 degrees or lower with the fall of night. This hovering of temperatures around the freezing point makes for a continual cycle of freeze and thaw. Both plant and animal life have developed a curious assortment of mechanisms to deal with these difficult conditions. In the cold, parched wastes of the páramo, water is a precious resource. Unfortunately, there is still little data on the hydrology and meteorology of this highland area. All that is really known is that the rainfall is far less than at lower altitudes, and that what little there is may be distributed over one, two or even four yearly wet

Above. Most of Colombia's rivers have their origin in the páramo. The soil, rich in decomposed organic material, the many lagoons, remnants of ancient glaciers, the abundance of sponge-like mosses, the low temperatures that impede evaporation, the ever-present mist – these are the conditions that contribute to the páramo's vital water-retaining properties.
Following page. The páramo is a vital link in the perpetual cycle of precipitation, retention and evaporation.

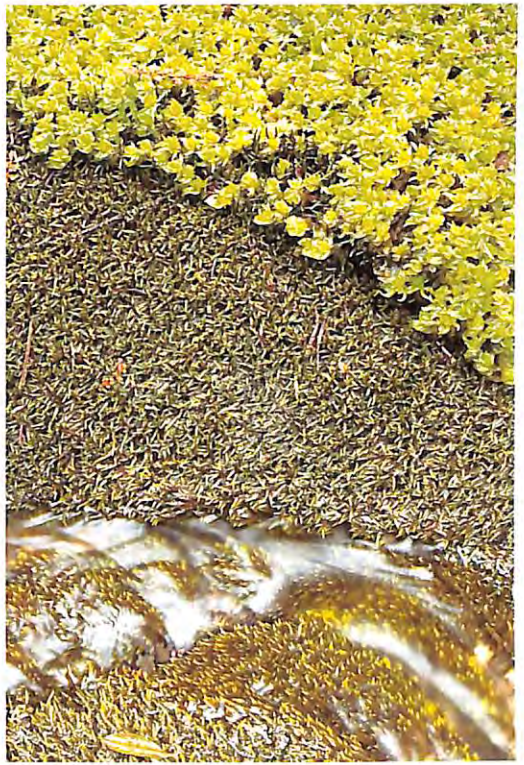
spells. In fact, it appears that the local vegetation may depend far more on condensed mist as a source of water, than on the scarce and sporadic rainfall. Of the entire highland region of the Andes, the páramos of Ecuador and Colombia are by far the wettest. Average rainfall reaches about 200 centimeters per year – compared to only 30 centimeters in some areas of the Venezuelan páramo, such as the Serranía de Mérida.

Soils

Little is known of the soils of the páramos. In general terms they are young soils – perhaps only 10,000 years old. They tend to be dark, acidic, rich in organic material, poor in nutrients. Why? The prevailing low temperatures slow down the process of decomposition, thus leading to a scarcity of essential elements. Despite the low rainfall, some soils remain saturated year-round. This is because of the thick matting of moss (*Sphagnum*) that pervades certain areas of the páramo. This moss serves as a sponge, keeping the soil hydrated. Known locally as "esfangal" or "pantano anda bobos", it can retain up to 20 times its own weight in water. As the moss slowly surrenders its water content, the runoff feeds the countless streams that originate in the páramo.

A Biography of the Páramo

The history of the Andean highands dates back at least to the Cretaceous Period, when South America, Africa, Australia, Antarctica and part of Asia formed one grand continent dubbed Gondwana. The fragmentation of Gondwana into the continents we know today began some 90 million years ago. The earth's crust – broken into various irregular patches – started to slowly drift apart. As the patches drifted apart, they each took with them their complement of flora and fauna - a veritable Noah's Ark afloat in an ever-widening sea. This is why much of the flora found today in South America is also found on other continents. Some 60 million years ago, the Andes mountain range began to push up along the western coast of what was till then a flat continent. This process continued until the new



mountain range made contact with the North American continent, at the isthmus of Panama, between four and seven million years ago. The new mountain range, running from south to north, also separated the lowlands to the east from those to the west. As the two areas were separated geographically, flora and fauna quickly adapted to the new environmental conditions posed by each habitat. The low-lying isthmus of Panama allowed the interchange of a wide variety of organisms between the two great continents lying to the north and south. The Andes – while impeding the migration of tropical species from east to west – served as a path for the north-south migration of species native to cold and temperate climes. During the glacial periods of the Pleistocene, temperatures throughout the tropics fell in like measure. The organisms that had already adapted to such conditions were able to extend their habitats to lower altitudes on either side of the mountain range. During the inter-glacial periods, temperatures throughout the world rose. The flora and fauna native to colder climates once again saw their habitats reduced to the extreme northern and southern ends of the two continents, and to the few isolated enclaves located at the highest of altitudes.

The "velas de páramo" (Chuquiraga) *are found throughout the highlands, from Bolivia to the very borders of the Departments of Valle, Quindío and Tolima. This species* (C. jussieui) *favors the damper spots.*

In certain cases this isolation led to the formation of new species as evolution proceeded without benefit of contact with neighboring specimens.

The Plant Life of the Páramo

The environment is the principle agent of natural selection. Only those species able to withstand the rigors of their natural habitat will live to produce progeny. In the Colombian páramo, the rigors include freezing nighttime temperatures, intense solar radiation (up to three times higher than at sea level), fierce winds, poor soils and little rainfall. The plant life of the Andean highlands consists mainly of stout shrubs and grasses – creeping[1], stunted[2], rosette[3] - like. The leaves of highland flora are usually small, leathery, slightly concave and thick-skinned to avoid excessive moisture loss through evaporation and transpiration. Such leaves are also good at tolerating strong winds and high levels of solar radiation. They are also, it would seem, less tasty to the herbivores that graze at those altitudes. The presence of many tiny hairs on the leaf is evidently a mechanism to trap droplets of water from the surrounding mist. Diverse plants, such as *Pinguicola antarctica*, are able to complement their diet with small insects. In order to protect themselves both from herbivores and the severe climactic conditions, many plants such as

Above. Among the plant life of the páramo, the Asteaceae clearly predominate. In fact, it is to this family that the many species of "frailejón" belong. In fact, the Andes are home to seven genera of "frailejón" representing some 140 separate species. Of these, only two are found in the Department of the Cauca Valley.
Following page, left. Some of the smaller vascular plants (such as Nertera) *manage quite well with the bit of organic matter and moisture to be found in the fine fractures and crevices of rocky cliffs.*
Following page, right. The "cortapicos" (Bomarea) *abound in the páramo and highland forest. They grow either as epiphytes or as creepers.*

the *Plantago rigida* grow in thick, dense cushions – as if to seek safety in numbers. Others such as the *Hypericum* and *Diplostephium* also grow in abundant colonies. For all its diversity, however, the flora of the páramo is far less varied than the plant life found at lower altitudes. In fact, there is an inverse relationship between altitude and organic diversity. In the tropical jungles of Colombia's Pacific Coast, a tenth of a hectare marked off at random will easily contain some 260 woody plant species. As we move up the cordillera, however, this diversity steadily drops. At an altitude of 1,500 meters, perhaps only 130 species are in evidence, and at 2,500 meters, only about a hundred. Climb to 3,000 meters above sea level, and one counts only some 35 species, and upon entering the páramo proper, this number drops even further. In fact, along the Eastern Cordillera of the Andes – home to the world's largest extension of páramo, there are only about 280 genera of plants, corresponding to some 75 botanical families. The sparse plant life of the páramo is preponderantly represented by grasses (especially *Calamagrostis*), shrubs and small trees. Among the grasses, we find diverse species of Asteraceae, associated with forage (*Diplostephium, Baccharis, Pentacalia, Espeletia*). The flowers of these species tend to grow in "capitals"[4] and the seed is often covered with down[5] to facilitate propagation by the wind. The grasses of the páramo are dotted by the occasional shrub, such as the "chaquiro" or Colombian Pine (*Podocarpus oleifolius*), the "encenillo" (*Weinmannia*), the "cinco dedos" (*Oreopanax*), the "mortiño" (*Hesperomeles*) and "nigüito" (*Miconia*). Among the trees – short and stout – one finds the local "uvitos" (*Gaultheria, Vaccinium, Cavendishia, Pernettya*), along with the occasional "sietecueros" (*Miconia, Tibouchina, Brachyotum*). These trees are frequently hosts to a local variety of parasite (*Gaiadendron punctatum*).

The Fauna of the Páramo

The fauna of the páramo underwent much the same evolutionary processes as the flora. The glacial periods of the Pleistocene permitted the migration of many species from extreme northern and southern latitudes towards the tropics. During the inter-glacial warm spells, many of these species were cut off from their original habitats and proceeded on their own evolutionary course. Thus, we find a number of "endemic"[6] species in the Colombian páramo, similar to those of their ancestors in the extreme northern and southern climes, yet hardly identical. Isolation, however, did not have the same effect on all animal life. Mammals, for example, are more adapted to covering great distances than say, reptiles. Such is the case of the spectacled bear (*Tremarctos ornatus*), the "tapir of the páramo" (*Tapirus pinchaque*) and the puma (*Felis concolor*). In many cases, adaptation to the rigorous conditions of the páramo took the form of changes in behavior. The tapir and the spectacled bear, for example, learned to forage for food in the dense forests extending below tree line,

The natural population of eagles (Geranoaëtus melanoleucus), *one of the Andean highlands' most imposing birds of prey, has been greatly diminished through hunting and the destruction of its natural habitat. The eagle has long been vilified because of its supposed appetite for newborn livestock.*

but to retreat to the páramo when the availability of food was adequate at higher altitudes. Evolutionary adaptation in the form of actual physical changes is much more prevalent among those life forms having far less mobility – amphibians, arthropods, mollusks, annelids. The mammals of the Andean highland have been decimated by over-hunting and the destruction of their native habitat. Nonetheless, there are still a few deer to be found (*Odocoileus virginianus, Mazama rufina*), "rabbit deer" (*Pudu mephistophiles*), coatis (*Nasuella olivacea*), pacas (*Agouti taczanowskii*), spectacled bear, tapirs, pumas and others. In fact, the Andean highland is home to some 40 species of mammal – 31 of which can be found in the páramo of the Cauca Valley Department. Among the diverse mammals of the páramo, the rodents are by far the most numerous – especially rats and field mice (Sigmodontinae), native to diverse habitats. Other species, such as the "runcho" (*Caenolestes fuliginosus*) and the coati are to be found only in the three cordilleras of the Colombian Andes. The "rabbit deer" inhabits an even smaller region – only the central cordillera.. Among all vertebrates, birds are the páramo's most numerous. Their mobility, of course, means that they are far less circumscribed by the rigorous conditions of the páramo than earthbound animals. They are also better adapted to the low pressures and consequent low oxygen content of high altitudes.

Preceding page. The "primavera pechicolorada" (Anisognathus igniventris)*, native to the "subpáramo" of the Cauca Valley, is often found in mixed flocks of various species as they move from shrub to shrub in search of food. Upper left. The hummingbird of the* Eriocnemis *genus, autochthonous to the Adean highlands, is easily identified by the white plumage between its legs -rather like a pair of pants. This species* (Eriocnemys mosquera) *is rather common in the páramo of the Cauca Valley, thanks to an abundance of nectar-producing flora. Its strong legs permit it to feed while perched, rather than exclusively in fligh, as do other hummingbirds.*
Lower left. The "playeros" or "anda rios" (such as Gallinago sp.)*, favor the open, more humid areas of the highland. Their plumage provides excellent camouflage, but when discovered the entire flock takes wing, squawking shrilly.*

Left. Field mice of the genera Oryzomys, Thomasomys *and* Chilomys, *are found in abundance throughout the Andean highlands. These rodents play a vital role in propagating many species of plant life. The seeds they bury for future consumption are sometimes forgotten – and left to germinate.*
Below. The large highland mammals – once abundant – have been hunted almost to extinction. Their natural habitat is also much reduced. Nonetheless, the Páramo del Duende still harbors the occasional spectacled bear

Colombia's páramo is home to some 240 bird species – 170 of which can be found in the Cauca Valley Department. Some of these make their home at altitudes of 3,000 meters above sea level, or even higher. Those favoring the páramo frequently feed either on nectar (hummingbirds or Trochilidae) or on honey (Coerebidae). As one moves up to higher altitudes, the diversity of insects also decreases. As a result, the flora of the páramo depends more on birds than on insects for pollination. Flowers tend to be bright-colored and sport long corollas – the better with which to attract the honey and nectar-gathering birds that inhabit the region. In fact, the hummingbird has adapted so well to the conditions of the páramo that several high-altitude species have evolved – (*Aglaectis, Eriocnemis, Pterophanes, Lafresnaya* and *Ramphomicron*, among others). In order to keep heat loss to a minimum, the hummingbird

builds a well-insulated nest, snuggled deep within the rocks or vegetation, well away from the brisk winds that whip through the slopes, yet exposed to what little sunlight is available. As happens with all warm-blooded animals of extremely small size, hummingbirds lose heat rapidly. Their ratio of surface area to volume is quite high, thus requiring that their nourishment be both frequent and rich in calories. Furthermore, the hummingbird enters into a state of hibernation during the cold nights of the páramo, during which its metabolism slows down considerably. This energy-saving mecha-

Left. This bat (Sturnira erythromos) *is the smallest of a group that feeds on fruit. Its habitat is the mist-enshrouded highland forests of Colombia, Venezuela, Peru, Ecuador and Bolivia.*
Below. The wildlife of the páramo is a curious mixture of native and foreign species – some of which hail from the tropical lowlands, Patagonia – even the arctic. The white-tailed deer (Odocoileus virginianus) *is one such visitor from the Far North.*

nism enables the hummingbird to sustain its frenetic activity throughout the daylight hours. With few exceptions, one does not find reptiles in the páramos. Being cold-blooded, there simply is not enough heat available for them to sustain their metabolic functions. Perhaps the only exception is a type of lizard (*Stenocercus*) that inhabits the Sierra Nevada del Cocuy, in the Departments of Boyacá and Casanare. This lizard spends long hours resting on rocks exposed to the sun, as if to absorb the vital warmth they provide. Except for a few frogs, almost no amphibians[7] inhabit the northern highlands of the Andes. Of the 57 genera of frogs and toads found in Colombia, only *Atelopus, Centrolene, Colostethus, Eleutherodactylus, Gastrotheca, Hyla, Osornophryne* and *Phrynopus* are able to survive in the harsh conditions of the páramo. Curiously, all of the above genera – with the exception of *Hyla* – are to be found almost exclusively in the Andes. As for *Hyla*, only one species of this genus of tree-dwelling frog is found in the páramo, principally in the eastern cordillera, although one also finds tropical salamanders of the *Bolitoglossa* genus. In the páramo of the Department of the Cauca Valley, the only species of frog are *Centrolene buckleyi* and diverse *Eleutherodactylus*. Truly, the diversity of amphibians inhabiting the páramo (just three to ten species) is quite limited, especially as compared to what one finds in the tropical habitats of lower altitudes. Furthermore, these species bear

more resemblance to the dwellers of other highland areas than to those of the tropical lowlands. As long as the temperature does not fall below freezing, the frogs of the páramo remain active – be it foraging for food or searching for mates. In fact, they can be surprisingly active – both during the day and at night - even when the temperature is quite near the freezing point. This activity is especially in evidence in the Duende páramo of the Western Cordillera, where the low temperatures seem to silence all other forms of animal life. The reproductive behavior of the frogs of the páramo is not unlike that of their counterparts at lower altitudes. *Eleutherodactylus, Osornophryne* and *Phrynopus,* all deposit their eggs on dry land. These eggs evolve directly into frogs without passing through the larval or tadpole stage. Salamanders of the *Bolitoglossa* genus exhibit similar reproductive behavior. However, *Atelopus* and *Centrolene* do produce tadpoles that survive quite well in the numerous streams that have their origin in the páramo. Unlike the frogs of lower altitudes, those of the páramo seldom deposit eggs in pools or lagoons. The only exceptions are the *Colostethus* and a species of *Hyla*, which inhabit the Eastern Cordillera, and the *Gastrotheca* of the Macizo Colombiano. Though the larger forms of animal life may be scarce, the life forms that dwell within the soils of the páramo are far more varied. In fact, they make a vital contribution to the formation and maintenance of the soil in which

Preceding page, top. This salamander (Bolitoglossa sp novo), *native to the Páramo del Duende, still awaits its taxonomic description.*

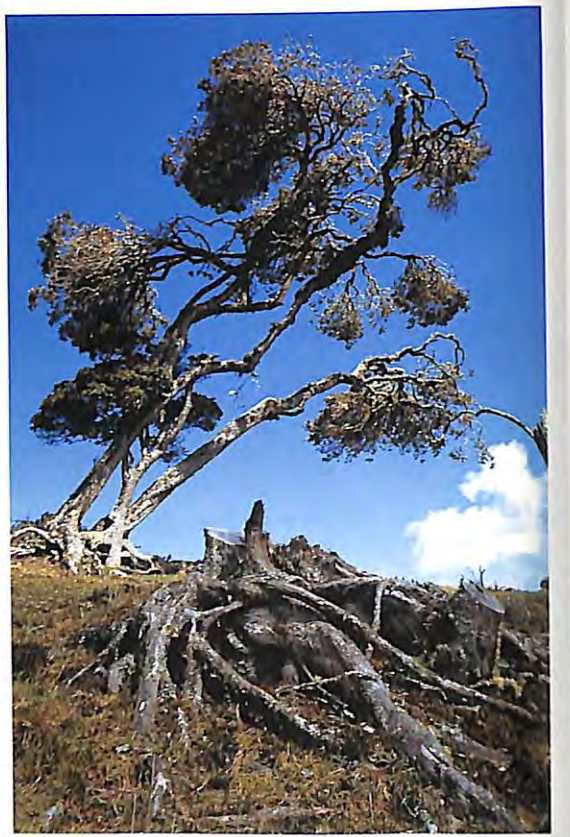
Preceding page, center and bottom. This "crystal frog" (Centrolene buckleyi), *is found from Ecuador to Venezuela. In fact, it is the only species of its family to make occasional incursions into the páramo per se. It lays its eggs on leaves overhanging ponds and streams so that the tadpoles fall directly into the water.*

Below. Although the diversity of insect life in the páramo is much less than what is found at lower altitudes, there are nonetheless a good many species of herbivores (Coleoptera), sap-feeders (Homoptera) and blood-suckers (Diptera), etc.

they live. The most important of these are the earthworms (Lombricidae). These are followed by woodlice (Colembola), beetles (Coleoptera) and spiders (Arachnidae), among others. The diversity of beetles to be found in the páramo of the Department of the Cauca Valley is relatively high, and they have an important role to play in their ecosystem. The Passalidae, for example, help decompose tree trunks and accelerate the process of mineralization.The páramo, besides sheltering divrse species not found elsewhere, also provides a corridor for both vertical and horizontal migrations. Vertical migration, as species descend to lower altitudes and then retreat to the safety of the highlands. Horizontal, as species from extreme southern and northern climes - even from the Artic - seek suitable conditions on their transcontinental migrations. However, the destruction of the surrounding forests and the implacable advance of pastures have increasingly isolated these priceless stepping-stones for migratory species, leading in many cases to their local extinction.

Threats and Conservation

The páramo and the tropical forests that extend below the tree line have come under increasing attack by three activities – agriculture, cattle grazing and the felling of trees for lumber. In all three cases, the land is cleared – either by ax and chainsaw or by burning. The latter method is especially detrimental to the flora and fauna of the páramo. Unlike the plant and animal life of temperate zones, able to cope with the natural forest fires and brush fires that occasionally occur in northern latitudes, the species of the



páramo have evolved no defenses. While it is true that certain species of flora do sprout again after a fire, repeated burning wreaks havoc on the ecosystem as a whole. Burning serves to eliminate the dry brush, eschewed by cattle, and promotes the growth of tender, edible shoots. But besides burning the original flora, the uppermost layer of soil is also destroyed – along with the seeds that would serve to regenerate the vegetable matter in its original form. Furthermore, continued grazing and trampling by cattle compresses the soil – reducing its capacity

Preceding page. The greater part of the original forest covering the Páramo de Barragán and Santa Lucía has been destroyed by the onslaught of civilization. Only a few fragments remain, providing refuge to the hardier species of flora. Those species most prized for their wood are also the most endangered. Furthermore, the seed-dispersing animals necessary for their propagation are now far fewer in number.
Right, top. The presence of abundant dead leaves on the shrubs is a sure sign that they remain untouched by fire.
Right, bottom. When the páramo is burned, the younger shrubs succumb and only the larger, more mature shrubs survive. The survivors lose their protective covering of dead leaves – leaving them more exposed than ever. Grasses invade the burnt areas, turning the páramo into just another pasture.

to retain moisture, diminishing the diversity of plants that can survive in it and in general impoverishing its ability to sustain the complex ecosystems of the páramo. Besides doing away with the original plant life, intensive farming makes liberal use of lime, fertilizer, pesticides and herbicides. Lime neutralizes the natural acidity of the soil, while fertilizers favor certain types of plant life at the expense of others. Certain pesticides and herbicides find their way into organic tissues, thus entering the food chain of the fauna that derive their sustenance there. All these artificially induced changes cause negative and sometimes unforeseeable consequences on the ecosystems of the páramo, besides altering the natural processes of succession and regeneration. Agriculture and cattle grazing are introduced in an unfortunate cycle aimed at deriving maximum short-term benefits. After burning the original vegetation, settlers plant a few crops until the soil simply gives out. Once it is no longer suitable for planting, the land is given over to cattle grazing. Furthermore, it is common practice to drain swamps and lagoons with a view to enlarging the exploitable area. Man has undertaken yet other activities – perhaps less widespread but no less pernicious to the páramo - such as mining, road building and the construction of dams and telecommunications towers. He has also introduced foreign species

Left. In the Páramos of Barragán, Las Domínguez and Pan de Azúcar, the locals – in cooperation with the Autonomous Regional Corporation of the Cauca Valley (CVC), have fenced off a good number of hectares from further exploitation. The lands behind this "yellow line" are off limits to cattle grazing, thus assuring the regeneration of at least part of the páramo. Following page. Corral for livestock, Páramo de Barragán.

of plant and animal life such as pine, cypress, eucalyptus, the native "urapan" and trout. The appearance of these new species, in a misguided attempt at conservation, has in many cases transformed the original landscape of the tropical forests below the tree line. Highlands have been converted into homogeneous pastures, dominated by a few aggressive varieties that effectively take over soils once occupied by native species. The páramo, however, is ill-suited to cattle grazing and agriculture. Its value lies precisely in its biodiversity, not in its homogeneity. The páramo fulfills a vital function in absorbing moisture and in regulating the flow of the countless streams that have their origins there. The páramo must be preserved not only in order to assure the proper flow of water to the dams and farmland lying downstream, but also to preserve the many forms of plant and animal life found nowhere else.

Human Settlement[8]

A wealth of archeological and historical evidence points to the early presence of man in Colombia's Central Cordillera – at least since the eleventh century AD. The environs of the Bolo and La Vieja Rivers were peopled by the Buga Indians. The area between the Bolo and the Palo Rivers was inhabited by the Bolo Indians. By the fourteenth century, the Buga culture had

come to occupy a fairly extensive region –stretching from present-day Sevilla to the Amaime River. From the fourteenth to the sixteenth centuries – a period known as the "Sonso Tardío I" – the Quebrada Seca culture occupied the lands contiguous to the Amaime River. The era of the "cacique" or chieftain was at hand.

The Spanish chronicler Cieza de León, describes the inhabitants of the Buga region as "very brave warriors who faced the Spaniards with no trace of fear." In the Las Hermosas Valley, the local Indian peoples cultivated corn, potatoes, "arracacha", beans and the local "ahuyama", with techniques not much different from those found today. Along the banks of the Bolo Blanco and Bolo Azul Rivers (in the Municipality of Pradera), one can still find the occasional old-timer who remembers when the local "buchitolo" Indians mined salt and bartered for goods. In fact, the páramo lying in the Municipality of Florida is still claimed by a local militant organization of native peoples. However, the truly native peoples are now a distinct minority – far outnumbered by the vast influx of people of mixed blood. For the most part, the newcomers have not settled the páramo itself but rather the ample lands lying between 2,700 and 3,000 meters. They are predominantly landless laborers – the landowners preferring the comfort and safety of nearby cities. Their main activity is ranching – burning new areas, grazing as long as the soil holds out, moving on.

The Páramos of Barragán and Santa Lucía were at one time important agricultural areas. Today, their soils much impoverished, they rely on cattle grazing.It now appears that the human settlements are also dwindling. Earlier in the century, many peasants – lacking land but not initiative – colonized the slopes of the páramos in search of a better life. But with the onslaught of La Violencia in the 1950's – the political infighting that brought death to thousands – many fled back to the safety of the cities. The páramos remain the scene of acute social dysfunction. Although a few communities enjoy a fairly comfortable standard of living, others are strife-ridden. There are still large numbers of landless, impoverished peasants, barely earning subsistence wages, deprived of such basic social services as health care and education. Furthermore, the inhabitants of the areas adjoining the páramos bear the brunt of the costs of conservation. Their activities have been forcefully curtailed so as to protect the vital sources of fresh water needed downstream for dams, crops, cities. Indeed, the social and environmental problems of the páramos of the Cauca Valley Department are many and complex. Their solution will require equally complex measures – together with a good measure of compromise between the various players in this ongoing dilemma – peasants, landowners, governmental organizations, the citizenry as a whole.

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1 This term refers to plants that propagate by shedding a stem which then rolls to another location and sprouts roots.

2 Low-lying vegetation loses less heat and is less exposed to the strong winds of the páramo.

3 The leaves and flowers of certain plants may be arranged closely together in a rosette pattern.

4 Several flowers bunched at the end of a stem, similar to the capital of a column.

5 In some species the down is replaced by a tuft.

6 Autochthonous.

7 Text and footnotes on amphibians prepared by Prof. John Lynch of the Institute of Natural Sciences, Universidad Nacional de Colombia.

8 Text on human settlements written by Ana Elvia Arana of the Fundación Trópico.

Preceding page. In Barragán and Santa Lucía, abundant livestock now grazes in the "subpáramo" and "páramo". Immediate action will be required to establish guidelines with a view to conserving this dwindling resource.
Below. Communications towers have proved treacherous for many species of bird, unable to see the obstacles in time to avoid a fatal encounter.

Department of the Cauca Valley

Preceding page. Old, dry leaves remain attached to the "frailejón." This accumulation of "necromass", or dead vegetable matter, provides nutrients, retains moisture and shelters all sorts of small animals. Páramo del Duende, Western Cordillera.

The greater part of the páramo of the Cauca Valley Department is located in the Central Cordillera of the Colombian Andes. Covering some 613 square kilometers, and with altitudes above 3,400 meters, it forms a continuous highland area with the neighboring Department of Tolima. The many streams that originate in this páramo flow down into the Cauca Valley to irrigate its abundant farmland, thence to the Cauca River and northwards to the Caribbean. The Western Cordillera has two isolated areas of páramo – both within the boundaries of the Cauca Valley Department. One, covering but three square kilometers, is located in the Farallones de Cali Natural Park. The other – covering some 25 square kilometers – is located near the summit of Calima, bordering the Department of Chocó. The páramo of the Central Cordillera has been greatly disrupted by human activity. Fortunately, the isolated páramos of the Western Cordillera are protected by their very inaccessibility, located as they are at the summits of very steep mountains.

Western Cordillera

Until very recently, knowledge of the páramos of the western cordillera was limited to the areas known as Paramillo, Frontino and Chaquiro in the Department of Antioquia, a small area on the summit of Tatamá, between the Departments of Chocó and Risaralda, and an atypical area in the Farallones de Cali Natural Park in the Department of the Cauca Valley, almost devoid of brush. In 1997, the first scientific surveys of the páramos of the Cauca Valley Department were carried out. Specifically, a detailed study was made of the area known as Páramo del Duende, near the Calima summit.

This area had first been described in a report by a team of prospectors examining the region's hydroelectric potential, as well as in the notes taken by a local expedition. As far as is known, no other formal study had ever been made of this isolated region.

Left. In the more level areas of the páramo, where moisture is more easily retained, abundant grasses grow interspersed with clumps of "frailejón" shrub.
Following page. The shrubs of the páramo are largely confined to the areas bordering the highland forest, the banks of streams and the outer fringes of the elfin forests.

The Páramo del Duende

The Páramo del Duende covers some 25 square kilometers and is situated at altitudes between 3,300 and 3,800 meters above sea level. The area lies within the jurisdictions of three municipalities – Riofrío and Darién in the Department of the Cauca Valley, and Docordó in the Department of Chocó. Although this particular páramo is somewhat less humid than that of the Central Cordillera, it is nonetheless the source of numerous streams that feed some of the region's most important rivers – the Calima, the Riobravo, the Río Azul, the Riófrío and the Copomá.The vegetation of the Páramo del Duende can be classified into two main types – the grasses prevailing in the gentle meadows of deep, moist soils and the elfin forest that favors the dryer, shallower soils. The grasses are predominantly species of *Calamagrostis, Cortaderia* and *Festuca*, the sharp-bladed *Rhynchospora*, the rosette-shaped *Plantago, Werneria, Oritrophium, Valeriana* and *Paepalanthus*, straight-stalked varieties of Gentianaceae and Scrofulariaceae, and small grazing grasses such as *Nertera, Myrteola, Viola, Disterigma, Oreobolus* and *Xyris*. These grasses are interspersed with the occasional shrub – perhaps a species of Asteraceae, Rosaceae, Ericaceae, Hypericaceae or Melastomataceae. Amongst the diverse shrubs, the most prominent species – both for its beauty and abundance – is *Espeletia frontinoensis*. Favoring open

spaces, this shrub quickly invades areas laid bare by the occasional landslide.The second type of vegetation – the elfin forest, covers the better part of the páramo. Here we find dense shrub and giant ferns such as *Blechnum*, orchids with stalks three meters high (*Epidendrum*) and diverse grasses – some with gigantic stalks measuring five meters in height (*Neurolepis*). As for the shrubs, they are predominantly of the Asteraceae and Ericaceae families. Stalks, branches, along with the surrounding soil, are frequently blanketed by dense moss and liverworts (bryophytes), ferns (pteridophytes) and lichens – all of which help conserve moisture. Parasites such as the "matapalo" (Loranthaceae) seem to be everywhere, covering every available trunk and branch. Frequently, one also finds large areas covered with bromeliads, especially of the *Guzmania* genus. In deep ravines and in other spots protected from high winds and very low temperatures, small clumps of trees abound, their trunks and branches wreathed with all sorts of epiphytes such as orchids, bromeliads, ferns, anthuriums, mosses, lichens and liverworts. This copious cover is often complemented by creepers such as wild raspberry (*Rubus*), valerians (*Valeriana*) and others such as the Asteraceae. The edge of this elfin forest is populated by yet other shrubs such as the calceolaria (*Calceolaria*), the baccharis (*Baccharis, Pentacalia*), the schefflera (*Schefflera*), together with diverse bromeliads. Amongst the more common arboreal species, one finds the Colombian pine, the wax laurel (*Myrica*), the "mano de oso" (*Oreopanax*), the "tibar" (*Escallonia*), the "nigüito" (*Miconia*), the "encenillo" (*Weinmannia*), the "sietecueros" (*Tibouchina*) and others. The *Espeletia frontinoensis* has also been found in the Frontino Páramo and in the Macizo de Tatamá. In fact, this was the first species of shrub to be positively identified in the páramo of the Cauca Valley Depart-

Preceding page. Able to accumulate substantial water between its rosette-shaped leaves, bromeliads provide refuge for many species such as frogs and insects.
Right. The "frailejón" is the páramo's most abundant shrub. Easily identified by its erect, rosette-shaped leaves, yellow blossoms and trunk bedecked with dead foliage, it sometimes reaches a height of eight to ten meters.

Left. The "semillero andino" (Spinus spinescens) is fairly common in the highlands of Colombia's central and western cordilleras. It forms flocks – small but quite noisy – that feed on the seed of the "frailejón".
Following page. The cloaked trunks of the "frailejón" are just right for the hatchlings of the "semillero andino".

ment. Thus far, some 250 species of grasses, trees and shrubs have been identified in the Páramo del Duende – mostly species of the Asteraceae, Poaceae and Ericaceae families. Two entirely new species have been discovered, belonging to the genera *Aequatorium* (Asteraceae) and *Columnea* (Gesneriaceae). As the scientific study of the region advances, it is still possible that this remote region will yield additional discoveries. Thus far, only four species of amphibian have been identified in the Duende Páramo – a salamander (*Bolitoglossa*), two frogs of the *Eleutherodactylus* genus and a "glass frog" (*Centrolene buckleyi*). The salamander and the frogs of the *Eleutherodactylus* genus constitute entirely new species – still lacking a complete scientific description. Some 25 species of bird have been spotted in the Duende Páramo, the most abundant being the nectar-feeding species. In fact, five separate species of hummingbird have been identified – *Eriocnemis mosquera, Chalcostigma herrani, Heliangelus exortis, Metallura tyrianthina* and *Ramphomicron microrhynchum*. Additionally, three honey-feeders have been found - *Diglossa humeralis, D. cyanea* and *Conirostrum sitticolor*. Nonetheless, it is the birds known as "primaveras" (*Anisognathus, Iridosornis*) and "semilleros" (*Spinus spinescens*) that break the all-encompassing silence of the Duende Páramo. Several bird species were spotted for the first time in the Duende Páramo. In fact, the red-breasted "primavera" (*Anisognathus igniventris*) had never before been seen in the Western Cordillera. Seven other species were spotted for the first time in the Cauca Valley Department : *Mecocerculus leucophrys, Conirostrum sitticolor, Chalcostigma herranii, Eriocnemis mosquera, Hellmayrea gularis, Notiochelidon murina* and *Diglossa humeralis*. In general, the mammals of the páramo are difficult to detect. In fact, only 14 species have been spotted, including bats (*Anoura geoffroyi, Sturnira erythromos* and *Eptesicus sp.*), mice (*Oryzomys albogularis, Thomasomys aureus, Chilomys sp.*), "runchos" (*Caenolestes sp.*), shrews (*Cryptotis sp.*), coatis (presumably *Nasuella olivacea*), pumas and bear. One of the outstanding characteristics of this páramo is the prevalence of the spectacled bear, as evidenced by the abundant tracks, lairs and dung. The only scientific information on the Duende Páramo is the preliminary data compiled on amphibians, birds and mammals by two brief expeditions to the area. These expeditions were organized by the Autonomous Regional Corporation of the Cauca Valley (CVC) – the Department's environmental authority – with the collaboration of the Empresa de Energía del Pacífico (EPSA), FEDENA, CIPAV and the Institute of Sciences of the Universidad Nacional de Colombia. This preliminary information does not yet do justice to the area's rich biological diversity. The initial inventory of fauna would seem to indicate fewer species than those of the Central Cordillera. However, this apparent paucity might be explained by the fact that the Duende Páramo remains largely undisturbed. There may well be more autochthonous species present, though still unobserved by man. This state of affairs is quite different from that of the Central

Cordillera, where the border between the páramo and the forest that extends below the tree line has been thoroughly displaced. There, the species native to the páramo and those inhabiting lower altitudes make continual incursions into each other's territory. Because of its isolation, the Duende Páramo remains in remarkably good condition – having suffered neither fire nor the effects of agriculture and cattle grazing. In fact, the conditions that presently prevail there are probably not unlike those that prevailed throughout all the páramos before the arrival of man. The two points of closest contact with civilization are at an altitude of just 2,500 meters, at El Roblal in the municipality of Riofrío, and at La Nevera in the municipality of Darién. Fortunately, both settlements show a high degree of awareness with regard to the natural legacy in their custody. In fact, the settlements boast two ecological organizations – Salónica Verde and FEDENA – both of which are highly active in promoting conservation and education. These organizations, and others like them, depend heavily on community support. Without such support, the cause of conservation would be lost from the beginning.

The Páramo of the Farallones de Cali

At the higher elevations of the Farallones de Cali Natural Park, one finds a small, atypical páramo – just three square kilometers in area – almost devoid of shrubs. Nonetheless, its climactic and botanical characteristics unmistakably qualify it as a genuine páramo. Its topography is rugged, with steep slopes and jagged cliffs. Unlike other páramos, it is entirely devoid of gentle valleys and meadows. With the exception of the shrubs, the flora of this páramo is not unlike the flora of the Duende Páramo or the Tatamá Páramo. It consists of grasses (Poaceae) and other highland plants that grow on the small stretches of relatively flat plain, dotted with a number of tiny lagoons of glacial origin. The daunting height of the surrounding mountains has proven an insurmountable barrier to many plant species. The bushes of the Duende Páramo, for example, just a few kilometers to the north, are unknown in the Páramo of the Farallones. The vegetation of the Páramo of the Farallones is basically of two types – elfin, transitional forests and small extensions of grassland. The elfin forest is remarkably dense. Where the slopes are very steep and the underlying rock is exposed to the elements, only orchids sur-

Preceding page. A pond of glacial origin, Pico Pance, Farallones de Cali National Park.
Right. It is far easier to hear the "bujío" than to spot it – given its preference for evening and nighttime activity. Furthermore, its plumage provides excellent camouflage. Eschewing nests, this bird lays its eggs directly on the ground. This curious behavior has earned it the sobriquet of "lazy" or "egg dragger". The "bujío" feeds on insects which it traps in mid-flight with its oversized mouth. This "bujío" with striped wings (Caprimulgus longirostris) *is particularly prevalent in tropical highlands.*

vive (*Epidendrum, Stellis, Pleurothallis*), together with the occasional bromeliad (*Puya, Greigia, Guzmania*), the odd Ericaceae (*Vaccinium, Pernettya*) and perhaps a few lycopods (*Lycopodium, Huperzia*), lichens and mosses. Other species include the Asteraceae (*Ageratina, Diplostephium, Pentacalia*), the Ericaceae (*Gaultheria, Thibaudia, Pernettya, Vaccinium, Disterigma*), the Hypericaceae (*Hypericum*), the shorter, arboreal species of Asteraceae (*Pentacalia, Gynoxys*), the Cunoniaceae (*Weinmannia*), the Melastomataceae (*Miconia, Tibouchina*), the Loranthaceae (*Gaiadendron*), the Araliaceae (*Oreopanax*), the Clusiaceae (*Clusia*), the Berbeidaceae (*Berberis*), the Desfontainiaceae (*Desfontainia*), diverse arboreal ferns (*Blechnum loxense*), and long grasses (*Chusquea* and *Epidendrum*), that form small colonies at the very fringe of the forest. One of the most noticeable of the herbaceous species is a cetain bromeliad (*Guzmania*). Sporting red bracts, this species forms dense colonies both within the forest and along the fringes. Within the forest itself one finds abundant small herbs - occasionally epiphytes such as orchids (*Stellis, Lepanthes, Elleanthus, Pleurothallis*), bromeliads (*Racinaea, Tillandsia*), Araceae (*Anthurium*), ferns (*Hymenophyllum, Elaphoglossum, Polypodium*), abundant mosses, liverworts and lichens. Sometimes one finds individual specimens or small clumps of *Greigia*, a plant not unlike the native "puya", but with short, axial shoots. The vegetation covering the small, level areas of plain is composed mainly of short grasses, especially of the Poaceae family (*Calamagrostis*). This species grows in dense clumps, and seems to thrive in the wake of a natural disaster – be it a brush fire or a landslide. In areas as yet unspoiled, one finds a number of small, herbaceous plants interspersed with the aforementioned grasses. Among these, one might mention the Rosaceae (*Lachemilla*), the Geraniaceae (*Geranium*), the Violaceae (*Viola*), the Apiaceae (*Niphogeton, Azorella, Hydrocotyle*) and the Ericaceae (*Disterigma*). The arid, rocky outcrops, with little or no soil, are far less fertile. There, only lycopods, moss, Poaceae, small Ericaceae and the local "puya" grow. But in the more humid areas, one finds a diversity of herbs such as the Gentianaceae (*Halenia, Gentianella, Gentiana*),

Preceding page. Favoring dry land, frogs of the Leptodactylidae family are largely independent of water. Their eggs, laid directly on dry foliage, do not pass through the tadpole stage but instead hatch into fully-formed frogs. Nonetheless, some humidity is required. This Eleutherodactylus sp. novo *awaits a full taxonomic description. Right. Farallones del Cajambre, Farallones de Cali National Park.*

the Valerianaceae (*Valeriana*), the Myrtaceae (*Myrteola*) and the Onagraceae (*Epilobium*). As the level of moisture increases, one begins to find dense colonies of certain plants such as the Xyridaceae (*Xyris*), the Cyperaceae (*Oreobolus*) and the Asteraceae (*Werneria, Oritrophium*). Among the short, shrub-like plants one finds varieties of *Hypericum, Vaccinium, Gaultheria, Pernettya, Ugni, Diplostephium* and *Baccharis*. The larger shrubs, such as *Pentacalia* and *Diplostephium*, are limited to the very fringes of the forest. Some varieties, however, can be found in fairly dense colonies (*Loricaria, Chusquea* and *Diplostephium*). The fauna of the Farallones Páramo is not unlike that of the Duende Páramo. Besides the diverse autochthonous species, one also finds the occasional visitor from lower altitudes, come in search of food. Consequently, it is not uncommon for diverse animals – especially birds – to sometimes abandon their more common habitat and venture into the heights of the páramo. The Farallones Páramo is managed and protected by the Special Administrative Unit of the System of National Parks of the Ministry of the Environment, Southwestern Region.

Central Cordillera

The páramos of Colombia's Central Cordillera cover two separate areas – the first, extending from the Macizo Colombiano to the southern border of the Department of Quindío, and the second, covering the volcanic regions of the Ruiz, Santa Isabel, Quindío and Tolima snowcaps. These two areas are separated by a strip of highland forest, interspersed with peaks that, in some cases, also belong to the páramo ecosystems.

During the glacial periods of the Pleistocene, these two areas formed one continuous páramo. Though it later divided into two separate areas as temperatures rose, their plant and animal life remain practically identical. The area of Central Cordillera páramo corresponding to the Department of the Cauca Valley covers approximately 613 square kilometers – though no boundaries mark its borders. Known officially as "Las Hermosas", the locals call it by a host of names – that of a nearby farm, rocky outcrop or other prominent feature. Contrary to common belief, the entire páramo is not a national park – only some 250 square kilometers are actually within the boundaries of the "Las Hermosas" National Park. Towards the northern end of the Cauca Valley Department, in the Municipalities of Sevilla and Tuluá, one finds the páramos of La Cascada, Barragán, Los Andes, El Diamante, La Esperanza and others. The páramo corresponding to the Municipalities of Tuluá, Buga and Palmira, is almost entirely within the precincts of the National Park. More towards the south – between the Municipalities of Pradera and Florida – the páramo is known locally by the names of Avelino, Tinajas, and others. There are also another two, isolated areas of páramo - Barragán and Santa Lucía in the Municipality of Tuluá, and Las Domínguez and Pan de Azúcar between the Municipalities of Ginebra and El Cerrito.

Left. Japón Peaks, municipality of Tuluá.
Following page. The highland settlements of the Cauca Valley Department are comprised mostly of immigrants of mixed blood. Most of these settlements are not located in the páramo per se, but rather at altitudes of 2,700 to 3,000 meters above sea level.

The Las Hermosas Páramo

The Las Hermosas Páramo is exceptional for its abundant lagoons of glacial origin. Its highest peaks – some of which surpass 4,000 meters – were at one time snow-capped. A number of streams have their origins in this páramo – streams that feed some of the Department's most important rivers – the Nima,

the Tuluá, the Bugalagrande and others. Although there exists the inevitable encroachment of man, the fact that at least part of the páramo is now within the bounds of a national park does much to facilitate conservation efforts. In general terms, the region is one of steep slopes, fragile soils and rocky outcrops. Local pastures are interspersed with bare rock – mute testimony to the loss of the thin topsoil. The local vegetation may be classified into four basic types – pastures, fragments of highland forest, areas of páramo greatly modified by the presence of man, and a few isolated areas of páramo as yet unspoiled.

The Andean highland forests were at one time the source of a rich variety of timber – local species such as "encenillo" (*Weinmannia*), Colombian pine or "romerones" (*Podocarpus, Prumnopitys*), cedar (*Juglans, Cedrela*), "carisecos" (*Billia*), "amarraboyos" (*Centronia, Meriania*), laurels (*Ocotea, Nectandra, Licaria, Persea*) and palms (*Ceroxylon, Geonoma*). These local species are now much reduced in number, endangered, and in some cases entirely extinct in the locality. The elfin forests, now restricted to the very steepest areas of the páramo, exist in dense clumps of diverse trees, bushes and undergrowth. Predominant varieties are the Ericaceae (*Pernettya, Gaultheria, Vaccinium, Cavendishia, Plutarchya*), the Rosaceae (*Hesperomeles, Rubus*), the Grossulariaceae (*Escallonia*), the Melastomataceae (*Tibouchina, Brachyotum, Miconia*), the Poaceae (*Cortaderia, Neurolepsis, Chusquea*), the Asteraceae (*Gynoxys, Pentacalia, Diplostephium, Baccharis, Ageratina, Aequatorium*) and others. The greater part of the Central Cordillera páramo has been burned at one time or another. This is evidenced by the much reduced diversity of the local grasses. Fire destroys a great many species associated with grassland and scrub land. Once burned, the land loses its protective covering of dead leaves and regenerates only with the greatest of difficulty. Only the hardiest species survive – such as the Poaceae and Cyperaceae – which spread to occupy the land in its totality, to the exclusion of other species. The predominance of only a few species in turn leads to the further impoverishment of the soil. The only species of shrub in the Las Hermosas Páramo is *Espeletia*

Preceding page. For many of the native Indian peoples of the Andes, the lagoons of the páramo have special significance. They are the repository of the hostile spirits that defend the páramo from those with evil intentions. According to the Indians of Rioblanco, in the Department of Cauca, water reaches the earth in four different forms – one of them being the drizzle of the páramo, supposedly generated by the lagoons.
Below: Waterfall in the las Hermosas páramo.

hartwegiana, which grows together with other varieties of Asteraceae such as *Pentacalia, Diplostephium, Loricaria, Baccharis, Ageratina, Gynoxys* and *Chuquiraga*, among others. As one proceeds to the more remote areas of the páramo, far from the depredations of man, the plant life becomes much more varied. One finds diverse varieties of Asteraceae, "chites" (*Hypericum*), "nigüitos" (*Miconia*), "mortiños" (*Hesperomeles, Miconia*), "uvitos" (*Cavendishia, Disterigma, Plutarchya, Vaccinium, Gaultheria*), the "siete cueros" (*Tibouchina* and *Brachyotum*), ferns (*Blechnum* and *Jamesonia*) and "puyas" (*Puya*). It is in these areas, far removed from roads, settlements and human activity, that one finds the greatest variety of plant life – including the more delicate species that have not survived elsewhere. Among these, one finds the varieties requiring very moist soil, such as *Isoetes, Ranunculus, Werneria, Oritrophium, Halenia, Pedicularis, Bartsia, Plantago* and others.

The destruction of many of the original forms of plant life, together with irresponsible hunting, have decimated many native species of fauna in the Central Cordillera. The most victimized are the large vertebrates, which require extensive grazing area and are also the most prized as game. There are now few bear, tapirs or puma outside the boundaries of the National Park. The spectacled bear must now compete for its favorite food – the "puya" – with the abundant livestock that grazes on the slopes of the páramo. One does find, however, numerous rooting grounds where coatis have overturned the soil in search of worms and insects. One also finds the occasional tunnel left by a local species of rabbit (*Silvilagus brasiliensis*). Much more frequent, however, are the smaller mammals such as field mice (*Oryzomys* and *Thomasomys*), and a variety of bat native to the Andean highlands (*Anoura geoffroyi, Sturnina erythromos, Histiotus montanus, Lassiurus blossevillii*). The predominant bird of the central cordillera páramo is the hummingbird (Trochlidae). In fact, the Trochlidae are represented by fully twelve different species (*Aglaectis cupripennis, Chalcostigma herrani, Colibri coruscans, Coeligena lutetia, Ensifera ensifera, Eriocnemis mosquera, Eriocnemis derbyi, Haplophaedia aureliae, Heliangenlus exortis, Lafresnaya lafresnayi, Metallura williami* and *M. tyrianthina*, among others). The hummingbirds are followed by diverse honey-suckers (Coerebidae) and bluebirds (Thraupidae), together with the local "tangara or primavera", which feed on the fruit of various shrubs. The páramo is also home to various insectivores such as the "atrapamoscas" (*Ochtoeca fumicolor*). In the dense bush of the ravines and in the few remaining clumps of forest, one may also find the occasional "comprapán" (*Grallaria*). The amphibians are perhaps the most affected of the páramo's fauna. Burning and overgrazing have all but destroyed the native amphibians, with the exception of the local variety of frog (*Eleutherodactylus*).

Left. Lichens, a mutually beneficial arrangement between algae and mushrooms, favor rocky surfaces. Thriving on the smallest traces of vegetable matter, lichens prepare the soil for the plant life to follow: mosses, liverworts, ferns and small vascular plants.
Following page. Amica (Senecio formosus).

The páramos of Barragán and Santa Lucía

The páramos of Barragán and Santa Lucía still conserve a few areas in their primordial state – free of burning and grazing. Other areas, however, have been entirely taken over by farming and ranching activities. In the Barragán páramo, the unspoiled areas are to be found only at the summits of the highest peaks. Thanks to the steepness of the slopes and the density of the underbrush, these areas are virtually inaccessible to cattle. Between these unspoiled areas and the highland forest there are narrow fringes of elfin forest, together with underbrush in a transitional state. This is underbrush that had been burned many years ago, but is now in the process of making a full recovery. The predominant varieties are the Asteraceae family (*Pentacalia, Diplostephium, Gynoxys, Espeletia, Baccharis*), the Melastomataceae (*Miconia, Brachyotum, Tibouchina*), the Ericaceae (*Cavendishia, Pernettya, Gaultheria*) and the Rosaceae (*Hesperomeles*), interspersed with diverse grasses, mosses, liverworts and ferns – especially along the lower strata. Among the most abundant grasses, one finds various species of Poaceae (*Calamagrostis, Festuca*), Rubiaceae (*Arcytophyllum, Nertera*), Asteraceae (*Gnaphalium, Baccharis, Gamochaeta, Oritrophium*), Valerianaceae (*Valeriana*), Fabaceae (*Lupinus*), Iridaceae (*Orthrosanthus, Sisyrinchium*), along with a number of ferns (*Jamesonia, Blechnum, Elaphoglossum*). One also finds the occasional clump of shrubs – some of which can reach a height of over six meters. Instead of shedding their dead leaves, these tall shrubs retain them – forming a thick, protective coat that helps retain moisture. In other areas of the páramo, active measures have been taken to prevent further grazing and clearing by fire. These measures appear to have been successful, as many species of autochthonous flora and fauna have reappeared after a protracted absence. In fact, the process of regeneration has led to the connection of several previously isolated clumps of forest – thus contributing to the recovery of the páramo to something approaching its former extension and diversity. Many of the newly recovered plant species owe their propagation to the local birds. Foremost among these is the "guardarocío" or "chite" (*Hypericum*), whose comeback has been truly remarkable. This tree is frequently found intermingled with diverse species of Asteraceae such as *Chuquiraga, Baccharis, Diplostephium, Pentacalia* and *Gynoxys*. The *Chuquiraga* is especially easy to spot. Growing in dense clumps, its vivid orange blossoms and sharp-pointed, narrow leaves cover the entire plant. The regeneration of the undergrowth appears to be proceeding vigorously – especially in the dryer areas. The moist areas are favored by diverse plants with rosette-like leaves, such as *Werneria, Oritrophium, Plantago* and *Valeriana*. Also to be found in abun-

Preceding page. The "befaria" (Befaria resinosa) *is a common sight in the páramos of the Cauca Valley Department. Its colorful flower produces a sticky resin – quite tasty for insects and hummingbirds. Right. The continuous and indiscriminate practice of burning the land not only reduces its biological diversity but also its ability to retain moisture. The páramos, once humid and fertile, are reduced to arid grassland whose monotony is broken only by the occasional shrub of "frailejón".*

dance is the *Eryngium humboldtii*, of the Apiaceae. In its early stages, this plant resembles a common thorn bush, given the many spines that protrude from its leaves. Other genera favoring the moister areas are the *Geranium, Bartsia, Hydrocotyle, Halenia, Gentianella, Pedicularis, Lycopodium, Huperzia, Isoetes, Xyris, Oreobolus, Rhynchospora* and *Carex*. Unfortunately, the greater part of the Barragán and Santa Lucía páramo has been severely disturbed by burning and overgrazing. In such areas, the only plant life to be found is the common *Calamagrostis*, interspersed with the occasional shrub and herbs, Cyperaceae (*Rhynchospora, Carex*) and valeriana. Gone are the formally abundant species of grasses, and the few that remain are for the most part limited to the moister areas. Recently burnt areas show the dire effects of fire on the páramo. What few bushes remain are practically devoid of older leaves, their fire-ravaged trunks blackened. Many of the younger shoots are nipped in the bud by grazing cattle, affording them no opportunity to reach adulthood and propagate the species. An occasional "puya" or thorn bush (*Puya trianae*) breaks the homogeneity of the pasture. This plant produces a blossom whose height can reach two and a half meters, and constitutes an important part of the diet of the once frequent spectacled bear. The animal life of the Barragán and Santa Lucía Páramos exhibits an apparently rich diversity, but only because it combines the fauna of the Andean highland

Preceding page. The "cauliflorous" structure of much of the plant life of the páramo is evidently a mechanism for dealing with the strong winds and ultraviolet radiation of high altitudes. This would explain the shape of the "puyas".

Right, top. This Rubus glabratus, *a close relative of the raspberry of Castile, belongs to a group displaying a rich diversity of species, shapes and sizes. Several species of the Rosaceae family were able to adapt to the harsh conditions of the páramo.*

Right, bottom. Like the hummingbird, the flower-piercer (Diglossa) *feeds mainly on nectar. Unlike the hummingbird, though, the flower-piercer perforates the corolla at its base. Its long, curved, sharp-pointed beak – together with its U-shaped tongue, are ideally suited to the task. When withdrawing the nectar, the tongue does not make contact with the reproductive structures and so does not contribute to the plant's pollination.*(Doglossa lafresnayi).

forest with that of the páramo per se. In reality, the species that may strictly be classified as belonging to the páramo are now much reduced in number and diversity. The tapir, the bear and the puma, much talked about by the local peasants just two or three decades ago, seem to have totally disappeared. As in other Colombian páramos, the Barragán and Santa Lucía still exhibit and abundance of hummingbirds. Perhaps the most common is the "copper hummingbird" (*Aglaectis cupripennis*), easily identified by its bright color, its fairly large size – and by the aggressiveness with which it defends its territory. The open areas of the páramo are frequented by sparrows and by the local "semillero" (*Catamenia innornata* and *Zonotrichia capensis*). These birds feed mostly on the seed of the diverse grasses and bushes. As for mammals, very few remain. Perhaps the only species still found in any abundance are the savanna rabbit, field mice and bats. The principle economic activities of the páramo are cattle grazing – which sustains a prosperous dairy business – and agriculture – mainly potato farming. However, the intensity with which these activities have been practiced over the last few decades have greatly affected local ecosystems. The soil is much depleted; the sparse vegetation retains little moisture. In the summer, there are now frequent dry spells. The surrounding communities have developed a belated awareness of the damage that has been done. Today, various ecological organizations are attempting to prevent further harm, and perhaps to partially undo the damage already done. One of these organizations, "Páramo y Frailejones", had its origins in a local school and is avidly supported by students and teachers alike. Some of the local landowners, with the encouragement of the Autonomous Regional Corporation of the Cauca Valley, have begun to fence off springs, clumps of forest and páramo, with a view to assuring its protection and survival.

Left. Some species of bird, like the sparrow (Zonotrichia capensis), *are less susceptible than most to the degradation of their habitat. Ranging from Mexico to Tierra del Fuego, sparrows are to be found everywhere – in fields, crops and pastures, on the fringes of highland forests, even in cities.*
Right, top. Flycatcher (Ochthoeca fumicolor).
Right, bottom. This "primavera" (Iridosornis rufivertex) *is found throughout the highland and elfin forests of Venezuela, Colombia, Ecuador and Peru. Although principally a fruit eater, the "primavera" complements its diet with abundant insects and larvae.*

The Páramos of Pan de Azúcar and Las Domínguez

The páramos of Pan de Azúcar and Las Domínguez, located between the Municipalities of Ginebra and El Cerrito, not far from the township of Tenerife and the city of Palmira, form a sort of peninsula in the Central Cordillera. The greater part of the highland forest that at one time surrounded this peninsula is now largely gone – replaced by pastures and potato fields. Only on the steepest of slopes and in the deepest of crevasses can one still find small clumps of the once dense highland forest. Still to be found are the occasional "encenillo" (*Weinmannia*), "riñón" (*Brunellia*), "mano de oso" (*Oreopanax*), laurel (Ocotea, Licaria), "sinmuerte" (*Sessea*), "carga agua" (*Clethra*), "coloradito" (*Vallea*), "tibar" (*Escallonia*), "mortiño" (*Hesperomeles*) and "nigüito" (*Miconia*). The vegetation of the Páramo de Pan de Azúcar and Las Domínguez has been repeatedly exposed to fire and is now far less diverse than it once was. The elfin forest and dense thickets are now all but gone, and the open areas too are populated by only a few species. In fact,

Preceding page. Fire has dramatic consequences on páramo plant life. Only the hardiest survive – mature plants capable of withstanding the scorching heat. The smaller plants, and those requiring much moisture, give way to the homogeneous grasslands on which cattle now graze. Right. One of the strategies for trapping moisture directly from the mist, withstanding intense cold and solar radiation and repelling herbivores, is the abundance of hair-like structures that cover the leaves in their entirety. This "fuzz" comes in a great variety of colors, forms, sizes and densities.

there are only three main types of plant life still remaining. Along the lower fringe of the páramo, around 3,500 meters above sea level, there are still a few small clumps of elfin forest and transitional highland forest. These isolated spots shelter a few venerable trees – their twisted trunks densely covered by moss, liverworts, lichens, bromeliads, orchids, "curubos de monte" (*Passiflora*), and diverse hemiparasites such as *Dedropthora, Tristerix, Psittacanthus*, whose fragrant blossoms are a real treat for the occasional hummingbird that chances their way. On the forest floor, one finds an abundance of orchids, bromeliads (*Greigia*), ferns, mosses, liverworts and other moisture-loving plants.

The few remaining clumps of elfin forest are confined to the lower fringes, deep crevices and most humid spots of the páramo. Although dense, they are few in number and limited in size. The occasional tall tree may break its low profile, but for the most part it is home to shrubs and very short trees. Among the most abundant of the genera is the *Diplostephium* – easily recognized by the whitish hue of its foliage. The "midget forest" is also home to two of the páramo's more common grasses – *Cortaderia bifida* and *Neurolepsis elata* – whose shoots can reach a height of some five meters. The greater part of the Páramo de Pan de Azúcar and Las Domínguez has been irretrievably altered by human activity, its once diverse plant life largely

Preceding page, top. A perforating beetle (Curculionidae), sporting a parasitical mite.
Preceding page, bottom. An immature specimen of Orthoptera.
Bottom. Fairly common in the highlands, at altitudes between 2,600 and 3,400 meters, this flycatcher (Mecocerculus leucophrys) *avidly seeks out the insects that inhabit the bushes.*

Left. Although certain small mammals such as mice and rabbits are less at risk, the destruction of the páramo could yet lead to their local extinction.
Following page. This hummingbird (Coeligena lutetia) *belongs to a genus autochthonous to the highlands. It favors the fringes of the highland forests, up to altitudes of 3,600 meters.*

replaced by the grasses and shrubs favored by grazing cattle – (Iridaceae, Rosaceae, Cyperaceae, Hypericaceae, Bromeliaceae, Asteraceae, Ericaceae and others). Trees and the larger shrubs are indeed few. The soil, having lost its protective layer of dry foliage to fire, no longer supports the larger species that were once so abundant. In general terms, one finds that the páramo has everywhere lost its former capacity to sustain any degree of diversity. It is true that there are still a few, isolated segments of páramo unspoiled by fire – mainly along the steeper and more inaccessible slopes, where cattle do not venture. These few spots still conserve something like their former variety of plant life – especially the grasses and shrubs that previously covered large, unbroken areas of páramo.

In the more humid areas, along the banks of streams and shores of lagoons, one can still find a number of species whose rosette-shaped leaves form a dense carpet over the páramo floor – the Asteraceae, Plantaginaceae, Xyridaceae, Cyperaceae, Geraniaceae, Ranunculaceae, Isoetaceae. And, in the more humid and shady areas, one might even find the occasional carnivore such as the *Pinguicola antarctica*. The leaves of this plant are covered with a multitude of fine, sticky hairs from which insects know no escape. The *Pinguicola antarctica* favors the company of mosses and liverworts, which also make their home in the poorer, rockier soils.

In the less damaged areas of the páramo, one finds fewer of the grazing varieties of plant life and more of the shrubs that originally covered large, unbroken extensions. It is in these remote, conserved areas that the shrubs of the original páramo are able to attain their full height – up to six meters. They also retain much of their older, dead foliage – vital for conserving the scarce moisture of the windswept páramo. All told, perhaps 150 plant species are still to be found, representing some 50 botanical families, the most abundant being the Asteraceae, Ericaceae, Poaceae and Melastomataceae.

Although the entire páramo has suffered the sorry consequences of man's depredations – overgrazing, fire, roads, dams, communications towers – there are still a number of larger mammals left in the wild such as deer, "guaguas" and coatis. Not to mention birds. The small clumps of highland and elfin forest provide ample food for a diverse variety of fowl such as the "primaveras" (*Anisognathus igniventris, A. lachrymosus, Iridosornis rufivertex*) and "semilleros" (*Catamenia innornata, Haplospiza rustica, Zonotrichia capensis*). The collared pigeon (*Columba fasciata*) is another frequent visitor. And, as in other areas of the Colombian páramo and Andean highland, it is not uncommon to find mixed flocks – different species searching for food in the same place, oblivious to each other, or perhaps united in their desire to seek refuge from an approaching predator.

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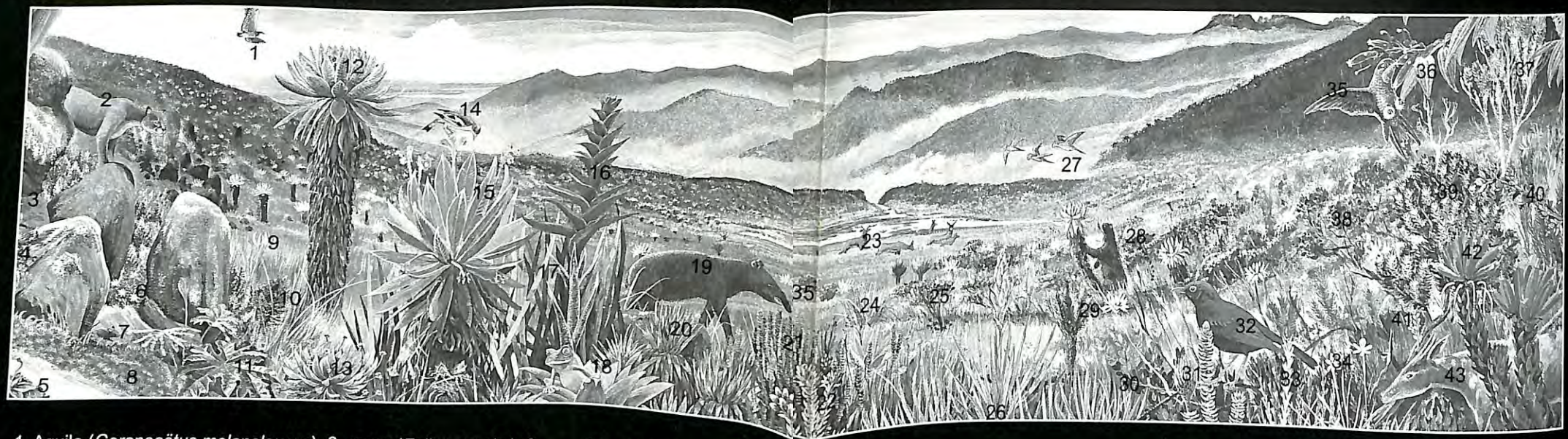
Distribution of the Páramos of Colombia

1. Western Cordillera
2. Central Cordillera
3. Eastern Cordillera
4. Sierra Nevada de Santa Marta

Distribution of the Páramos in the Department of the Cauca Valley

1. Páramo del Duende
2. Farallones de Cali
3. Barragán y Santa Lucía
4. Pan de Azucar y Las Dominguez
5. Las Hermosas

Artist's conception of a páramo in Colombia's Department of the Cauca Valley



1. Aguila (*Geranoaëtus melanoleucus*), 2. puma (*Felis concolor*), 3. *Disterigma empetrifolium*, 4. licopodio (*Lycopodium clavatum*), 5. planta carnívora (*Pinguicola antarctica*), 6. *Werneria crassa*, 7. ratón (*Oryzomys sp.*), 8. musgo (*Sphagnum sp.*), 9. paja de páramo (*Calamagrostis sp.*), 10. *Loricaria complanata*, 11. hierba de pantano (*Gunnera sp.*), 12. frailejón de la cordillera Occidental (*Espeletia frontinoensis*), 13. *Paepalanthus ensifolius*, 14. semillero andino (*Spinus spinescens*) 15. frailejón de la cordillera Central (*Espeletia hartwegiana*), 16. bromelia (*Guzmania confinis*),17. *Neurolepis elata*, 18. rana de cristal (*Centrolene buckleyi*), 19. danta de páramo (*Tapirus pinchaque*), 20. bromelia (*Greigia nubigena*), 21. *Baccharis tricuneata*, 22. gentiana (*Gentianella dasyntha*), 23. venado de cola blanca (*Odocoileus virginianus*), 24. Cortaderia biffida, 25. *Pentacalia vaccinioides*, 26. *Puya occidentalis*, 27. loras (*Leptosittaca branickii*) 28. oso de anteojos (*Tremarctos ornatus*), 29. [illegible]ho (*Blechnum loxense*), 30. *Vaccinium floribundum*, 31. ve[illegible] páramo (*Chuquiraga jussieui*), 32. mirla (*Turdus fuscater*), 3[illegible]astilleja (*Castilleja fissifolia*), 34. *Sysirinchium trinerve*, 35. [illegible] (*Eriocnemys mosquera*), 36. quereme (*Cavendishia nitida*), 37. pino romerón (*Podocarpus oleifolius*), 38. Siete cueros (*Tibouchina grossa*), 39. *Diplostephium floribundum*, 40. Hesperomeles *pernettyoides*, 41. *Dendrophthora clavata*, 42. Befaria *resinosa*, 43. venado conejo (*Pudu mephistophiles*).

Scale varies according to species.

Plants and animals are both from the Central and Western Cordilleras.

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With a view to affording the non-specialized reader access to a great deal of scientific information of relevance to the conservation of our environment and the sustainable development of our natural resources, the Autonomous Regional Corporation of the Cauca Valley , CVC, has undertaken the publication of a collection of works on the Strategic Ecosystems of the Department of the Cauca Valley.

Through the pages of " *The Highlands* of Colombia's Cauca Valley Department", the second volume of the collection (also available in Spanish), we come to understand the plant and animal life of the tropical highlands. We come to know the names, customs, relationships and a wealth of fascinating minutiae regarding the biology, ecology and conservation of some of the players in the dynamic struggle of forces that is now taking place in the páramos of the Colombian Andes.

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IMÁGENES DE LA NATURALEZA