NATIONAL PARK

MANU

A LEGACY LANDSCAPE

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Dedicated to the National Service of Natural Protected Areas (SERNANP), especially its park rangers, for their constant efforts to keep Manu and its boundless splendor alive.

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Authors:

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Editor: Anel Pancorvo Salicetti, Apus Graph Ediciones

Editorial Team: Christof Schenck, Antje Muellner, Dagmar Andres-Bruemmer, Hauke Hoops, Ingrid Chalán, Anel Pancorvo Salicetti

Editorial Coordination: Ingrid Chalán, Frankfurt Zoological Society (Peru), Dagmar Andres-Bruemmer, Frankfurt Zoological Society (Germany)

Design and Layout: Mario A. Vargas Castro, Apus Graph Ediciones

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National Service of Natural Protected Areas (SERNANP)

SERNANP is a government agency under the Ministry of the Environment. It oversees Peru´s nationally managed terrestrial and marine natural protected areas. Its main goal is biodiversity conservation, and it promotes the sustainable use of natural resources and environmental services, thus contributing to the country´s development.

The Frankfurt Zoological Society in Peru (FZS)

The Frankfurt Zoological Society has been supporting conservation work in Peru since the early 1970s, thanks to its commitment to the area of Manu and the protection of vicuñas in Pampa Galeras National Reserve. Since 1990, when it began its giant otter project, it has had a constant presence in the Madre de Dios region. In 2002, it launched the Program of Support for Protected Areas, which later expanded to become the Andes to Amazon Conservation Program. The FZS provides support to both government and civil society partners for the effective management of extensive natural protected areas that have extraordinary biodiversity and reduced human impact. Headquartered in the city of Cusco, with a field office in Puerto Maldonado, the FZS has a dedicated team that implements fieldwork. The main work areas are improving the protection and oversight of natural protected areas, capacity building, monitoring of emblematic wildlife species, planning of nature tourism, environmental education, and ecologically friendly management of natural resources.

Apus Graph Ediciones

A publisher with 21 years of experience in the publication of large-format books in Peru and abroad. The company has important clients in the public and private sectors and has published 50 large-format books. It co-edits and prints with publishers and printers on three continents. Books published by Apus Graph Ediciones have been presented in cities such as Frankfurt, Hamburg, Milan, Rome, Turin, Florence, Genoa, Venice, Lugano, Geneva, Zürich, Zaragoza, Warsaw, Panama City, Bogotá, Lima, Trujillo, Arequipa, Cusco, Hong Kong and Beijing. It has operations and representatives in Peru, Italy and Switzerland.
Specializing in topics related to Andean archaeology, the anthropology of the sacred and biodiversity, in the Andes and the Amazon, it has published books about the heritage of Peru that are highly regarded for their scientific quality and visual appeal.

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Foreword

This year will mark the 40th anniversary of the Manu Biosphere Reserve. It will also be the 30th anniversary of the designation of Manu as a UNESCO World Heritage Site. Manu National Park and the protected areas surrounding it are highly deserving of these distinctions. In this book, experts and connoisseurs of Manu coming from a wide range of disciplines, will guide you though the huge, almost untouched rain forests of Madre de Dios.

Zoologists and botanists, as well as ethnologists, have only the highest praise when they speak of Manu. But how can Manu best be protected for the future? This is a question about which experts do not always share the same opinions. The preparation of this book led to an intense exchange of views among the authors, all of whom have been closely connected with Manu for years, or even decades, through research, conservation or working for the benefit of the local population. This diversity of views and approaches is reflected in their writings, and this book thus provides not only exciting insights into one of the largest treasure troves of nature on the planet, but also into the dilemma of linking conservation and development.

This book, which was conceived and directed by the Frankfurt Zoological Society (FZS), was prepared in close collaboration with Peru´s National Service of Natural Protected Areas (Sernanp). For almost three decades, Sernanp and the FZS have worked side by side to protect Manu. The book also provides insight into the longstanding partnership between the two institutions and their successful efforts. The Peruvian publisher Apus Graph Ediciones has brought great passion and professionalism to the project, and the most outstanding photographers have provided unique images.

The tireless efforts of Sernanp´s park rangers have enabled Manu to remain a radiant jewel for the past four decades. In addition, donors — both private and governmental — from Peru, Germany and the United States have provided financial support to preserve this heritage of humanity, which is entrusted to the care of our generation.

What the Serengeti is to Africa, Manu is to South America: an icon of nature conservation and biodiversity. We are all called to help preserve this «Legacy Landscape», this World Heritage, and to ensure that it will be passed on, unharmed, to future generations. Let this book inspire you.

Klaus Becker
President of Frankfurt Zoological Society

Prologue

Irina Bokova
UNESCO Director General
(November 2009 to November 2017)

United Nations Educational, Scientific and Cultural Organization · World Heritage Centre

With the support of the Frankfurt Zoological Society

This year, Manu National Park, one of the world´s largest reserves, celebrates the 30th anniversary of its designation as a UNESCO World Heritage Site and its 40th anniversary as a Biosphere Reserve.

This dual designation reflects the incredible diversity of flora and fauna within its 17,000 square kilometers. With 4,212 species of plants and 1,030 species of birds identified so far, Manu is a generous home for all. Animals such as the jaguar, giant armadillo, tapir and giant otter live side by side with more than 1,000 people who largely maintain their traditional way of life. It is filled with numerous Incan and pre-Incan ruins, further testifying to its rich indigenous history.

Manu National Park also reveals the inherent complementarity between nature and culture. Its inclusion in the UNESCO World Heritage List and its designation as a Biosphere Reserve represent a key contribution to the protection of the world´s natural heritage and biodiversity. Under the World Heritage Convention, which was adopted in 1972, the World Heritage List includes natural, cultural and mixed sites notable for their outstanding value to humanity. The Man and the Biosphere Programme, launched by UNESCO in 1971, recognizes terrestrial, marine and coastal ecosystems and works to safeguard these sites as places where relationships between people and nature can be sustainable. Manu´s two designations not only are mutually reinforcing, but they are also transformative, promoting international cooperation for appropriate sustainable management of the site.

The participation of a wide variety of stakeholders, from the national government to dedicated NGOs and local communities, has been crucial for the management and conservation of Manu National Park. One example of this innovative approach, supported by UNESCO and aimed at the governance of sites like Manu, is a pilot project implemented by the Peruvian government and the Association of Artisans of the Biosphere Reserve. Although logging is prohibited in the area, the members of the association received permission to collect high-value timber — such as cedar, mahogany and catahua — that floats down the Manu river naturally during the rainy season and take it to market. This plan has benefited more than 40 families in local communities, contributing to alternative forms of economic and social development.

I wish to commend the work of the Frankfurt Zoological Society in highlighting these achievements, and I have no doubt that Manu will continue to set the standard for the sustainable management of our planet´s diverse natural heritage for many years to come.

Journeying from Cusco toward Manu, travelers pass centuries-old funerary towers known as the *Chullpas de Ninamarca*, testimony to the rich Andean culture.

The empire of species

Christof Schenck and Pedro Gamboa

There is nowhere else on earth like Manu National Park. Although that statement may sound rash, we trust that it will serve as an invitation to discover — through these pages, in this wonderful journey through Manu´s history, culture, landscapes and biodiversity — why there is no other place like it in the world.

If Manu brings to mind the most pristine forests in the Peruvian Amazon, that may be because this majestic natural protected area begins in the Andes of Cusco and continues down to the Peruvian Amazon, cascading through a boundless symbiosis of natural life.

It is not surprising then, that it ranked highest in a recent survey of biodiversity in emblematic natural sites around the world. Similar studies of insects, fish, amphibians, birds, mammals and plants had already shown the immense diversity of this remote place. The bird population alone consists of more than 1,000 species, making Manu home to one out of every ten bird species on earth.

This may lead us to wonder about the origin of this diversity. Why have thousands of species made Manu National Park their habitat? There are two primordial reasons. First, and most important, is that climatic conditions in the South American tropics remained relatively stable over long periods of time, resulting in increasingly multifaceted ecosystems.

The second is related to human population density. Despite the Spanish Conquest and the subsequent rubber boom, this density in Manu always remained low. Native families were integrated into the tropical ecosystem, living in balance with nature and without the tools of modern civilization.

The national park has maintained its natural wild character for longer than almost any other place on earth. This is evidenced by the presence of indigenous peoples that remain in isolation, keeping their ancestral traditions and avoiding contact with the outside world.

Over the past few centuries, humanity´s increasing ability to modify landscapes caused steep declines in biodiversity in many places around the world. In Manu, however, this did not occur. This is partly because the steep slopes of the Andes allowed only limited access from the west and south, and partly because its vast, dense forests obstructed intruders from the north and east.

The hot, humid climate, combined with tropical diseases, posed additional barriers to exploration. Rapids on the lower course of the main waterway connecting to the Amazon River also prevented large boat traffic. Even now, there is only one road providing access to the upper edge of the park and its western buffer zone.

The park´s lowlands are characterized by a dynamic floodplain blanketed with megadiverse rain forests.

Manu is considered one of the most biodiverse places on earth. One out of every 10 bird species on the planet is found in Manu, including the Golden-collared Tanager and the famous Cock of the Rock.

Manu National Park was officially established in 1973, but long before that academics, government officials and other public figures had made concerted efforts to win political support for its creation.

Its establishment was finally recommended, and it was initially designated Manu National Reserve in 1968. The following year, work began on construction of the Panahua and Tayakome ranger stations.

The Cocha Cashu Biological Station, a cornerstone of the foundation laid for conservation of the park´s exceptional biodiversity, was established a little later, with the support of Paul V. Pierret, associate professor at La Molina National Agrarian University (UNALM). The second chapter of this book describes this fascinating period in greater detail.

The founders could not have done a better job. Before the term «biodiversity» was even coined, at a time when the tropical forest was seen more as an endless resource to be exploited than a treasure to be protected, they drew a line around this biological hot spot. They included an area reaching from the high Andes, more than 4,200 meters above sea level, down to 150 meters in the Amazonian lowlands, spanning a vast elevation gradient and a multitude of different ecosystems. They incorporated the complete watershed of a large meandering river, the Manu, with various bodies of water in its diverse floodplains.

Because of its relatively smooth, round shape, the park has a short boundary compared to the area it contains. Well-designed zoning accommodates both free-access and restricted areas.

National park status has been essential for the protection of Manu. This is the gold standard for protected areas, and Manu is among the largest parks in the world. With Alto Purús National Park, its neighbor to the north, it covers a land area rivaling some European countries in size. These features paved the way for the park´s recognition as a Biosphere Reserve in 1977 and its designation as a World Heritage Site ten years later, further enhancing its protection.

Where the Andes meet the Amazon untouched mountain chains form the *ceja de selva*, the «jungle´s eyebrow».

In the 1980s, scientists, photographers and filmmakers began to explore and share some of the treasures and secrets of this remote place with a broader audience. Among experts, Manu became synonymous with grandeur, biodiversity and wilderness, a place shaped not by man, but by the will of the land. Nevertheless, Manu remained largely invisible to the general public, hidden in the shadow of famous parks such as Serengeti or Yellowstone.

Manu National Park has been protected both by its own inaccessibility and by the hard work of a group of highly committed park rangers. The park´s administration — first, park managers and authorities of the Ministry of Agriculture´s National Institute of Natural Resources (INRENA), and second, the National Service of Natural Protected Areas (SERNANP), which falls under the Ministry of the Environment — have always stood staunchly behind this protected area. They have defended activities which raise awareness about the park´s value and its contribution to biodiversity, such as sustainable tourism, and have remained committed to local people and communities, so they can continue the sustainable practice of their ancestral activities.

The Frankfurt Zoological Society (FZS), an international conservation organization founded in Germany, has also played an important role protecting the park. The FZS began working in Manu in the park´s early days, mainly studying black caimans. That was one of the first studies to emerge from the Cocha Cashu Biological Station, where much of the scientific research on Manu has since been conducted.

Later, in 1990, the FZS launched a comprehensive giant otter research and conservation project in Manu. This project has since grown into a large-scale landscape program encompassing Manu National Park and Alto Purús National Park, the largest protected area in Peru. Over the past quarter-century, the Frankfurt Zoological Society and SERNANP developed a strong and valuable relationship that has made them partners and companions in this successful venture.

Although Manu has survived recent decades in better shape than many other tropical protected areas, that does not mean this will continue to be true.

To the south, gold mining has turned thousands of hectares of pristine forest into a toxic wasteland. Catastrophic mercury pollution is widespread. The expansion of human settlements, agriculture, illegal logging and coca production also pose serious threats.

The global hunger for fossil fuels puts additional pressure on the protected areas and buffer zones around the park. Potential roads to and near the park could also have serious impacts. Many people still dream of hundreds of dams in the Amazon basin that could affect the climate and disconnect Manu from other important areas.

There also are challenges within the park. For example, there is one settlement in the Andean zone. Serious efforts are being made to relocate it and make it a conservation partner. Villages of indigenous peoples in the park´s lowlands also require coordinated support to ensure that their needs and demands are addressed with minimal impact on the protected area.

Nearly half a century after Manu´s establishment as a national park, keeping it healthy and protected remains a Herculean task. Success will depend largely on solutions developed with the people living in and around the park. The buffer zone and the integrity of the landscape will also determine Manu´s destiny.

Park rangers are the backbone of the park, surveillance and monitoring being among their primary tasks (top). Improving the livelihood of communities in the buffer zones is key for their approval of the protected areas (below).

The creators of the park laid the groundwork, but now it is up to all of us to secure the future of this biological cathedral — this carbon sink, this water engine, this library of life — created over millions of years by nature itself.

Manu National Park needs local, national and international recognition, pride and support. It needs permanent and generous financing. It needs dedicated people working together strategically, on the ground, to protect it. Above all, it needs global citizens excited about exploring its treasures, discovering its secrets and understanding its challenges.

Manu National Park needs you, the reader of this book!

The highest peak of Manu, the Apu Kañahuay, leads the traveler's eye from the evergreen forests to the stark cliffs and further up to the sky. It is no wonder the mountain is called in Quechua: «The one, who is close to God».

Where the Andes meet the Amazon

Rob Williams and José Antonio Ochoa

The geography of South America is dominated by the Andes Mountains and the Amazon River basin. These two great geographical features define its landscape and have played a leading role in shaping its evolutionary and natural history, making it home to a great diversity of wildlife. They have also shaped and limited human colonization, the formation of ancient and modern cultures, and the use of natural resources.

The uplift of the Andes is relatively recent. It began during the Miocene, some 25 million years ago, as the Nazca plate pushed eastward and slid under the South American plate, creating a region of high volcanic and tectonic activity, and uplifting a rugged, mountainous spine down the western side of the continent.

This chain extends more than 7,000 kilometers, from the shores of the Caribbean in Colombia to Tierra del Fuego in Argentina and Chile. This makes it the longest continental mountain range on earth and the second highest, with snow-capped peaks towering more than 6,000 meters high scattered along its length.

While the western Andes are primarily composed of young rocks of volcanic origin, the eastern part of the range was formed by the uplift of ancient rocks of diverse origins, including some of the oldest and most weathered rocks on earth.

Before the uplift of the Andes, rivers flowed westward, toward the Pacific, but as the mountains rose, their courses changed and the waters began to flow eastward, toward an inland sea. The sediments eroded from the rising mountain range, carried by myriad streams and rivers, filled this inland sea, converting it into what are now the Amazonian lowlands, a tropical region stretching over 3,000 kilometers to the Atlantic coast of Brazil.

The rivers that now flow from the eastern Andes are the headwaters of the Amazon and together form the greatest river system on earth. The Amazon carries more water than any other river system, with an average discharge of 209,000 m^3/s, and it accounts for 20% of the freshwater entering the world´s oceans.

The Amazon is the longest river on the planet, and its most distant source is in the headwaters of the Mantaro River in Peru, some 7,067 kilometers from its mouth. Along with the main headwaters in the Andes of Colombia, Ecuador, Bolivia and Peru, waters flow north from the central plateau of Brazil and south from the Guyana shield of Venezuela, Guyana, Suriname and French Guiana. Its basin encompasses 7,050,000 square kilometers, approximately 40% of South America.

The most biodiverse protected area on earth

The tropical forests of the Amazonian lowlands — which hold biodiversity records for mammals, amphibians, reptiles, birds, fish, butterflies, beetles, dragonflies, trees and fungi, among others — form the most biodiverse area in the world. Similarly, the adjacent eastern slope of the Andes is the most biodiverse montane area.

Manu National Park is located where the Andes meet the Amazonian lowlands. It is the place where the high Andes end abruptly, dropping precipitously toward the expansive lowlands of the Amazon basin.

This privileged location, with an elevation range of 4,000 meters, encompasses the entire watershed of the Manu River, which extends from the high *puna* grasslands to the Amazonian lowlands. Few protected areas have been so well designed as to contain an entire watershed. This facilitates protection of the park, making access difficult and relatively easy to control.

The staggering richness of life in Manu is the result of its geographic location, which makes it home to species that are found in the high mountains, montane forest and lowland forest. Its forests and rivers shelter many species still unknown to science. In the first years of the new millennium, this allowed the discovery and scientific description of new species of birds, mammals, reptiles, amphibians, fish, butterflies, plants and dragonflies.

Because access to most of this area — especially the least-explored montane slopes and ridges — is so difficult, undoubtedly many taxa have yet to be discovered and described.

The Manu River is formed by the union of tiny streams that rise in the cloud forest and highlands and cascade down the eastern slope of the Andes, swelling at every junction to form the meandering river that defines the lowlands.

It is not a major tributary of the Amazon, into which its waters ultimately flow, but is one of several tributaries of the Madre de Dios River. Farther downstream, the Madre de Dios becomes the Madeira River, which flows through Bolivia and joins the Amazon in Brazil. The

Beginning in Cusco, the trip to the port of Atalaya, the jumping-off point for travelers to Manu, takes about 10 hours and reveals the full transition from the Andes to the Amazon.

Once the traveler arrives in the Manu lowlands, rivers and oxbow lakes define the travel routes and boats become the means of transport.

Manu River basin is a tiny part of the headwaters of the Amazon, encompassing just 0.2% of its catchment. Nevertheless, the Manu watershed is home to more different forms of life than all of North America and Europe combined.

Remote and wild, the park is part of one of the last wilderness territories still largely unchanged by human activities such as agriculture and resource extraction. Still largely free of roads and large human settlements, this area stretches from the eastern Andes of southeastern Peru toward the lowlands of western Brazil.

Besides Manu, other protected areas and indigenous territories are found in this area. They form a corridor of contiguous conservation areas with enormous biodiversity, which are home to indigenous peoples who live in small villages. These people have little or no contact with the outside world, using the forest as hunter gatherers and growing subsistence crops.

Access routes

There are three main routes to Manu National Park: 1) by land, from the city of Cusco; 2) by boat, along the Madre de Dios River to the village of Boca Manu; or 3) by light plane, to a small airstrip in the community of Diamante, near Boca Manu.

The land route — the traditional way of reaching Manu — has been used for trade since the time of the Incas and is traveled today by most visitors to the park. The traveler leaves Cusco, passes through the town of Paucartambo, and in less than four hours reaches Acjanaco, the first ranger station of the National Service of Natural Protected Areas (SERNANP) and the gateway to Manu.

In this high Andean area, a road branches off to Tres Cruces, an overlook where visitors can enjoy a sunrise spectacle that makes it appear as though the dawn is born in Amazonia, with the first rays of the sun. From the time of the Inca Empire until the 1920s, this was one of the entryways to the territory that is now part of the national park.

The route followed a road known as Trocha Unión. Travelers along this path — which began at 3,800 meters above sea level and was 16 kilometers long — passed through puna and montane forest ecosystems until they arrived at San Pedro (at 1,700 meters) and then, a bit farther along, at Chontachaca. From there, they could reach the valley of Kosñipata, known for its production of coca and sugarcane alcohol.

Another footpath to Manu began in Challabamba, in the Mapacho Valley, and led to Callanga, passing through the Qurqurpampa sector. In the 16th and 17th centuries, Spanish explorers followed this route for geographic expeditions, especially to search for Paititi. Legend has it that Paititi was a famous Inca city built entirely of gold and hidden deep in Amazonia. Years later, in the late 19th and early 20th centuries, the same paths were followed by many naturalists who conducted the first studies of the park´s flora and fauna.

Following the road, some 82 kilometers from Acjanaco, after about four more hours, the traveler reaches the town of Pilcopata, capital of the district of Kosñipata. Nowadays, the Kosñipata Valley shelters several towns, including Chontachaca, Patria, Asunción and Atalaya, which is also a port on the Alto Madre de Dios River. Although most local inhabitants raise tropical crops (mainly banana, pineapple, papaya and cassava) or livestock, some entrepreneurs have opened lodges and small hostels to serve tourists.

The port of Atalaya is just 12 kilometers from Pilcopata, making it possible to reach the Alto Madre de Dios River in less than 40 minutes. It is the first of several access points where colorful boats or canoes nestle against the river banks. Farther along the same road are other communities, including Shintuya, Santa Cruz, Shipetiari and Nuevo Edén, which also have river ports. In Santa Cruz, there is another SERNANP ranger station, while a national park office is located in Salvación, the capital of the province of Manu.

Travel by boat from the Alto Madre de Dios River to the community of Boca Manu takes between six and eight hours, depending on the season and the water level. From here, at the confluence of the Manu and Madre de Dios rivers, the traveler has access to the Manu River and the heart of the park.

This is not the only route to Boca Manu. It is also possible to travel up the Madre de Dios River from the community of Colorado, a journey of about five hours. Colorado is a small logging and mining town accessible by a rustic road. The journey takes about an hour from the Interoceanic Highway near Santa Rosa, which is three hours from Puerto Maldonado, the capital of the region of Madre de Dios.

Setting off up the Manu River, half an hour from Boca Manu, the traveler reaches the Limonal ranger station, the entry point where rangers welcome all visitors to this sector of the park. Four or five hours farther upstream, after passing the lodges and campsites of the tourism companies that operate in Manu, is Pakitza, the last ranger station in the park.

From there, access is limited to students and researchers, who can continue to the Cocha Cashu Biological Station, located two and a half hours from Pakitza. The only permanent human inhabitants are Matsiguenka people who live in the communities of Maizal and Tayakome, on the banks of the Manu River, and Cacaotal and Yomibato, along the Fierro River.

The majestic landscapes of Manu

Twelve hours of travel separate Acjanaco from Boca Manu. Along the way, travelers can revel in views of three sweeping landscapes: the *puna*, the montane forests and the Amazonian lowlands.

It is impressive to observe such a radical change in such a relatively short time and distance, from a cold environment with sparse vegetation at more than 4,000 meters to the warm, humid climate of the dense Amazonian forests. Each of these three landscapes is the sum of a complex transition of ecosystems along an elevation and climate gradient that is unique in Peru.

This translates into high biodiversity and countless endemic species. No other protected area in the country has this marvelous combination of three great natural landscapes, with their singular ecosystem mosaics.

The principal reason for this huge environmental variation is the rugged topography of the eastern flank of the Andes, with its many narrow ravines, deep canyons and steep slopes. As they descend, the slopes gradually become less pronounced, and tropical valleys appear, until the Andes meet the sweeping Amazonian lowlands.

Above 3,600 meters, the climatic conditions are more adverse and the topography is gentler, with broad, unforested areas known as *puna*. The vegetation is dominated by grasslands, particularly a type of grass the Andean villagers call *ichu*, which grows in scattered clumps and is well adapted to the cold climate.

Some parts of the *puna* are shrubland, and it is also possible to find small trees, such as the *queñua* (*Polylepis* spp.) and *chachacomo* (*Escallonia myrtiloides*). Above these plateaus, at 4,050 meters, towers the peak of Apu Kañahuay, the highest point in Manu National Park.

Descending, the montane forest gradually appears. Between 3,600 and 3,500 meters, the transition zone between the puna and the montane forest is the place where the humid

Andean bear experts from the FZS, on patrol to check camera traps in the high-Andean area near the Mapacho Valley.

forests of the rim or «eyebrow» of the jungle and the high jungle begin. The Incas gave the name *yunkas* or *yungas* to these dense cloud forests, with their rainy, humid climate, which descend to between 500 and 600 meters. Botanists such as Augusto Weberbauer, Felipe Marín Moreno and John Terborgh have described various vegetation zones in this area, although the change in vegetation actually occurs gradually.

The high part, between 3,500 and 2,500 meters, is the dwarf forest, characterized by shrubs and small trees that reach a height of no more than 15 meters, where Ericaceae, Asteraceae and orchids abound.

The cloud forest is slightly lower, between 2,500 and 1,300 meters. It is shrouded by day in dense clouds, which can produce rainfall exceeding 2,500 millimeters per year. The trees, which reach heights of more than 20 meters, are taller than those of the dwarf forest, and their trunks are hung with epiphytes, mosses and ferns, as well as orchids and bromeliads. Tree ferns also abound, and some areas are dominated by a bamboo species known as *Chusquea*.

The lower part of the *yungas*, extending from 1,300 to 500 or 600 meters, is the rain forest. Its vegetation includes trees that tower to heights of more than 30 meters, as well as palms and a lush understory. The climate in this forest is warm, with more than 5,000 millimeters of precipitation annually, making it the rainiest place in all of Manu.

The slopes in this area are moderate, which historically has made them suitable for agriculture, so the area, including the valleys of Kosñipata, Tono, Callanga and Piñi Piñi, is one of the most deforested in the park.

Fauna in the *yungas*, in the park´s upper reaches, is Andean, while tropical and sub-tropical species appear farther down the slopes, as the Amazonian influence becomes evident.

The meandering river

Below 500 meters lie the Amazonian lowlands, an expansive plain across which rivers meander like huge snakes. This landscape so impressed the Incas that they gave the name *Amaru-mayo* («snake river» in Quechua) to the river now known as the Alto Madre de Dios.

From the port of Atalaya to Boca Manu, the traveler gets a view of the real Amazonia, although it is even more evident to those journeying from the Manu River. The climate is warm and tropical, with an average temperature of 24°C. Although it rains less here than in the rain forest, precipitation exceeds 2,000 millimeters a year, with humidity exceeding 75%. The topography is rolling, with some plains, as well as many ravines and small hills that do not rise above 500 meters.

The vegetation can be divided into at least four layers: the understory, the middle layer, the canopy and emergent trees.

The understory consists mainly of shrubs, young trees, seedlings and herbaceous plants. This vegetation is adapted to a world with little light. The middle layer is made up of medium-size trees, including palms, with a height of 15 to 20 meters. Canopy trees are about 30 meters tall. Their crowns form the top level of the forest and receive the most light.

Above this level tower some giant trees that can reach more than 40 meters in height, such as the *kapok* or *lupuna* (*Ceiba pentandra*), *chihuahuaco* (*Dipteryx micranta*), and Brazil nut (*Bertholletia excela*). These species have buttress roots that support their colossal size.

The cloud forest just below the tree line is characterized by small, sturdy trees and an abundance of epiphytes, including bromeliads.

In many parts of Amazonia, just a few tree species predominate. Examples include the *aguajales*, palm swamps dominated by the *Mauritia flexuosa* palm, and bamboo thickets called *pacales*, which consist of bamboo species of the genus *Guadua*.

Amazonian forests are ever changing. One of their most notable features are their dynamic rivers, which constantly shift their courses because of the erosion that occurs at their meanders. While one side gradually loses forest, as the bank erodes and trees fall into the river, a new forest is born on the opposite side.

A sandy beach gradually forms, followed by a typical succession forest, mainly dominated by three species: wild cane (*Gynerium sagittatum*), *tessaria* (*Tessaria integrifolia*) and *cetícos* (*Cecropia* spp.). None reaches more than 20 meters in height. Little by little, this riverine vegetation gives way to mature forest.

The meandering rivers also create oxbow lakes, known locally as *cochas*, which form some of the most beautiful and spectacular landscapes in Amazonia.

Two such lakes stand out in Manu National Park — Cocha Cashu and Cocha Salvador. Many scientific studies of the park´s flora and fauna have been conducted in the former, while the latter, the largest in the Manu watershed, has become a tourist attraction. The *cochas* of Manu are home to animals such as the black caiman, the giant otter, and many bird species that frequent the vegetation along the river banks.

Like the plants, different Amazonian fauna species live at different levels in the forest. Many are found only in the canopy — macaws, toucans, monkeys and millions of arthropods have adapted to the upper reaches — while mixed flocks of birds and many amphibians, reptiles, spiders and insects inhabit the understory.

Tree diversity in Manu is very high, as much as five or 10 times that of temperate forests.

Trees in the tropical forest compete for light, sometimes towering to heights of more than 40 meters. Buttress roots stabilize the massive trunks.

Every corner of Manu National Park is different. It is a privilege to glimpse its many life forms, its plants, animals and microorganisms, each so different from the others and so fascinating because of the incredible adaptations that have evolved over thousands of years.

Manu is a living laboratory, a wonder of nature that beckons all to visit and discover it.

The hoatzin is a common sight around Manu's oxbow lakes. Its conspicuous appearance and raspy voice make it easy to detect.

It takes luck to see a rare sight like this, hundreds of white-lipped peccaries crossing the Manu River.

Numerous indigenous tribes inhabit the vast rain forests east of the Andes.

History of Manu National Park: The first two decades

Marc Dourojeanni

Like any other significant human endeavor, protected areas are the fruits of the efforts of many hands and minds. Any attempt to simplify their history tends to be unjust. Manu National Park is a case in point, as many people participated in the process leading to its establishment.

While creating it was a long, arduous process that took nine years, from 1964 to 1973, maintaining, improving and defending the park is a daily battle for rangers, government officials, scientists, journalists and society as a whole.

The first Manu

Manu historically has been the territory of many different Amazonian peoples. The valley was inhabited by various Andean peoples, probably including the Incas. Recent groups include the Matsiguenka, whose presence is largely due to the Summer Institute of Linguistics (SIL), which helped a group from the Upper Urubamba settle in the 1950s in the area that is now the village of Tayakome.

Many non-indigenous people also knew of the area. The first appears to have been Pedro Álvarez Maldonado, a Spaniard who, traversing the Madre de Dios watershed between 1567 and 1569, gave the river the name Manu.

Many other explorers, including some missionaries, also passed through the valley before Carlos Fermín Fitzcarrald, traveling down the Manu River with his crew, forcibly transported his boat between the Urubamba and Madre de Dios river valleys in 1893. The valley later was the scene of intensive extraction of rubber, a resource that would be exhausted by about 1912.

The first Dominican mission in Manu was established in 1908. Beginning in the 1950s, SIL missionaries visited the settlement periodically to proselytize and to obtain the meat and pelts of wild animals, whose hunting they encouraged by providing firearms and ammunition to the natives. By that time, logging was also under way in the lower part of the Manu River.

Several loggers operated in the area, along with two small sawmills that mainly processed cedar. The wood was transported by plane from Puerto Maldonado to Lima. Several commercial hunters who traded in pelts and leather also operated in the valley. A notable one was Celestino Kalinowski, a taxidermist who provided specimens to zoos and museums. During the 1960s, the Shell Oil Company also explored for oil in Manu.

In 1959, a study by the Southern Peru Regional Development Project mentioned the Lower Manu Valley as a promising area for colonization. It also proposed the creation of a national forest. As a result, the 3,000-square-kilometer Manu National Forest was established by Supreme Resolution Nº 442-AG in October 1963.

In 1964, the National Office of Natural Resources Assessment did an evaluation of Manu´s natural resources. Although its designation as a national forest slowed the logging and led to the dismantling of the sawmills, both hunting and logging continued.

The Manu Reserve

Also in 1964, the FAO/UNDP-Peru Forest Project Nº 116 began, with the goal of making forestry development and planning more professional. Besides implementing the recently created School of Forestry Sciences at La Molina National Agrarian University (UNALM), its objectives included the establishment of a Forestry Research Institute consisting of the Forestry and Hunting Service and the university. International experts involved in the project included a Belgian, Paul V. Pierret, who coordinated efforts related to protected areas and wildlife management. Pierret had experience in the management of protected areas and wildlife management in Africa and Cambodia.

I was professor of forest entomology at the time and was assigned to be Pierret´s partner. We worked on studies of fauna and human food, vicuñas, and courses for park rangers, as well as the planning of protected areas. In 1965, I was named to head the institute´s Protection and Conservation Department and began to coordinate the work of Pierret and other experts from the FAO Project (including Rudolf Hofmann and Kai Otte) and other agencies (Ian Grimwood), as well as that of recently recruited professors who gradually joined the institute (Renán García, Augusto Tovar).

At the time, Peru had only one national park, Cutervo National Park, which was established in 1961 to protect a cave that had a population of oilbirds. The creation of this first park was the initiative of Salomón Vílchez, a Peruvian congressman who promoted and won approval of the law that established it. Later, in 1965, Congress created another park, in Tingo María, to protect another cave that housed another population of the same bird.

In the Amazon, the human population density is among the lowest on the planet. Wilderness prevails, and the ecosystems are not shaped by humans.

This was unprecedented. Despite Peru´s enormous biological and ecological diversity, its only two parks were designed to protect the same species. Moreover, the protected areas were not large enough and did not have well-defined boundaries. The areas had been proposed by people who had good intentions but lacked scientific knowledge.

As soon as he arrived in Peru, Pierret wrote of the need for a system of protected areas that would be representative of each natural region and the different ecological niches on the Andean slopes of the three major watersheds. Thanks to the National Committee for the Protection of Nature, which was established in the mid-1940s and consisted of renowned academics, proposals for more parks in Peru began to circulate.

In 1963, Flavio Bazán was head of the Forest Service and the national director of the FAO project. It was his job to identify promising protected areas, and his first recommendation to Pierret was to include Manu as an area of interest for a national park in the jungle. Bazán saw Manu as «the ideal place» for a national park. Slightly more than two years later, in April 1965, the taxidermist Kalinowski sent a letter to Felipe Benavides, president of the Board of Trustees of National and Zonal Parks, expressing concern about the growth of predatory hunting in Manu. The parks board was responsible for supporting the creation of the Parque de Las Leyendas, the Lima zoo to which Kalinowski provided specimens under permits granted by the Forest Service.

Based on those ideas, Pierret and I prepared an initial plan to establish or improve protected areas in various parts of the country: Paracas and Lachay, on the coast; Huascarán, Pampa Galeras and Titicaca, in the highlands; and Cutervo, Tingo María, Pacaya-Samiria and Manu, in Amazonia. Other, smaller areas were also included.

In June 1965, the British expert Ian Grimwood arrived in Peru to provide assistance with matters related to wildlife and protected areas. On our recommendation and that of Bazán, Grimwood visited Manu in April 1967, accompanied by the forestry technician Juan Touiller.

With this visit, Grimwood became the first conservationist to visit Manu. Not only was he fascinated by the area, but he also considered it the best place for a large Amazonian park. He outlined a proposal for borders that would encompass an area of 12,300 square kilometers. The existence of logging contracts as far as the Panahua River, however, led him to exclude the lower part of the Manu River.

A few months after that visit, Pierret reached Manu, accompanied by Carlos Ponce del Prado, who had begun working in the Forest Service´s Wildlife Department in 1967. One of his goals was to seek places to establish ranger stations. With the consensus of Grimwood, Pierret and Ponce about the importance of the area, Bazán authorized construction of the stations which, although informal, was crucial for creation of the national park.

Between 1967 and 1973, many events enabled those involved to gain greater knowledge of the area, confirm its value and protect it more efficiently. Besides additional sources of funding, Pierret won the support and commitment of the World Wildlife Fund (WWF) — whose vice president, Lukas Hoffmann, had visited Manu in 1967 — to build the first ranger stations.

By 1968, when the reserve had two boats, Pierret and Rudolf had identified Cocha Cashu as the best place for scientific research. The next year, thanks to a donation from the Frankfurt Zoological Society, Hoffmann, along with UNALM students Manuel Ríos and Jimmy Evans, built the Cocha Cashu Biological Station. Carlos Linares, who would become the first head of the reserve, also participated in this work.

Although there was no reason not to change the status of Manu National Forest and expand its area in order to establish a national park, doing so was extremely difficult. Peruvian President Fernando Belaunde opposed the idea because he had decided to promote the Marginal Highway, a longitudinal road along the bank of the Manu River, to encourage the settlement of the area.

It took pressure from the International Union for the Conservation of Nature (IUCN), the WWF, The Nature Conservancy (TNC) and many other organizations, as well as various national and international figures, including Jean Paul Harroy and Gerardo Budowski of the IUCN, for Belaunde to reconsider his position. Harroy even managed to speak with him personally in an effort to gain his acceptance of the proposal for the reserve that had been prepared by the Forestry and Hunting Service based on the studies by Pierret, Hofmann and Ponce. Despite all the efforts, however, Belaunde did not approve.

It was Orlando Olcese, a former UNALM rector, who would finally win approval for Supreme Resolution N° 005-1968-AG of 7 March 1968, which established the Manu Reserve. Olcese convinced Belaunde that his refusal was doing political harm to his administration, and shortly thereafter came the military coup by Juan Velasco Alvarado, which ousted Bazán from his post and turned the Forest Service into an office in the Ministry of Agriculture. A decade later, however, in his second term as President of Peru, Belaunde did everything in his power to eliminate the national park.

The establishment of the reserve was just the first step. At the urging of the Forest and Hunting Service, with Supreme Decree N° 322-AG of 1968, the Ministry of Agriculture created a National Council for the Conservation of Renewable Natural Resources. One of its responsibilities was to decide the fate of Manu. The council disappeared with the change of government, and Supreme Decree N° 338-1970-AG was approved in 1970 at the urging of the General Office of Forestry and Wildlife, headed by Eduardo Izquierdo. This decree created an interdisciplinary commission to define the boundaries of the park.

Despite these efforts, delays continued. The responsibility for ensuring that the boundaries of the future park were defined fell mainly to Carlos Ponce — who was not yet head of the corresponding area of the General Office — and to UNALM professors, one of whom was Manuel Ríos.

In 1969, Carlos Linares was named head of the reserve. He was soon succeeded by Bruno Sanguinetti. That same year, Kai Otte arrived in Peru, also as an expert affiliated with the FAO. Because he was very interested in the biology of the black caiman, Otte was able to obtain funding from the Frankfurt Zoological Society, and once his FAO commitment ended, he decided to work at Cocha Cashu with the help of ranger Jorge Cárdenas. This contribution from the Frankfurt Zoological Society made possible the first scientific research in Manu.

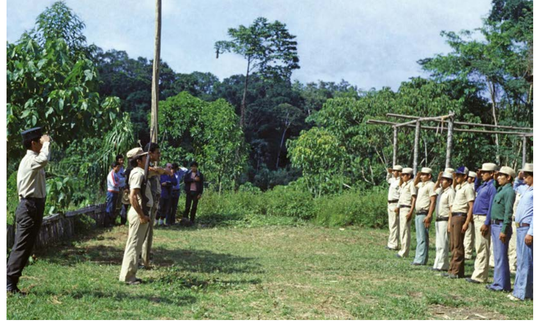
An anthropological expedition was conducted in late 1969, under the direction of Marcel d´Ans, a Belgian working at the National University of San Marcos. Other activities were led by Ponce, Hofmann and other professionals from UNALM and the General Forestry Office who traveled to Manu on various occasions, exploring the region, delivering supplies or inspecting the progress of various works.

Creation of the national park and its first decade of existence

Upon my return from Belgium, after earning my doctorate in 1971, I resumed my post at UNALM. At the request of the Ministry of Agriculture, and with the participation of other colleagues, I prepared a description of the proposal for the park.

After it was approved by the interdisciplinary commission, the minister of agriculture presented it to President Velasco. On 29 May 1973, the president signed Supreme Decree N° 644-AG, which declared the establishment of «Great Manu National Park» encompassing 15,328.06 square kilometers. Three months later, I became director general of forestry and

Jesús Queme has dedicated his life to Manu. He started working as a ranger 25 years ago at the former Romero ranger station (left) and still greets visitors today at the Limonal ranger station (right).



The first rangers were sworn in after Manu National Park was established in 1973. The seven ranger stations are still quite simple and functional.

hunting and named Carlos Ponce to be director of conservation. Antonio Brack, who had recently arrived from Germany, was appointed assistant director of wildlife.

With this team, we focused on the national parks, especially Manu. Thanks to this team, Manu had its own budget and more technical staff and rangers between 1973 and 1980. During that period, Adolfo Cuentas and Washington Galiano were in charge of the park.

Under Cuentas´ management, the administrative office was built at Pakitza and the ranger stations at Acjanaco, Tono, Pinquén and Palotoa were constructed. Strict control over entry into the park was also established at Boca Manu. The first inspection of the western boundary to Nuevo Oriente and the Fitzcarrald isthmus was also conducted. The loggers who still resisted leaving the old Manu National Forest also were finally evicted.

The most important milestone in those seven years was the beginning of the collaboration between the General Office of Forestry and Hunting and the already famous ecologist John Terborgh, through an agreement with Princeton University. Thus began the saga of Cocha Cashu, with a parade of great scientists who gradually revealed the natural history of Manu.

In 1976, Peru nominated Manu for designation as a biosphere reserve. On 1 March 1977, UNESCO declared Manu and a neighboring area of settlements the world´s sixth biosphere reserve.

In 1980, with Luis Cueto as director general, the 2,570-square-kilometer reserved zone was created by Supreme Resolution N° 151-80-AA-DGFF. It was later increased to 2,602.4 square kilometers by Directoral Resolution N° 131-99-MA-DRA-MD. In 2002, the size of Manu National Park was finally redefined by Supreme Decree N° 045-2002-AG, including a large part of the reserved zone. With this modification, it encompassed 17,162.95 square kilometers. Under the new protected areas law, a buffer zone was also created.

In 1980, the Regional Development Body proposed establishing a rural ranching settlement in 1,200 square kilometers of Manu National Park, an effort rejected by the national government.

The difficult decade of the 1980s

The return of Fernando Belaunde to the presidency of Peru raised new difficulties for Manu. His administration made various changes in public management that did nothing to help the country´s natural protected areas. Despite the good intentions of nearly all the directors general of forestry under the Belaunde administration and, subsequently, that of President Alan García, the available public budget shrank until it was so limited that there was reason to fear for the future of all the country´s reserves and national parks.

That situation was eased with resources from international non-governmental organizations such as the WWF and TNC, which, around 1983, promoted the creation of partner organizations in Peru to manage the donated funds. This began with the formation of the Support Committee for Conservation Projects, which sought to channel funds, mainly for Manu, and of which I was president.

Unfortunately, it did not work, and was succeeded by the creation of the two oldest environmental organizations in Peru, the Peruvian Association for the Conservation of Nature (APECO), founded in 1983, and the Peruvian Foundation for the Conservation of Nature (Pronaturaleza), established in 1984. The two organizations worked intensively in Manu during the 1980s. The former was oriented more toward education, and the latter toward management.

Because of the Peruvian government´s virtual abandonment of the park, Pronaturaleza periodically managed all logistics and ranger staff in Manu. The organization was founded by people who were involved with Manu — Carlos Ponce, Manuel Ríos and myself — and I was also its first president. Those were difficult times, and the work of the foundation´s executive director, Gustavo Suárez de Freitas, was crucial.

Although the grants from WWF were essential, there were also other sources of funding. According to calculations by Pronaturaleza, presented in 2004, 11 grants for Manu were managed between 1984 and 1994. In the 1990s, the government gradually resumed responsibility for protected areas and implemented the National Fund for Protected Areas of Peru. This reduced, but did not completely eliminate, the role of Pronaturaleza.

The most serious problems for Manu in the 1980s came from the Peruvian government itself. It was President Belaunde who insisted on building the Marginal Highway to «conquer» that region. He also ordered the National Navigation and Port Company to study the possibility of connecting the Ucayali and Madre de Dios basins by building a canal to facilitate navigation.

In 1983, Belaunde made the first official announcement of the so-called «Fitzcarrald route» between the Serjali and Cashpajali rivers. Not only was his intention reiterated on various occasions, but it was announced that the president himself would travel the route aboard the Peruvian Navy ship Stiglich. Both this announcement and his praise for the rubber baron Fitzcarrald drew immediate criticism from the press and the public. Nevertheless, Belaunde accompanied the expedition to the isthmus. This, however, led to a serious incident in which Segundo Brito, one of the members of the group charged with clearing a path, was wounded by an arrow shot by a group of indigenous Mashco Piro. The armed reaction to this event involved the use of helicopters and the deployment of Navy and Air Force troops, who apparently were responsible for the deaths of two Mashco Piro. This episode, which occurred during the second week of January 1984, was widely questioned in the national press.

As a result of Belaunde´s proposal, a group called the Committee for the Defense of Manu National Park, headed by Gustavo Ruiz, formed around APECO. Its main concern was not the waterway connection, but the Marginal Highway, which the president continued to promote after the failure of his naval expedition.

The IUCN was also involved in the issue; its president, Mohamed Kassas, wrote to Belaunde expressing the environmental community´s concern about the matter and offering assistance in finding alternatives to the project. That would not be the only letter the Peruvian government received from abroad. Others were sent to the Ministry of Agriculture, Congress and various government officials. By late 1984, it appeared that the Marginal Highway had been forgotten. But the project was never shelved, and it remains on the official map of the Ministry of Transportation and Communications under the name «PE5S».

During this decade, Oscar Paredes, Adolfo Cuentas, Luis Angel Yallico and Modesto Challco were directors of Manu National Park. Cuentas, who served three times for a total of 11 years, and Challco, who served twice for a total of six years, are the park directors who served the longest in Manu´s history. Many of the significant works and actions benefiting the park were achieved thanks to the perseverance and courage of these two managers. Both balanced their time between the park, Cusco and Puerto Maldonado, facing all kinds of hazards and setbacks because of the lack of resources and bureaucratic hurdles.

The first management plan for the park, which was prepared by UNALM, was approved in 1986. The first management committee was also created that year, and the union of Manu park rangers was founded. In 1987, the park was recognized by UNESCO as a World Heritage Site. During that period, Abel Muñiz, a long-time Ministry of Agriculture official and an influential local figure, took on the task of defending the park at the local and regional levels.

Although there has been tourism in Manu National Park since the late 1970s, it became truly developed in the decades that followed. It was promoted by visionary entrepreneurs who did a great deal to develop it, but who sometimes appeared to be more concerned about their businesses than about the preservation of the natural heritage that was the very reason for their existence.

And that is how matters stood when the 1990s began.

Although the number of tourists began to increase in the mid-1990s, only about 2,500 visit Manu National Park each year, showing that it is still a niche destination for adventurous travelers who are especially interested in flora and fauna.

As time goes by

Christof Schenck

The 1990s got off to a stormy start. Alberto Fujimori won the presidential election, inflation skyrocketed and the conflict between the Peruvian government and the subversive group known as the Shining Path became increasingly violent. But even as fear and terror spread throughout the country, Manu National Park slept peacefully; far from urban centers, sparsely populated and of no strategic importance, it was isolated from the insecurity and brutality that reigned in Peru. It was overseen by a handful of park rangers whose main task was to control access to the park.

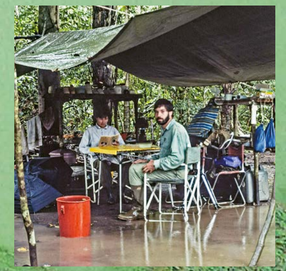
At the Cocha Cashu Biological Station, the research team led by John Terborgh was trying to decipher the endless mysteries of the jungle. Charles Munn, one of Professor Terborgh´s former students, had made the oxbow lake called Cocha Totora his base and was devoting himself to studying macaws for the development of tourism.

In 1986, Edward O. Wilson published his book *Biodiversity,* shining a spotlight on a concept that took its name from the words «biological» and «diversity», which society gradually adopted to describe life on earth, with its wide array of genera, species and ecosystems. In 1992, the focus on biodiversity conservation received a significant boost when the Convention on Biological Diversity was introduced during the legendary Earth Summit in Rio de Janeiro. Today, 186 countries, including Peru, have committed to abide by it.

By that time, Manu National Park was already known among experts because of its wealth of species, but almost no Peruvian government representative imagined that a protected area 3,000 kilometers northwest of the place where the Earth Summit was held was home to the most diverse treasury of species on the planet.

Flagship research in Manu

The German biologist Elke Staib and I traveled in the national park in 1985, encountering the extremely rare giant otter, also known as the river wolf. In 1990, the Frankfurt Zoological Society gave us a grant for the study and protection of the giant otters. This marked the return of the Frankfurt Zoological Society — in cooperation with the Munich Wildlife Society — to its early center of activities. During the years that followed, a small team was dedicated to the giant otter project in the Madre de Dios region, with a special focus on the Manu National Park.



Mapping lakes and building observation towers for low-impact tourism were part of the comprehensive giant otter program, which started in 1990. The team consisted of biologists Elke Staib and Christof Schenck and field assistant Jesús Huaman. Yaminahua indigenous people sometimes visited their camp.

Thanks to this work, giant otters were counted systematically for the first time, their preferred habitat and social behaviors were analyzed, and threats to their survival identified. From the start, the scientific discoveries were reported quickly to the park management and authorities so appropriate decisions could be made and measures taken. The authorities in charge appreciated the data and were happy to use it for their management decisions.

Spatial analysis soon showed that oxbow lakes are crucially important for giant otters because they have no current, water level fluctuations are minimal, and their many nutrients make them rich in fish. The larger the lakes, or the closer together, the better for the otters.

The main river plays an important role here as a «pathway» for aquatic animals. But there was a problem: the Romero refuge — which essentially functioned as a ranger station — had been built some 20 kilometers from the mouth of the Manu River, leaving a significant stretch of the river unpatrolled. This problem was made clear by the illegal logging taking place near the river.

On the scientists´ recommendation, the park managers decided to move the ranger station downriver to its current site at Limonal, which dramatically improved the protection of one of the most important stretches of the river. Besides this significant initiative, and with the addition to the park of nearly 2,000 square kilometers of the Reserved Zone that had been under temporary protection, people began to realize the great importance of the lower part of Manu.

Biological studies of the behavior and population of the giant otters posed additional challenges. Although these diurnal otters are so curious that they approach boats, they are also highly sensitive and easily disturbed. Take, for example, the case of the slow increase in tourism operations, which not only brought more canoes to cochas Salvador, Otorongo and Juárez, but also led to the inclusion of more oxbow lakes in the tours.

The endangered giant otter is Manu´s flagship species. Playful and vocal, the otters live in family groups and are active during the day.

The impact of these changes on the giant otters was unexpected. For four years in a row, we noted that the otters in Cocha Salvador raised no offspring. Research on otters in captivity had shown that the female´s milk dries up under stress, and Salvador was the lake most visited by tourists. Because it is the Manu River´s largest oxbow, it was also home to the largest group of otters.

A computer model used to determine the probability of long-term survival of the park´s population concluded that in fact all the giant otters were threatened with extinction, and the population was barely holding its own. With no cubs in one or more of the large, important groups, the population was decreasing and the likelihood of new groups forming was minimal. The consequence was a downward trend that created a negative feedback loop: the number of offspring in a single oxbow lake impacted the overall survival of otters along the river and in oxbow lakes for hundreds of kilometers.

These results convinced the park administration to take a number of steps to avoid disturbance of the otters. First, the boats in Cocha Otorongo were removed, and the lake was closed to boat traffic. Instead, in 1993, the Frankfurt Zoological Society built the first observation tower in the region on the edge of the lake.

Second, a single catamaran was permitted in Cocha Salvador, operating under the supervision of the park administration. Refuge areas were established where boat traffic was prohibited. In the other lakes, except Juárez and Cashu, boats were no longer allowed. Some tour operators still took canoes to the lakes illegally, however, and park rangers were forced to spend the season camped out at Cocha Salvador to maintain order.

Finally, training courses were provided to tour operators and tour guides, codes of conduct were established, and brochures and flyers were printed.

Coloring books, puppet shows, festivals and field visits are part of the giant otter education program. The program has reached approximately 20,000 children in the past two decades.

The success of the operation was impressive. Almost immediately, new cubs appeared, the family of giant otters in Salvador became accustomed to this modified tourism, and the possibility of observing the animals increased significantly.

In Manu National Park, this was a clear demonstration of how applied research, advice and courageous decision making, in coordination with the responsible authorities, can contribute significantly to the protection of the commons.

The island that is no more

Other issues in Manu were resolved less successfully. Distemper and parvovirus infections were detected in dogs in indigenous communities. Although these diseases are known to pose a danger to wild animals, no ongoing vaccination program was established in the region.

More ominously, as part of the giant otter program, levels of mercury in fish were examined for the first time. The analyses were not favorable. By then, gold mining from river sediments, using mercury, had increased hundreds of kilometers away from the park. The first results from samples that included fish from the Manu National Park were published in 1994, and high mercury levels were found, especially in large catfish.

Apparently the harmful heavy metal accumulates in these fish, which transport it long distances to the intact wildlife in the park. Because this vague threat was far from Manu, however, no one paid attention. Nor would it have been possible to address it because the park administration has no control over what occurs outside of the protected areas.

In the decades that followed, gold mining in southeastern Peru expanded uncontrollably, driven by the increase in international gold prices as well as the paving of the Interoceanic Highway. As with the rubber boom, global trends shaped events in the region, but this time the catastrophe was greater: hundreds of square kilometers of primary forest became a toxic wasteland, and a health emergency was declared in Madre de Dios. These toxic deposits will remain in the soil, water and organisms for thousands of years. At this point, it is unclear whether the alluvial plains will ever regenerate. Nevertheless, over these many years, illegal gold miners failed to enter the national park, not only because of its remote location, but also because park authorities controlled it well enough to keep them out. The very few miners who tried to enter from the north were evicted immediately.

Working together for the greater good

In the years that followed, the Frankfurt Zoological Society increased its activities and its cooperation with the National Service of Natural Protected Areas (SERNANP). Some «special expeditions» to less-accessible areas near the edges of the park were undertaken. Field staff from the two organizations slogged through mud, steady rain and swarms of mosquitoes to reach the most remote, unexplored corners of the park.

Based on satellite data and overflights, they also documented the expansion of settlements on the edges of Manu and inside the park. Added to the training of park rangers, which was already part of the program, was the construction or renovation of the ranger stations and better maintenance of infrastructure.

An FZS-designed environmental education program featuring Pepe, a cartoon giant otter, was another resounding success. In 1994, coloring books for children telling the story of Pepe and his otter family were printed and distributed along with colored pencils. Today there are games, festivals, excursions, seminars, initiatives for school children, posters, giant otter counts coordinated with scientists, and even Facebook groups with Pepe as their theme. The books about the giant otter were translated into native

languages, were also distributed in countries such as Ecuador and Brazil, and even reached zoos in the United States.

Because of Pepe, the giant otter became a flagship species — an emblem of pride for the park — and because of the enormous success of the project, more books and similar programs were subsequently created for spectacled bears, tortoises, macaws and other animals. These campaigns were based on the slogan «people will only protect what they know». Over time, the giant otter of Manu National Park became one of the best-known species in the region, symbolizing an intact forest that is worth protecting and enchanting thousands of children and parents.

Major projects in Manu

Contrary to what might be expected for this treasure trove of biodiversity, Manu was not the beneficiary of major international support. Except for a series of small programs of limited duration by different organizations, only three significant initiatives stand out:

BIOLAT (Biodiversity in Latin America)

In 1986, the U.S. Congress agreed to promote exhaustive research into biodiversity. This was a visionary decision. The politicians understood that this was not just a matter of nation states, but of a common planet: in particular, wealthy western nations had to become involved in the study and protection of the earth.

BIOLAT had five components: (i) a scientific inventory of all living creatures; (ii) immediate processing of the data obtained; (iii) development of infrastructure for species inventories and monitoring, as well as the training of young national trainees; (iv) development of biodiversity networks; and (v) presentation of results to society and public officials.

In the 1990s, this program allowed the Pakitza ranger station, in the heart of Manu, to become a research and training center of the Smithsonian Institution. For many years, BIOLAT boats traversed the Manu, carrying scientists, students and supplies to Pakitza. Their pioneering studies of the diversity of species of beetles and other insects, as well as life in the forest canopy, increased the number of known species in the world by at least a power of 10.

Many Peruvian scientists began their careers at Pakitza and many program goals were achieved, but it was impossible to establish a permanent monitoring and inventorying program. Only many years later, in 2010, was Cocha Cashu included in the Tropical Ecology Assessment and Monitoring Network.

Like many parks, Manu still lacks an extensive monitoring program for collecting, analyzing and disseminating data. Such a program would make it possible to monitor populations of certain key species — at least from among birds, mammals, fish, amphibians and reptiles — and record climate data, including water levels. It would also make it possible to determine forest coverage and track both the development of the local populations and tourism statistics.

ProManu

The largest park development program so far resulted from cooperation between the Peruvian government and the European Union in 1998, with a grant of several million dollars over six years.

This program also consisted of five areas: (i) strengthening of Manu National Park through expansion of surveillance and environmental monitoring; (ii) creation of regulations for sustainable use in the area around the park; (iii) control of migration and regulation of

Ranger station sign from 1992, showing the park´s size before its expansion 20 years later.

land-use rights; (iv) improvement of the quality of life of the park´s neighbors; and (v) strengthening of the administration of protected areas managed by the National Institute of Natural Resources (INRENA).

Large scale programs as ProManu face enormous challenges, especially when they focus on regions that received little attention in the past. Because the initial stages are long and the final ones are short, projects sometimes cannot be finalized or achieve sustainable impacts.

ProBosque Manu

In 2013, collaboration began between the Frankfurt Zoological Society and SERNANP for the protection of forests and management of natural resources in the Manu Biosphere Reserve. The German government´s International Climate Initiative granted two million euros for projects over a five-year period. This initiative had begun in 2008, when the conference of the Convention on Biological Diversity was held in Germany and Chancellor Angela Merkel pledged significant funding for climate and biodiversity protection. Along with the conservation of genera, species and ecosystems, protection of the global climate became a major task for our generation.

Besides the development of tourism and sustainable use in Manu, the ProBosque project addresses a number of other problems and challenges, including long-standing pasture rights in the fragile high Andean grasslands, wildfires caused by small farmers, conflicts with threatened Andean bears, the community of Callanga in the Andean part of the park, and the growing indigenous population, with its development needs, in the park´s lowlands.

This project will end in 2018, and it will be up to the Frankfurt Zoological Society and SERNANP to maintain its important components, find new sources of funding and ensure that the significant progress that has been made is not lost.

If one thing is clear from the experience of projects in Manu, it is that two challenges are the most complex: the relatively short duration of projects and the lack of sufficient ongoing baseline funding.

Welcome to the park

Manu National Park slowly became a destination for foreign visitors in the 1990s. Whereas relatively few visitors arrived in the early years, the growing number of tourists — especially young backpackers — created a market niche for specialized travel agencies. Two of the pioneers were Expediciones Manu and Manu Nature Tours, which later won the concession to build Manu Lodge, which opened on Cocha Juárez in 1988.

In 1996, the park suffered a tragedy when an American tourist disappeared after a swim in Cocha Juárez. His body was later found with signs of a black caiman attack. It was impossible to confirm that the caiman was the cause of death, but people had been feeding caimans in Juárez and they had become bolder and more dangerous. The lesson was clear: wild animals should not be tamed, especially in a national park.

For many years, tours to Manu were purely camping trips. The tourism season was very short — during the dry season between May and October — and visitors tended to be traveling on the cheap. Added to this were the high cost of transportation and adverse conditions in the jungle. Manu is not the Serengeti. Although there are more species than in the African savannah, most are small, timid, nocturnal. Even if a species is active during the day, it would be difficult to observe it because of the dense vegetation.

As in other places, the relationship between the park administration and travel agencies was not always ideal. Concession payments and entrance fees were unpopular among tour operators, who saw themselves as promoters of Manu, and the park administration had to enforce park regulations. As a result, the park administration has been the target of various lawsuits.

What is happening in Manu, however, is not very different from other parks around the world. Many tour companies do not recognize that their business depends on the use of the commons, and that this implies a basic responsibility. Ecological tourism depends on people´s love of nature and is therefore an important ally in environmental protection. Nature tourism should contribute to the conservation of its economic base, if only out of self-interest.

Although the number of tourists has fluctuated, it has always been relatively low. Manu used to receive in a year the number of people who visited Machupicchu in a single day. There has been a gradual increase, however. In 1990, there were 811 visitors, a figure that rose to 2,807 in 2000, and slightly more, to 3,544, in 2015.

Tourism development has been greater around the park than within its boundaries. From the cloud forest to the lowlands, new lodges sprang up in the buffer zones outside of the park. In 2017, there were 35 lodges on the route from the Andes and along the banks of the Madre de Dios River. Depending on the location, some offered much shorter tours from the tourism magnet that is Cusco.

The region around Puerto Maldonado developed even more because it was easier to arrive by air or road. Tourist numbers there increased substantially. The Tambopata National Reserve, south of the provincial capital, saw more than 50,000 visitors in 2016. For a time, charter flights were available to Boca Manu, shortening travel time to Manu National Park. Costs were high, however, especially if the plane was not full. In most cases, the only way to visit Manu was to travel by land for several days — a spectacular route, but also the longest and most hazardous.

Accidents, in fact, were frequent. Trucks that plunged off cliffs mainly affected local residents, who were forced to use them because buses did not travel that route at the time. There were also air tragedies. In the summer of 1992, a charter plane heading for Boca Manu crashed in the upper part of the Madre de Dios River with no survivors; the pilot and two young tour guides, one from England and one from Peru, died in the crash. Flights were suspended, and despite sporadic attempts, the air route was never restored.

Some years later, a new episode involving planes drew attention to the area because of a landing strip in Diamante, near the mouth of the Manu. Apparently a Colombian drug cartel had learned that larger planes could land on the remote air strip, which originally was built for oil and gas exploration. They ordered some residents of Diamante to rehabilitate and maintain it. While tourist flights landed on it by day, by night it belonged to the drug traffickers. For months, the roar of plane engines could be heard from deep inside the park.

In 1994, a large-scale military operation was conducted in this area. Most of the Colombian drug traffickers vanished when the military troops arrived, and the people who paid with long prison sentences for this lucrative — and sometimes forced — labor were mainly residents of Boca Manu and Diamante.

Low tourism numbers were not the only challenge to the Cusco-Manu air route. It was also technically difficult because of the large amount of precipitation and because it required crossing the Andes. Another attempt, with Russian biplanes, also failed, and it was not until 2016 that flights from Puerto Maldonado to Diamante and Pilcopata were renewed, but even those efforts were not successful.

Tourism in Manu: blessing and curse

Besides the small number of visitors, partly because of its difficult access, tourism in Manu National Park is very limited in time and extent. The dry season — which is also the tourist

A lodge run by local Matsiguenka people was the first effort to enable Manu´s inhabitants to benefit economically from the park. Nevertheless, the lodge is not free of controversy.

season — is just half the year, and tourists visit only one percent of the total area of the park, concentrating on the area near the Manu River and a few oxbow lakes.

This area, however, is the heart of the park. Alluvial plains, sand banks, lakes and flooded forests are among the most dynamic habitats in the tropical forest. Some species, such as giant otters, caimans, freshwater turtles, fish and many species of birds, are dependent on them.

Despite mosquitoes, heat, snakes, and ants that tunnel through tent floors, sandy beaches have always been the favorite campsites for tourists and researchers during the dry season. The growing number of campers, however, became a problem over time. When more than 50 tents covered much of the beach beside Cocha Salvador, one could imagine being in central Europe instead of one of the most pristine jungles. A notable problem was the lack of sanitation infrastructure, and forest paths quickly turned into muddy tracks with little vegetation.

It is helpful to remember that campers were not the only occupants of the beach. For turtles and birds that nest in the sand, the beach is a vital place: the higher and larger it is, the more important it is for them. Walking or camping on beaches destroys nests and eggs and frightens birds away.

In addressing this problem, the park administration revealed how seriously it took its mandate to protect the park and its prudence in adapting regulations to the growing number of tourists. As more and more people were attracted by the jungle, that idyllic camping on sandy beaches ended. Tour operators were assigned individual places in the forest and were given other responsibilities, such as the construction of sanitation facilities. Over time, under the watchful eye of park managers, some of those campsites expanded to become lodges.

Matsiguenka hotel keepers

In 1999, a tourism initiative of the German government, implemented by what was then the German Technical Cooperation Agency GIZ, led to the creation of the Casa Matsiguenka, a rustic lodge near Cocha Salvador. Tourism operators received funding for basic equipment for camps, and the lodge was given to the indigenous Matsiguenka communities living in the park.

The idea was that the Matsiguenka — who were not allowed to use shotguns for hunting, nets for fishing or chainsaws to fell trees — would be able to benefit economically from Manu for the first time.

With the Casa Matsiguenka, however, some significant risks emerged. In the lodge, the Matsiguenka were exposed to viruses and bacteria from around the world. Although many were pathogens that were fairly harmless to foreigners, the immune systems of the relatively isolated tribes were unprepared to resist them.

To make matters worse, the local health service did not function well. The lodge´s system of shifts and staff turnover also meant that germs were frequently transported to communities, which were otherwise protected from tourism. At the time, Tayakome and Yomibato were relatively egalitarian societies, but the lodge catapulted them into the modern cash economy. With their high-tech clothing, flashlights, cameras and smartphones, tourists awakened new needs in these ancient, natural communities.

The Matsiguenka also had to adapt their lifestyle and diet to the demands of the tourist trade. Hunting does not mix well with nature tourism, for example, because mammals and birds become shy and hard to spot. Without «corner stores», it is difficult to take care of staff and visitors, and people do not become tourism operators, cooks or guides overnight and without training.

The Matsiguenka still depend mainly on fishing and hunting, with only small-scale agriculture. Their skill in fashioning precision arrows is astounding.

Although it seems logical that economic benefits of tourism should reach local residents in protected areas, reality is always more complicated. Although the Casa Matsiguenka has existed for nearly 20 years, maintaining it and making it a thriving enterprise remain a challenge.

Numbers aren't everything

Key objectives in the definition of national parks offered by the International Union for the Conservation of Nature, to which Peru has been committed from the beginning, include environmental education and recreation, along with environmental protection. Tourism is defined as a responsibility of parks, as long as negative impacts on biodiversity are avoided.

All too often, the number of visitors serves as an indicator of success. Areas such as Manu will never draw a million people in the way of Kruger National Park in South Africa or Yellowstone in the United States. Manu is not an appropriate place for receiving so many visitors, and doing so would pose an enormous threat. But even if the number of visitors increased in the future, entry fees would cover just a fraction of the costs. In financial terms, the amount would be irrelevant.

Although it will never yield a financial benefit in the traditional sense, Manu is important and successful on a global scale. It is an investment in the future, a shield against climate change, a biological reservoir and a natural laboratory that is among the assets of Peru and the world. The funding for its maintenance must not depend on tourism.

Nevertheless, tourism must not be underestimated as a factor in its preservation. It contributes to local people's income and can create jobs in a region where other options, many of which are illegal, are extremely harmful. Tourism also raises the level of national and international appreciation of areas such as Manu. Thanks to the flow of people, national parks become known and valued worldwide.

Events around the park

Other important events — positive and negative — marked the most recent quarter-century of Manu National Park. In the northwest, gas began to flow from the Camisea gas field, one of the largest in Amazonia, with significant impacts on the local inhabitants. The cultivation of coca for manufacturing cocaine increased nationwide, including in the park's buffer zone. Gold fever along the Madre de Dios River was excessive and deadly. Gold and illegal logging became the main reasons for the forced construction of roads. SERNANP worked ceaselessly to counteract these developments, collaborating with the local population and government to move toward sustainable development in the biosphere reserve.

Manu´s eastern flank, along the Los Amigos River, became better protected after the Amazon Conservation Association took over a scientific research concession and convinced hundreds of loggers to leave the area. Another major contribution was the creation of Alto Purús National Park in 2004, covering more than 25,000 square kilometers. This made the Purús-Manu Region one of the largest national park complexes in the world, encompassing an area larger than Switzerland. BBC documentaries and articles in *National Geographic* drew increasing global attention to Manu – which until recently was a fairly unknown park.

Happy birthday, Manu!

On 29 May 2013, a wide variety of people gathered in the community of Salvación. Inhabitants and neighbors of the park were joined by park rangers, scientists, ecologists, filmmakers, reporters, missionaries, former park directors, and tourists. The mix could not have been more colorful.

After speeches about the biosphere reserve and UNESCO World Heritage Sites, the crowd gathered in the plaza of the community as night fell to eat, drink, and listen to music. At midnight, everyone sang «Happy Birthday», and the head of SERNANP, Pedro Gamboa, who had traveled from Lima for the occasion, cut a birthday cake dedicated to Manu.

Manu National Park was 40 years old! A park created by people for people. The celebration could not have been more fitting.

It has been registered in Manu National Park 52 species of macaws, parrots and parakeets belonging to the family Psitacidae. In the picture the Scarlet Macaw (*Ara macao*).

Chapter 3

Manu, Andean and Amazonian biodiversity

José Antonio Ochoa

My first impression of Manu National Park came on a chilly, misty morning. We had arrived at the Acjanaco ranger station, and a park ranger was registering the bus that was taking us to the overlook at Tres Cruces.

It was July 1989 and the night before, like many visitors from Cusco and other places, a group of high school friends and I had attended the famous festival of the Virgen del Carmen (Our Lady of Carmen) in Paucartambo. Faithful to the teenage custom of the time, the trip to Tres Cruces to see the impressive sunrise was an obligatory part of the tradition.

We arrived at four o´clock in the morning. Scarcely had we left the bus when the mist began to soak our clothes. The one thing we wanted was to find the best place to see the famous sunrise. But we were out of luck. Although we waited for many minutes, the fog blocked our view of the long-anticipated spectacle. Disappointed, almost in silence, we returned to the bus for the drive back to Paucartambo.

Along the way, something unexpected happened. The bus suffered a mechanical problem and we had to wait outside in the elements while the driver repaired it. I was sitting beside the road when an odd black bird with a hooked beak and a small white spot on either side of its head caught my eye. I watched for several minutes as it perched on some tiny, red flowers. It was persistently trying to eat something. At that moment, the driver shouted, «Jacuchis», a Quechua word meaning «let´s go». He told us he had solved the problem, and we set off again for Paucartambo.

A year later, as a biology student at the National University of Cusco, I learned that the little black bird was called *Diglossa mystacalis*, that it was one of the most common in the high Andean part of Manu National Park, and that it was commonly known as a moustached flowerpiercer. I also learned that these birds visit flowers to feed on the nectar but, unlike hummingbirds, they use their beaks to perforate the base of the petals and extract the tasty food.

More than 25 years have passed since that episode. At the time, it was impossible to know or even imagine that I had stood at the threshold of what would become one of the most famous national parks on the planet, and that I had seen a small part of Manu´s enormous biodiversity.

Before 1970, there was very little documentation of the flora and fauna of Manu. Although there were some bibliographic references about geographic features of Manu from 16th- and 17th-century Spanish chronicles, the first documentation of a biological species did not come until the end of the 19th century. It was published in 1897 by the naturalist O. Garlepp and was an account of brown woolly monkeys (*Lagothrix lagothricha*) in Callanga, in the Piñi Piñi River watershed, at 1,500 meters. It was not until 1911, however, that *Desmogramma callangaensis* became the first biological species described for science for Manu National Park.

At that time, access to the territory that is now the park was by horse trails. Not until a dirt road wide enough for a vehicle was built from Paucartambo to the Kosñipata Valley in the first half of the 20th century did access improve. Although the real purpose of that road was the extraction of natural resources, it also enabled naturalists to begin to conduct expeditions to the area.

After 1970, as researchers´ interest in the Alto Madre de Dios and Manu watersheds increased, Manu National Park was established in 1973. Since then, Manu has received special attention from Peruvian and foreign scientists because of its great biodiversity, the complexity of its ecosystems, its remote and pristine landscapes, and its special state of conservation. Cocha Cashu and Pakitza became the most studied places in Manu. Over the following decades, as the number of researchers increased, so did interest in tropical forest conservation.

Little by little, researchers began to inventory the plants and animals of Manu. The impressive figures brought it international acclaim and recognition as one of the most biodiverse places on the planet.

The birds, sounds and colors of Manu

Dawn in Manu marks not only the beginning of a new day, but also the continuation of the natural dynamics of the forest. Who better than the birds, which dominate the daybreak with their melodious songs and deep calls, to tell us that nature is following its course?

Flower-piercers, the most conspicuous birds in the transition zone between the puna and montane forest, visit flowers to feed on nectar. Six species of this group, including the Moustached Flower-piercer (*Diglossa mystacalis*), are found in Manu National Park.

The Yellow-billed Teal (*Anas flavirostris*) is typical of the puna and is frequently seen around bodies of water in the high Andean part of Manu.

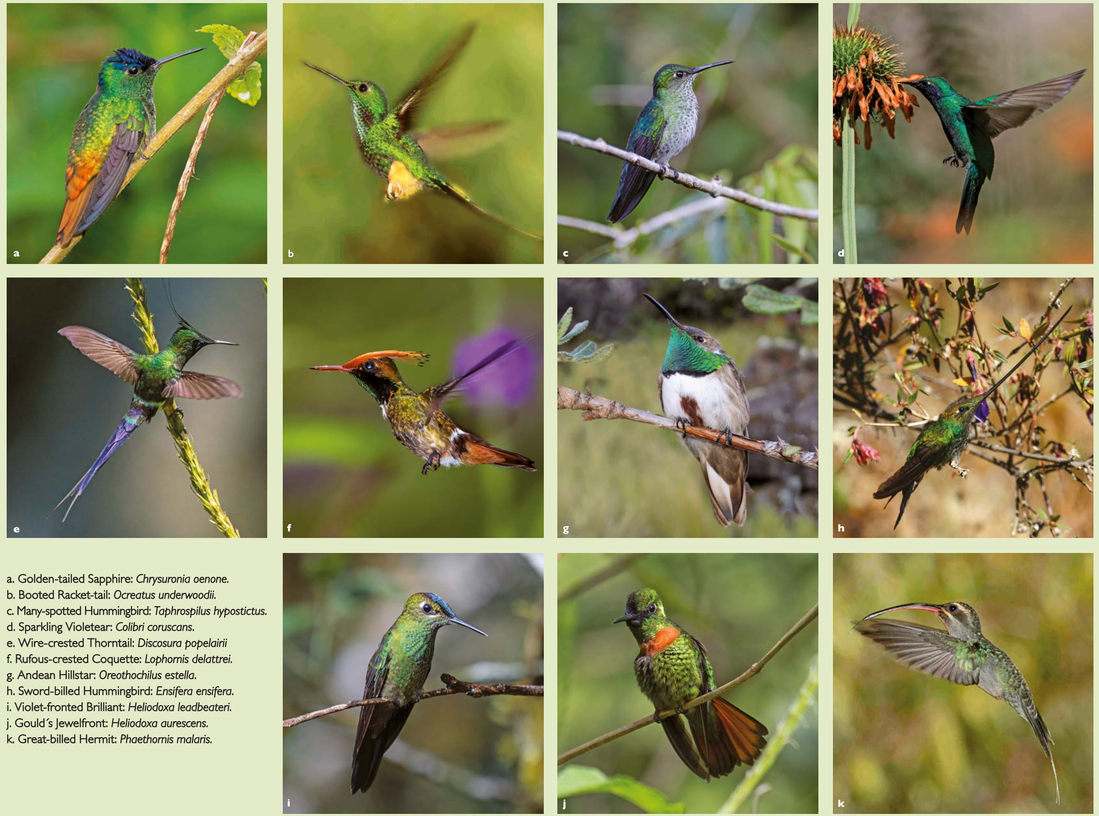
As the day goes on, we can appreciate their fascinating colors, shapes and behaviors. These are the characteristics that have long inspired and excited researchers and bird-watchers. Because of their enormous biodiversity, birds are one of the most emblematic vertebrate groups. Peru ranks third globally in bird diversity, after Brazil and Colombia, with more than 1,850 species recorded in the country.

Of this huge group, Manu National Park, with its 1,030 species, is the place with the most species on earth. This means that 10% of all the bird species in the world are found in Manu.

Visitors to the *puna* of the Tres Cruces sector may see the Jameson´s snipe (*Gallinago jamesoni*), also known as the Andean snipe. If startled by a person passing by the dense brush, it takes flight suddenly, emitting a characteristic call and revealing its whimsical bill. The rocky patches and scrubby vegetation in that area are also ideal for observing species such as *diucas*, *canasteros* and finches, as well as Taczanowski´s tinamou (*Nothoprocta taczanowskii*), whose scarcity has ranked it as a «vulnerable species» under Peruvian law. The *puna* is dotted with attractive ponds and lakes that are home to four species of ducks and geese of the genera *Anas, Lophoneta* and *Oressochen*. Twelve species of this group have been recorded in the park, and they are easy for visitors to observe.

Descending from the *puna*, the vegetation begins to include more bushes and some scrubby trees, and visitors can observe the foraging and flitting of species such as the chestnut-winged cinclodes (*Cinclodes albidiventris*) and the moustached flowerpiercer (*Diglossa mystacalis*). Despite the dense fog, the cloud forest is also dominated by hummingbirds, which play an essential role in pollinating plants. About 66 species have been recorded in the park.

As we descend toward the cloud forest, the number of species increases because of the greater variety of flowers and the denseness of the forest. This is an ideal place to see the majestic cock of the rock (*Rupicola peruviana*), the Andean motmot (*Momotus*



a. Golden-tailed Sapphire: *Chrysuronia oenone.*
b. Booted Racket-tail: *Ocreatus underwoodii.*
c. Many-spotted Hummingbird: *Taphrospilus hypostictus.*
d. Sparkling Violetear: *Colibri coruscans.*
e. Wire-crested Thorntail: *Discosura popelairii*
f. Rufous-crested Coquette: *Lophornis delattrei.*
g. Andean Hillstar: *Oreothochilus estella.*
h. Sword-billed Hummingbird: *Ensifera ensifera.*
i. Violet-fronted Brilliant: *Heliodoxa leadbeateri.*
j. Gould´s Jewelfront: *Heliodoxa aurescens.*
k. Great-billed Hermit: *Phaethornis malaris.*

aequatorialis), the masked trogon (*Trogon personatus*), the golden-headed quetzal (*Pharomachrus auriceps*), and one of my favorites, the gray-breasted mountain-toucan (*Andigena hypoglauca*). These are species that unquestionably inspire visits to these moody forests shrouded in their mantle of mist.

Farther down, in the rain forest, the understory shelters a considerable number of species of antbirds, bare-eyes, antshrikes, ant vireos and *hormigueritos*. They are crucial to the understory life cycle for a very important reason: they specialize in following ant armies to feed on insects dragged by the ants, which makes them sensitive indicators of altered ecosystems.

Emerging from the understory into clearings and open spaces, the air fills with the colors and sounds of the much-loved macaws, which fly over the canopy and concentrate — along with parrots and parakeets — at the famous clay licks. There they feed on clay to aid their digestion. In Manu National Park, there are protected species of macaws, such as the blue-headed macaw (*Primolius couloni*) or the military macaw (*Ara militaris*), which currently are classified as vulnerable under Peruvian law.

Another prominent group of birds are the raptors. Exceptional predators, they are indispensable for controlling the populations of other animals. Among them, the harpy eagle (*Harpia harpyja*), ornate hawk-eagle (*Spizaetus ornatus*) and crested eagle (*Morphnus guianensis*) stand out particularly.

Although little research on raptors has been conducted in the park, partly because many are difficult to see, Ursula Valdez and Martha Groom conducted a noteworthy study in 2013. They determined the composition, diversity and relative abundance of communities of diurnal birds of prey (*Falconiformes*) in pristine areas and areas modified by human activity in the lowland tropical forest.

Chestnut-eared Aracari: *Pteroglossus castanotis.*

In the heart of Manu, in the forest around the Cocha Cashu Biological Station, a record 560 bird species have been registered — in fact, it is renowned as the place where 331 species were recorded in a single day! That list was compiled in 1982 by Ted Parker and Scott Robinson in Cocha Cashu.

Manu´s waters and banks teem with bird life, including fascinating herons, which blend into the scenery, hunting small fish and crustaceans. On the beaches, one can see skimmers, migratory sandpipers, jabirus, terns, and some falcons and jacamars perching on branches at the forest edge along the river banks.


a


b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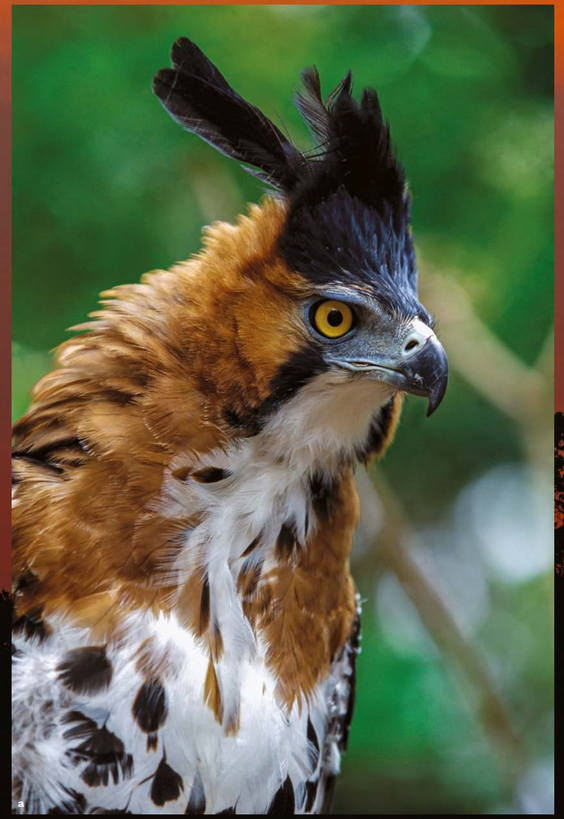
k

a. Torrent Duck: *Merganetta armata*.
b. Great Thrush: *Turdus fuscater*.
c. Yungas Pygmy-Owl: *Glaucidium bolivianum*.
d. Rufous Antpitta: *Grallaria rufula*.
e. Saffron-crowned Tanager: *Tangara xanthocephala*.
f. Masked Trogon: *Trogon personatus*.
g. Crested Quetzal: *Pharomachrus antisianus*.
h. Andean Motmot: *Momotus aequatorialis*.
i. Gray-breasted Mountain-Toucan: *Andigena hypoglauca*.
j. Green Jay: *Cyanocorax yncas*.
k. Cinnamon Flycatcher: *Pyrrhomyias cinnamomeus*.

Previous page: Blue and yellow macaws (*Ara ararauna*).



a. Ornate Hawk-Eagle: *Spizaetus ornatus*.
b. Chestnut-fronted Macaw (*Ara severus*), Mealy Parrot (*Amazona farinosa*), Blue-headed Parrot (*Pionus menstruus*).
c. Black Skimmer: *Rynchops niger*.
d. Blue-gray Tanager: *Thraupis episcopus*.
e. Roadside Hawk: *Rupornis magnirostris*.
f. White-throated Toucan: *Ramphastos tucanus*.
g. Collared Puffbird: *Bucco capensis*.
h. Horned Screamer: *Anhima cornuta*.
i. Capped Heron: *Pilherodius pileatus*.
j. Rufescent Tiger-Heron: *Tigrisoma lineatum*.
k. Roseate Spoonbill: *Platalea ajaja*.
l. Pied Lapwing: *Vanellus cayanus*.
m. Orinoco Goose: *Oressochen jubatus*.
n. Sand-colored Nighthawks: *Chordeiles rupestris rupestris*.

Bolivian black-capped squirrel monkeys (*Saimiri boliviensis*) travel through the forest in large groups (sometimes of more than 100 individuals) in search of fruits and insects. They are frequently seen along with large-headed capuchins (*Sapajus macrocepahus*), forming mixed monkey troops.

Monkeys, felines and other mammals of Manu

Few places in the tropics offer visitors the chance of seeing, within short periods of time, impressive animals such as the jaguar (*Panthera onca*), South American tapir (*Tapirus terrestris*), giant otter (*Pteronura brasiliensis*) and various species of monkeys.

Most tourists who return from a short trip along the Manu River have had the pleasure of seeing troops of Bolivian black-capped squirrel monkeys (*Saimiri boliviensis*), the most numerous of the 15 primate species found in Manu. Visitors may also stumble on a family of capybara (*Hydrochoerus hydrochaeris*) along the Manu´s banks, or awaken to the roar of a troop of red howler monkeys (*Alouatta sara*). Those who have the chance to travel to Cocha Salvador may see the family of giant otters that lives in that lake. Although not everyone is lucky enough to spot a jaguar, no one leaves Manu disappointed.

From highlands to lowlands, 228 mammal species have been recorded in the park and its buffer zone. This figure represents 4% of all mammal species in the world. Our knowledge of this enormous biodiversity is the result of the efforts of many researchers, including John Terborgh, Don E. Wilson, James L. Patton, Bruce Patterson, Louise Emmons, Carol Mitchell, Renata Leite-Pitman, and Peruvians Víctor Pacheco, César Ascorra, Sergio Solari, Paul Velazco and Horacio Zeballos, as well as a host of students from many of the country´s universities. Cocha Cashu and Pakitza deserve special mention. With 139 species recorded and estimates as high as 187, according to R.S. Voss and L. Emmons, they hold world records for mammal diversity.

This diversity, according to a study by Patterson and other scientists in 2006, includes eight feline species, five sloths and anteaters, two armadillos, 15 monkeys, 21 carnivores, a tapir, seven peccary and deer species, a marsupial shrew and a rabbit. The greatest mammal diversity, however, consists of rodents (59 species), bats (92 species) and marsupials (22 species). These three groups together represent 75% of all mammals in Manu, but because they are not as colorful or spectacular as the larger mammals, and they normally remain hidden, they often go unnoticed by visitors.

Particularly noteworthy are two species found exclusively in Manu. The first, *Monodelphis ronaldi*, is a marsupial described by Sergio Solari in 2004, based on a specimen collected in Pakitza. The second is a rodent, *Isothrix barbarabrownae,* a member of the Echymidae family, which inhabits the cloud forest at 1,900 meters and was described in 2006 by Patterson and Velazco.

The Manu short-tailed bat (*Carollia manu*), which is found in the cloud forest between 1,300 and 2,250 meters, was named in honor of the park by Víctor Pacheco and colleagues from San Marcos National University in 2004.

Many mammals are extremely important sources of food for people living within Manu´s boundaries. A study by Johny Farfan and Oscar Mujica, conducted between 2013 and 2017 for the Frankfurt Zoological Society, found that 24 mammal species are used for food in the communities Yomibato, Tayakome and Maizal. Primates such as the black spider monkey (*Ateles chamek*), brown woolly monkey (*Lagothrix lagothricha*) and red howler monkey (*Alouatta sara*), as well as the brown agouti (*Dasyporcta variegata)* and collared peccary (*Pecari tajacu*), are the most important mammals in the diet of the Matsiguenka, and probably also of the Mashco Piro who live in isolation within Manu´s forests.

Small mammals, such as marsupials, rodents and bats, are perhaps Manu´s least conspicuous inhabitants, but they are the most diverse. The diet of marsupials consists mainly of insects and other arthropods, small vertebrates, fruits and nectar. The enormous diversity of bats (92 species in seven families) also corresponds with varied dietary specialization, with different species feeding on blood, insects, fruit, meat and nectar.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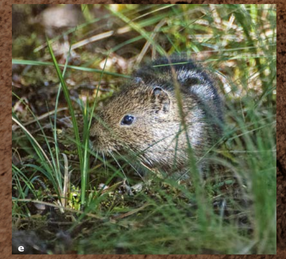
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a. Southern Tamandua: *Tamandua tetradactyla.*
b. Bicolor-spined Porcupine: *Coendou bicolor.*
c. Brown-throated Three-toad Sloth: *Bradypus variegatus.*
d. Southern Amazon Red Squirrel: *Sciurus spadiceus.*
e. Montane Guinea Pig: *Cavia tschudii.*
f. Common Opossum: *Didelphis marsupialis.*
g. Dwarf Brocket: *Mazama chunyi.*
h. Peruvian White-tailed Deer: *Odocoileus peruvianus.*
i. South American Tapir: *Tapirus terrestris.*
j. Capybara: *Hydrochaeris hydrochaeris.*


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k. Weddell´s Saddle-back Tamarin: *Leontocebus weddelli.*
l. Large-headed Capuchin: *Sapajus macrocephalus.*
m. Red Howler Monkey: *Alouatta sara.*
n. Black Spider Monkey: *Ateles chamek.*
o. Gray Woolly Monkey: *Lagothrix lagothricha cana.*
p. Bearded Emperor Tamarin: *Saguinus imperator.*

Animals with a double life

In January 2000, a group of biologists from San Antonio Abad National University in Cusco conducted studies of fauna along the Union Trail, a track inside Manu. Juan Carlos Chaparro, the group´s herpetologist, set up camp on a small hill at 2,750 meters and went out every night in search of amphibians and reptiles.

On the night of 13 January, he and a colleague from the university, John Achicahuala, spotted an unusual toad perched on a fern leaf. The tiny amphibian was blackish with a reddish belly. «How odd — it must be a new species!» Chaparro exclaimed. It was the Cusco team´s fourth visit to the area, but the first time they had seen this interesting animal. Some years later, in 2007, it was officially described and named *Rhinella manu*, in honor of the park. It is one of 18 endemic amphibian species inhabiting Manu and its buffer zone.

A night hike through the tropical forest is a magical experience. The scenery looks completely different, and an infinity of fauna appears, including insects, spiders, scorpions, mollusks, rodents, marsupials and even some birds. But the frogs are the showiest, not just for their riot of colors, but also for their calls, which enliven the night like no other creature. By day, they are concealed in the vegetation, beneath leaf litter, rocks or fallen trunks, but at night they emerge to feed and breed.

Like toads and salamanders, frogs belong to the class Amphibia, which means «double life». Most are tiny, less than five centimeters long, although there are also large amphibians like the cane toad (*Rhinella marina*), which can grow to more than 25 centimeters and weigh as much as two kilos. Some 158 species of amphibians have been recorded in Manu and its buffer zone, representing 28% of all known amphibians in Peru. That number will probably increase as more studies are conducted. Between 2016 and 2017, three new species were described for the area: *Ameerega shihuemoy, Pristimantis pluvialis* and *Psychrophrynella chirihampatu*. At least seven amphibian species live in the upper parts of Manu, above 3,500 meters, in the *puna* and shrubby scrubland. They are native to that area and have adapted to the extreme cold.

One of the most beautiful species in Manu´s upper reaches is a marsupial frog (*Gastrotheca excubitor*), which is characterized by a pouch or marsupium on its back. The young develop there, from the egg stage until tiny frogs hatch directly, without passing through a tadpole stage like other frogs. The discovery of this frog in the Acjanaco area in 1971 by herpetologist William E. Duellman of the University of Kansas and Óscar Ochoa, a professor from the University of Cusco, marked the start of herpetological studies in the national park.

Lower down, in the montane forest, the diversity of frogs increases to 43 species. In this sector of the park, which includes cloud forest and rain forest at an elevation of more than 700 meters in the Kosñipata Valley, biologists have discovered many species previously unknown to science just in the last decade. These include the famous glass frogs (e.g. *Nymphargus truebae*, *Centrolene sabini*), as well as the smallest Andean frog (*Noblella pygmaea*), the adults of which measure just 11 or 12 millimeters. This frog was discovered by German scientist Edgar Lehr and Peruvian-Swiss scientist Alessandro Catenazzi.

The greatest diversity of amphibians is found in the Amazonian lowlands. In some places along the Manu River, more than 80 species can be found in a single place. The predominant frogs are those of the genus *Pristimantis*, with 18 species, and *Dendropsophus,* with 17 species. The large frogs of the genus *Leptodactylus* are also found here, and are eaten by

The cane toad (*Rhinella marina*), the largest toad in the Neotropics, is an exceptional predator, feeding mainly on invertebrates, although its diet also includes plants and even carrion. It has a large parotoid gland behind each eye, which secrete a toxic white substance when the toad feels threatened.








a. *Phyllomedusa camba.*
b. *Gastrotheca nebulanastes.*
c. *Rhinella manu.*
d. *Oreobates gemcare.*
e. *Pristimantis pluvialis.*
f. *Psychrophrynella usurpator.*
g. *Telmatobious mendelsoni.*
h. *Gastrotheca excubitor.*











i. *Ameerega trivittata.*
j. *Philomedusa tomopterna.*
k. *Edalorhina perezi.*
l. *Philomedusa bicolor.*
m. *Dendropsophus leucophyllatus.*
n. *Ceratophrys cornuta.*
o. *Sphaenorhynchus lacteus.*
p. *Ameerega macero.*
q. *Hypsiboans lanciformis.*
r. *Leptodactylus knudseni.*
s. *Bolitoglossa altamazonica.*

The two-striped forest pitviper (*Bothrops bilineatus*) is one of eight viper species found in Manu National Park. These snakes use venom to capture their prey (small mammals, birds, lizards and frogs). They have also caused serious human accidents.

local villagers, who call them *walos*. The lowlands are also home to brightly colored poison dart frogs such as *Aamerega macero*, which takes its name from a Matsiguenka word («macero» meaning «frog»). The species list for Manu also includes a salamander (*Bolitoglossa altamazonica*) and three caecilian species, identifiable by their worm-like appearance and lack of limbs.

Reptiles

The park´s Amazonian forests are among the few places in the Neotropics that are home to healthy populations of anacondas (*Eunectes murinus*), black caimans (*Melanosuchus niger*), yellow-spotted river turtles (*Podocnemis unifilis*), red-tailed boas (*Boa constrictor*), and the dangerous bushmaster snakes known locally as *shushupe* (*Lachesis muta*). These tropical forest denizens are among the 132 reptile species found in Manu.

A reptile was the subject of the very first study conducted at what is now the Cocha Cashu Biological Station. In 1972, the German scientist Kai Otte studied black caiman populations there. By then, the population had decreased substantially because of indiscriminate hunting in the 1960s. Now, however, the populations have recovered, thanks to good management by SERNANP.

The list of reptiles in Manu includes four species of caimans, 36 of lizards, five boas, 57 snakes, eight vipers, and five species of coral snakes, among others. This high diversity is difficult to find in other regions of the world. While many reptiles, unlike amphibians, have wide ranges of distribution, two endemic species of lizard inhabit Manu and its buffer zone: *Anolis cuscoensis* and *Potamites erythrocularis*, which were described in 2008 and 2014, respectively.

Fish

Among vertebrates, fish are the group that has been least studied in the park. Just 1.2% of the more than 2,000 studies from Manu involve fish. In comparison, 16% of the studies focus on mammals. In 1996, Professor Hernán Ortega of San Marcos National University presented the most recent list of fish in Manu, listing 210 species belonging to 33 different families. The most diverse family is the Characidae, representing 42% of the total.

According to Ortega, fish diversity in Manu is similar to that of Tambopata and other parts of Madre de Dios, but different from that of the Ucayali River. Some very large species, such as *paiche* (*Arapaima gigas*), are not found in Manu. This diversity includes species that are very important as food for humans, such as the gilden catfish (*Brachyplatystoma filamentosum*), shovelnose catfish (*Pseudoplatystoma punctifer*), gilden catfish (*Zungaro zungaro*), spotted smallmouth (*Prochilodus nigricans*), and others.

Between 2014 and 2016, the ProBosque Manu project, implemented by the Frankfurt Zoological Society in partnership with the park administration, assessed the use of hydrobiological resources in the Matsiguenka communities of Tayakome, Yomibato and Maizal, including data about fish diversity. This will undoubtedly expand the list of known species in the park.


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a. Red-tailed Boa: *Boa constrictor.*
b. Emerald Tree Boa: *Corallus batesii.*
c. Manu Boa: *Corallus hortulanus.*
d. Coral Snake: *Micrurus obscurus.*
e. Parrot Snake: *Leptophis ahaetulla.*
f. Blunt-headed Tree Snake: *Imantodes cenchoa.*
g. Brown-banded Water Snake: *Helicops angulatus.*
h. Formosa False Coral Snake: *Oxyrhopus formosus.*
i. Amazon Wood Lizard: *Enyalioides laticeps.*
j. Horned Wood Lizard: *Enyalioides palpebralis.*
k. Collared tree lizard: *Plica plica.*
l. Cocha Whiptail: *Kentropyx altamazonica.*
m. Trinidad Gecko: *Gonatodes humeralis.*
n. Scorpion Mud Turtle: *Kinosternon scorpioides.*
o. Sucker Catfish: *Hypostomus* sp.
p. Piranha: *Serrasalmus* sp.


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Hidden biodiversity

Some years ago, during the first day of a field ecology course at the Tono ranger station, I asked my students what animals they had seen that morning. Several promptly answered that they had seen birds, including *oropendolas*, a pair of macaws and a flock of doves. Indeed, that morning all of us had heard and seen a flock of noisy *oropendolas* that enlivened our breakfast.

While they listed various bird species — including hummingbirds, crows, the groove-billed ani, tanagers and others — one intrepid student added, «I saw an *Ameiva ameiva* lizard». That was very possible, because that species is very common in open areas of Amazonia. Another student mentioned having seen a bat flying overhead the night before. But, surprisingly, no one mentioned invertebrates. That was true even though, at that very moment, at least three butterfly species were flitting around us, several bees were visiting nearby flowers, and some ant was undoubtedly out for a morning stroll. Nor did they mention the tarantula on the kitchen roof, which I´m sure more than a few had seen, much less the pesky mosquitoes that were biting them while we were talking. These were university biology students, and although they had significant knowledge and understanding of biodiversity, they shared the common bias of noticing only large animals. We almost always overlook the smallest animals, such as insects, spiders and other invertebrates, which are the most numerous and diverse in any habitat, and which ultimately monopolize the most ecosystem energy. It is specifically this biodiversity that we call «hidden biodiversity».

Hyperdiverse groups

In 1982, Terry Erwin, curator of Coleoptera at the Smithsonian Institution´s National Museum of Natural History, published a paper that changed our understanding of biodiversity. Based on simple mathematical calculations resulting from his study of tropical forest beetles (Coleoptera), he estimated the diversity of organisms in the world at some 30 million species. This estimate was, and remains, highly controversial, but regardless of the precision of his calculation, the paper prompted reflection on how much we — including scientists — still don´t know about our planet´s biodiversity.

So far, more than 1.5 million animal species have been described worldwide, in more than 40 phyla. According to a 2011 study by Zhang, arthropods are the most diverse group, with 1,242,040 species, representing 80% of the total. Groups such as Coleoptera, Diptera, Lepidoptera, Hymenoptera, Hemiptera and Araneae together represent more than 73% of the planet´s entire animal diversity. These six orders of arthropods are called hyperdiverse groups.

This pattern, of course, is also seen in Manu. Some studies have reported world records in biodiversity, especially around Pakitza, where scientists have recorded 1,300 species of Papilionoidea butterflies, 1,006 species of nocturnal Lepidoptera, 600 species of beetles of the family Carabidae, 224 species of the order Trichoptera, 117 species of dragonfly (Odonata), 34 species of Cicadoidea cicadas, 73 species of Mutillidae, 498 species of

Some 500 spider species, distributed in 33 families, have been reported around Pakitza. This enormous diversity is a clear indicator of the complexity of microhabitats in Manu´s forests.


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a. Pink Toe Tarantula: *Avicularia* sp.
b. Huntsman Spider: *Olios* sp.
c. Thorn Spider: *Micrathena* sp.
d. Net-casting Spider: *Deinopis* sp.
e. Wandering Spider: *Phoneutria* sp.
f. Orb-weaver Spider: *Eriophora* sp.
g. Jumping Spider: *Lissomanes* sp.
h. Green Huntsman Spider: *Sparassidae*.
i. Jumping Spider: *Breda lubomirskii*.
j. Whip Spider: *Heterophrynus elaphus*.
k. Harvestmen: *Protimesius amigos*.
l. Harvestmen: *Huadampillia* sp.
m. Yungas scorpion: *Tityus cf. bolivianus*.
n. Madre de Dios Black scorpion: *Tityus cf. metuendus*.


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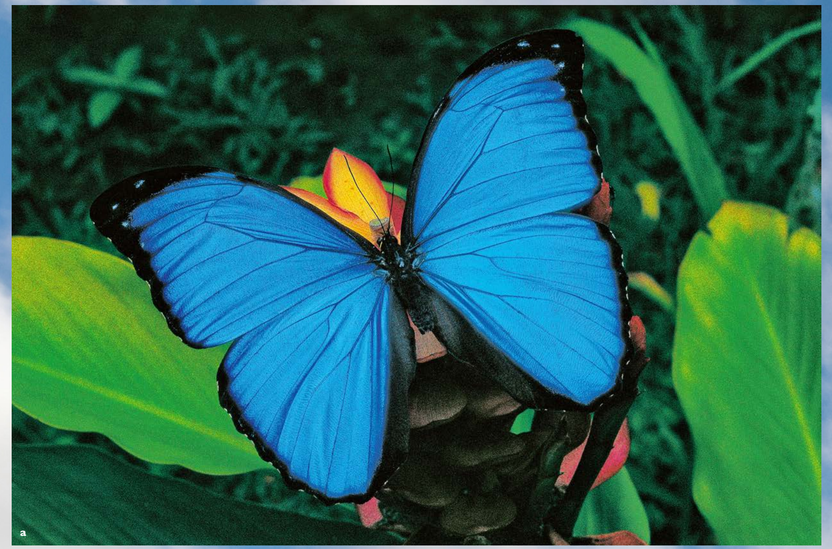
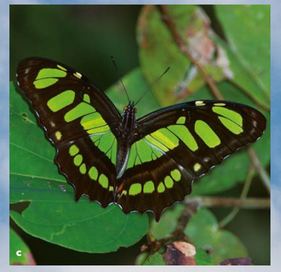
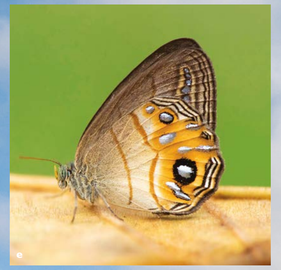
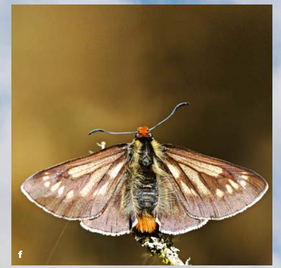
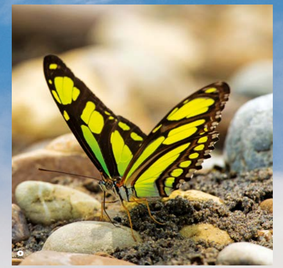
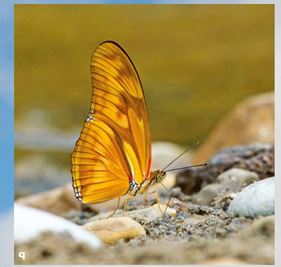


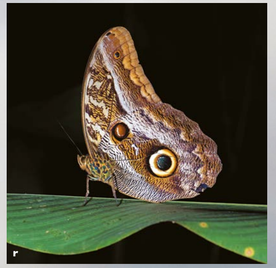




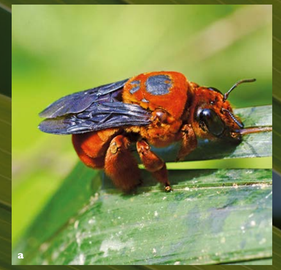


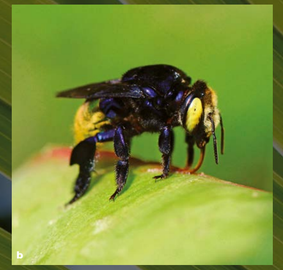


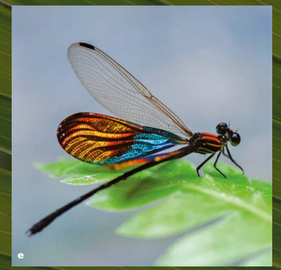


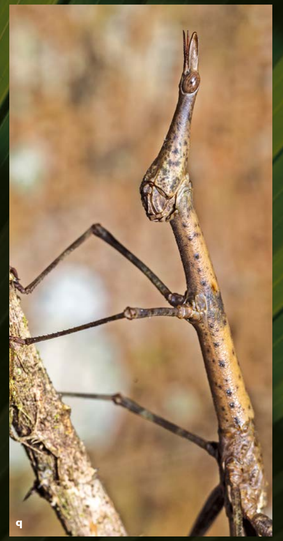


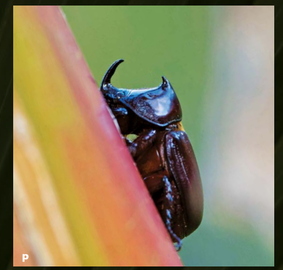
a. *Morpho menelaus occidentalis.*
b. *Haetera piera pakitza.*
c. *Siproeta stelenes.*
d. *Heliconius melpomene schunkei.*
e. *Splendeuptychia* sp.
f. *Metardaris cosinga.*
g. *Asterope whitelyi srnkai.*
h. *Mcclungia cymo trepotis.*
i. *Diaethria clymena marchalii.*
j. *Ziegleria ceromia.*
k. *Panacea prola amazonica.*
l. *Baeotus aeilus.*
m. *Dynamine gisella.*
n. *Pyrrhogyra crameri hagnodorus.*
o. *Philaethria dido dido.*
p. *Urania leilus.*
q. *Dryas iulia.*
r. *Caligo idomeneus idomenides.*

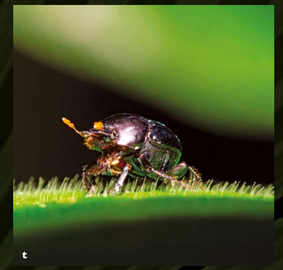












a. Carpenter Bee: *Xylocopa* sp.
b. Orchid Bee: *Eufriesea pulchra.*
c. Sundown Cicada: *Fidicina mannifera.*
d. Giant Cockroach: *Blaberus giganteus.*
e. Damselfly: *Chalcopteryx rutilans.*
f. Dragonfly: *Anatya guttata.*
g. Assasin bug: *Ricolla* sp.
h. Leaf Footed Bug: *Meiucha* sp.
i. Stink Bug: *Edessa* sp.
j. Green Leaf Katydid: *Roxelana crassicornis.*
k. Red-dotted Planthopper: *Lystra lanata.*
l. Long-horn Beetle: *Mionochroma aureotinctum.*
m. Green Rutelinae Beetle: *Chlorota chaparroi.*
n. Zigzag Fungus Beetle: *Erotylus voeti.*
o. *Molytinae* Weevil.
p. Rhinoceros Beetle: *Podischnus oberthuri.*
q. Stickinsect: *Paraproscopia* sp.
r. Harlequin Beetle: *Acrocinus longimanus.*
s. Dung Beetle: *Canthon* sp.
t. Dung Beetle: *Canthidium lentum.*

spiders, and at least 60 species of other arachnids (Scorpiones, Opiliones and Amblypygi). Callanga also merits special mention, as 282 insect species have been reported there.

A subaquatic scorpion

One of the strangest and most impressive life forms that I have ever encountered is a scorpion that is able to dive. This species is representative of the more than 200 species of the genus Tityus of the family Buthidae. It is found in Manu, exclusively inhabiting rocky ravines in the rain forest, between 350 and 700 meters. Like all scorpions, this species is nocturnal. It is found among stones on slopes close to the water, hunting insects and other invertebrates that happen by. Positioning itself facing downhill, it efficiently captures its prey with the help of pincer-like appendages called pedipalps. Although the scorpions can hold still in that position for several minutes, the damp stones are slippery and they sometimes fall into the water. They generally walk along the stream bed until they find some stones or a wall, then climb to the surface, where they position themselves to ambush prey again.

I sometimes saw individuals that stayed underwater for as long as 12 minutes. This behavior is rare and unique in this group of arachnids; most species inhabiting tropical forests are found in the understory, beneath leaf litter, in fallen logs, in grooves in trees and amid the vegetation. This diving scorpion is part of Manu´s enormous biodiversity. Its presence also implies a great variability in life forms resulting from millions of years of evolution, which has led to different adaptations and interrelationships among species.

Endemism and beta diversity

«Endemism» is a word that biologists and researchers use to indicate that a species or group of species exclusively inhabits one particular geographic region. Endemism varies depending on scale: an organism may be endemic to a mountain or mountain range, an island, a watershed, a country or a continent.

Protected areas are important not only because of the richness and abundance of the diversity found there, but also because of the number of endemics or species found exclusively within them. In other words, these are species that live only in a particular area, and nowhere else on the planet. Manu´s geographic location, with its range of Andean and Amazonian ecosystems, makes it unusual among protected areas in Peru and other regions of the Neotropics. It holds records not only for numbers of species, but also for endemics.

In the case of invertebrates, particularly arthropods, it is extremely likely that most of the species found there are endemic to Manu. A study by entomologist Michael G. Pogue of the Smithsonian Institution in several places in southeastern Amazonia yielded an important revelation: of the more than 2,000 species of nocturnal Lepidoptera found in Pakitza, only 3.2% were shared with the Beni area in Bolivia, which also had high diversity, with 933 species. The two localities are 550 kilometers apart. Similarly, a closer location, Tambopata in the department of Madre de Dios, located 235 kilometers from Pakitza, had a species overlap of 23%. In other words, the diversity of Lepidoptera species changes by more than

One odd characteristic of scorpions is their fluorescence under ultraviolet light. Arachnologists use special lamps to detect them at night. This photo shows a diving scorpion underwater in a stream near the Tono ranger station.

Among insects that undergo complete metamorphosis, such as butterflies, the larvae spend most of their time feeding on the leaves and stalks of plants, while adults will change their diet to consume the nectar of flowers. The photo shows a *Catonephele acontius* caterpillar.

Spiders have evolved to be excellent predators. Many species use various types of webs to catch their prey, while others set traps and some specialize in stalking. Here a jumping spider captures a moth.

70% between the two locations. This characteristic, which biologists call «high beta diversity», indicates that the species composition changes notably — by more than 50% — within relatively short distances, while few species are shared between two locations.

Regions with «high beta diversity» are extremely likely to be home to many endemic species. This pattern was reported by Terry Erwin for beetles of the family Carabidae in southeastern Peru, with less than 10% of species shared between two field plots just 50 meters apart in the same type of forest. If these figures are striking, it is reasonable to think that many endemic invertebrate species can be found in all of the natural protected areas in the Neotropics. This is mainly because of their limited ability to travel long distances. Nevertheless, this makes it even more noteworthy that Manu National Park is home to more than 20 endemic vertebrate species — a record! The list of endemics in Manu includes two mammal species, 18 amphibians and two reptile species, all of which are found only in Manu and its buffer zone.

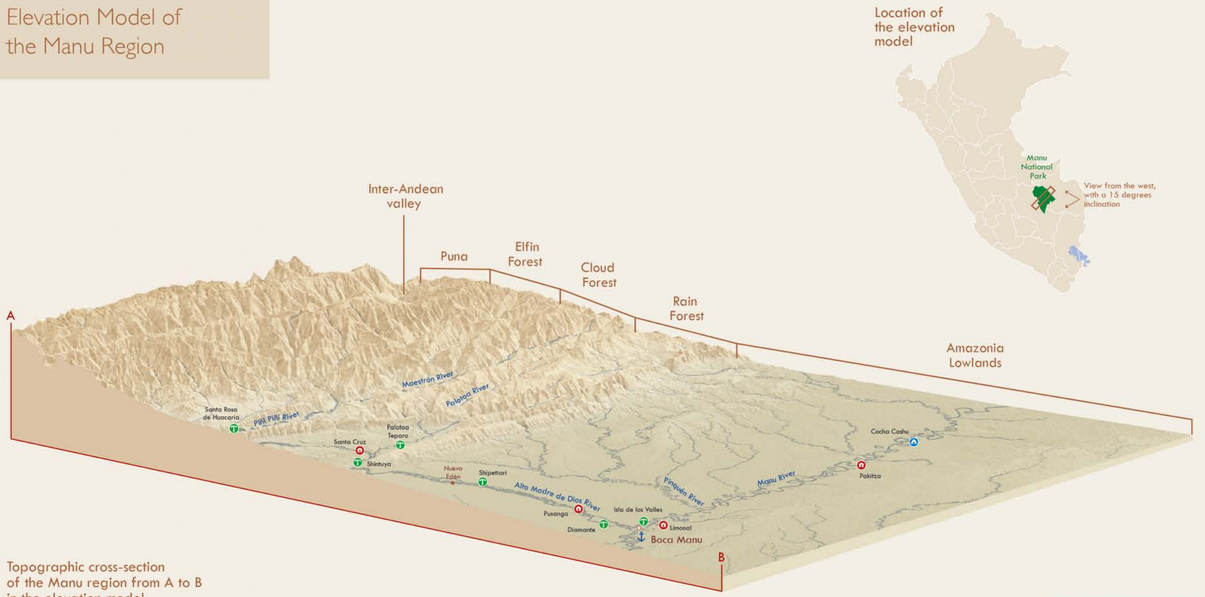
The biodiversity crisis

It is clear that through evolution, many species — or lineages of species — have been restricted to small regions or sectors of Amazonian and Andean regions such as Manu. While this process results in countless endemic species and enormous beta biodiversity, the limited range of these species means that there generally are few individuals of each species (low abundance). This translates into highly vulnerable ecosystems where small changes can cause sharp decreases in populations.

In 2011, A. Catenazzi and colleagues documented a rapid decline in amphibian populations in the cloud forests of the Kosñipata Valley. They determined that the decline was due to a fungus, *Batrachochytrium dendrobatidis,* which causes a disease called chytridiomycosis. The global spread of this disease may be related to human activities. For example, *Telmatobius timens* — a frog that once was very common in streams in the upper part of Manu — has practically disappeared from there, even though the protected area is well conserved.

Leaf-cutter ants build underground nests consisting of complex, interconnected chambers, separating chambers for raising their young from those for farming fungus. The leaves are used as substrate for the fungus garden.

Elevation Model of the Manu Region



Diversity of fauna species in Manu National Park, as a percentage of fauna in Peru and the world

Taxa	No. of species in Manu	Percentage in Peru	Percentage worldwide	Reference
Vertebrates				
Mammals	228	44%	3.9%	Solari et al., 2006, Medina et al., 2012
Birds	1030	56%	10.3%	Walker et al., 2006, Walker & Stotz, 2017
Amphibians	158	28%	2.2%	Catenazzi et al., 2013, Shepack et al., 2016, Serrano-Rojas et al., 2017
Reptiles	132	30%	1.5%	Catenazzi, et al., 2013
Fish	210	16%	0.6%	Ortega, 1996
Arthropods *				
Araneae (Arachnida)	498	?	1.2%	Silva & Coddington, 1996
Otros Arachnida **	60	5%	0.7%	Ochoa (unpublished)
Trichoptera	224	?	1.5%	Flint, 1996
Odonata	117	?	2.0%	Louton y Garrison, 1996
Papilionoidea (Lepidoptera)	1300	27%	6.9%	Robbins et al., 1996
Lepidoptera (polillas)	1006	?	1.1%	Pogue, 1999
Carabidae (Coleoptera)	600	?	1.5%	Erwin, 1996
Cicadoidea (Homoptera)	34	?	1.7%	Pogue, 1996
Mutillidae (Hymenoptera)	73	?	1.5%	Quintero & Cambra, 1996

* The figures for arthropods are only for the area of Pakitza
** Scorpiones, Opiliones and Amblypygi
The symbol «(?)» means there is no information about the diversity for all of Peru; global percentages are based on Zhang (2011)

If the biodiversity estimates by Erwin and other researchers (between 5 million and 50 million species) are close to accurate, we could face the possibility of high mass extinction rates due to deforestation. Because of the high replacement rate of species in tropical forests (beta diversity), the felling of a single tree means the death of many invertebrate species. This biodiversity crisis is magnified by the growing shortage of people trained in the study and classification of the different groups of animals and plants. This lack of taxonomists, as these specialists are called, is a serious problem.

It can take 10 years or more for a person to become a specialist in a particular taxon. Academic institutions play an essential role in training these experts. The greatest difficulty in designing conservation strategies is the lack of knowledge of biodiversity.

Manu National Park is probably the most diverse place on the planet. Conserving and maintaining it is an immense responsibility for all of us.

Flower diversity

Isau Huamantupa–Chuquimaco

The first studies of plant diversity in Manu National Park and its buffer zone were carried out in 1839, led by the French botanist Claudio I. Gay, who conducted the first substantial botanical collections in the headwaters area of Ajcanaco (Tres Cruces) and the Kosñipata Valley.

Later, the same areas and adjoining parts of the Alto Madre de Dios watershed were visited and explored by other renowned naturalists and botanists, including Antonio Raymondi in 1865, Augusto Weberbauer in 1919, and Francis W. Pennell in 1925. The first written works about the flora and fauna were published by two botanists from Cusco, Fortunato L. Herrera (between 1922 and 1933) and César Vargas (between 1936 and 1942). Their results later appeared in *Sinopsis de la flora del Cusco* and *Flora del departamento de Madre de Dios*, both published in 1974.

The most extensive studies followed the official establishment of Manu National Park in 1973. Foreign botanists — such as John Terborgh, Alwyn Gentry and Robin Foster —and many Peruvian researchers published more extensive studies, mainly of areas near the Cocha Cashu Biological Station and in the Manu River basin. These projects also focused on the installation of permanent field plots. There are now more than 30 field plots in Manu and its buffer zone.

Because of the many studies and publications about its flora and fauna, Manu National Park is considered the most-studied protected area in Peru. It is second only to the Tambopata National Reserve in the number of studies of flora and fauna.

Few tropical sites on earth can compare with Manu in terms of its enormous diversity of plants. This diversity results from the exceptional variability of habitats connecting the *puna* with the Amazonian lowlands. Besides snow-capped peaks, the area includes humid grasslands on the eastern slopes, humid montane forests, premontane forests and Amazonian rain forest.

Despite the abundant information about the diversity of flora, the exact number of plant species is unknown. This chapter is the first comprehensive compilation of information for all of Manu National Park and its buffer zone.

a. *Cyrtochilum aureum.*
b. *Epidendrum ardens.*
c. *Agalinis lanceolata.*
d. *Viola bangiana.*
e. *Faramea multiflora.*
f. *Epidendrum macrocarpum.*
g. *Demosthenesia spectabilis.*
h. *Centropogon* sp.
i. *Calceolaria* sp.
j. *Monnina pachycoma.*
k. *Ladenbergia oblongifolia.*

Passiflora tripartita.

Heliconia gloriosa.

Palicourea mansoana.

Vochysia mapirensis.

The overall list contains 4,212 species of vascular plants, including ferns. This means that those two areas are home to approximately 21.6% of Peru´s flora. The 14 botanical families richest in species, including the pteridophytes, contain more than 53% of all vascular flora.

The diversity of the family Orchidaceae is exceptional in Manu. More than 154 orchid species have been recorded in the Amazonian lowlands, while there are more than 280 species in the higher areas (between 1,500 and 3,200 meters). The highest orchid diversity is concentrated in the premontane rain forest, between the high- and middle-elevation mountains (700 to 1,600 meters), with 321 species in the Kosñipata Valley. In all, 720 species are currently known to exist in the area.

About 1,650 species of trees have been identified in the park and its buffer zone, equivalent to approximately 26.1% of all tree species in Peru. Madre de Dios alone is home to 1,500 tree species. The largest proportion of these known species are in permanent field plots under study in Manu, and 80% are in the extensive terra firme forests.

In most of the well-studied sites in Manu, such as Cocha Cashu, Maizal and Pakitza, the diversity of trees in one hectare is considered moderate: approximately 25% lower than estimates for Loreto and the Ecuadorian Amazon, which hold world records with 250 to 303 species in a single hectare.

Along the slopes of Manu´s Andean foothills, however, numbers that are uncommon for the southern Amazon have been recorded. The figures range from 236 to 249 tree species per hectare, apparently influenced by the mixture of soils in small areas and by the variations of microhabitats at slight differences of elevation, abiotic factors that are still poorly understood in the Peruvian Amazon. Other interesting groups include the families Rubiaceae, which includes coffee, with 252 species; Leguminosae (186); Asteraceae (160); Melastomataceae (154); and Piperaceae (120) (see table).

Another important characteristic of the national park is the presence of 60 species of the genus *Inga*, which accounts for more than 60% of *Inga* species in Peru. As with trees in the Amazon rain forest, however, levels of endemism on the slopes apparently are low. This may be deceptive, however, because areas identified as hotspots, including most of the park´s montane forests, have not yet been studied thoroughly.

Manu and the surrounding area represent more than 1.5% of the world´s flora. Compared to other protected areas of similar size, the diversity of flora in Manu is slightly higher than that of Madidi National Park in Bolivia (with 3,981 species), and notably greater than that of Yasuní National Park in Ecuador. Despite the knowledge that has been gained, however, approximately 60% of the park has not yet been studied. These areas are mainly the parts bordering the Megantoni National Sanctuary, and

those adjoining the lower Urubamba, the extensive mountain range of Pantiacolla, and the Alto Madre de Dios watershed. It is therefore likely that Manu National Park´s known floral richness will increase in the coming years; it could be home to more than 30% of Peru´s flora. It is estimated, for example, that the number of orchids could easily exceed 1,500.

These conditions undoubtedly mean that in comparison to other places, Manu is home to the healthiest populations of plants, because little of its area has been affected by human activities. All of this leads us to believe that in the coming years, Manu National Park and its buffer zone will become the most important natural protected areas in Peru in terms of diversity of flora.

Despite the great importance of this diversity, both areas are constantly threatened by activities and policies related to human impacts. These range from large-scale development projects, such as oil and gas exploration, to lesser problems with local populations, mainly in the buffer zones, where there is constant hunting, logging and deforestation.

Comparison of diversity of flora in Manu National Park with other natural protected areas

Protected Area	Families	Species	Spermatophytes	Trees	Orchids	Flora - Country (%)	Flora - Global (%)	Area (has.)
Manu (Peru)	157	4,212	~3,850	1,650	720	21.6%	1.54%	1,881.200
Cenepa (Peru)	181	3,504	3,236	~1,250	89	18.0%	1.29%	614,700
Iquitos Reserves* (Peru)	164	2,740	2,380	1,280	54	13.0%	1.00%	~3,100
ANP-Selva Central** (Peru)	181	2,701	~2,200	~1,100	200	13.80%	0.99%	302,600
Madidi (Bolivia)	211	3,981	~3,100	~1,750	121	25.90%	1.46%	1.895.740
Ducke Reserve (Brazil)	135	2,136	~1,850	1,129	96	0.6%	0.78%	10,000
Yasuní (Ecuador)	~190	3,100	~2,700	1,813	94 (epiphytes)	17.2%	1.14%	1,200,000

*= Alpahuayo – Mishana, Yanamono and Explore Napo.
**= Yanachaga – Chemillén National Park, San Matías – San Carlos Protective Forest and the Yanesha Communal Reserve.
The symbol ~ means «approximately».

Passiflora quadrangularis.

Tropical forests cover only seven percent of the global ice-free landmass, but host an estimated 40-70 percent of all species. Most of them yet to be discovered.

Scientific explorations in the park

Patricia Álvarez-Loayza and John Terborgh

Investigating is almost like breathing. From the time we are born, we investigate. Our bodies, our environment, the faces that look at us, our movements. We absorb everything we can, and then, as we grow, we continue to explore and absorb everything with innate curiosity. At some point in our lives, however, this congenital ability to question wears thin. We are no longer curious, no longer surprised at everything around us. The seeking, exploring, questioning the world, all of this seems to attenuate in us.

Scientific researchers, however, are people who never stop asking questions. Thanks to their work, human knowledge continues to grow and evolve. They are like curious children: science is their favorite toy and an endless source of pleasure. The researchers who had the good fortune to study in Manu National Park received the key to an enormous Eden, filled with megadiverse forests and precipitous mountains, tucked away in a tiny corner of the planet known to many researchers as the enchanted forest.

Ancestral wisdom of the inhabitants of Manu

The territories of Manu and their biodiversity have been known for hundreds of years. Although this knowledge was never written down, the native peoples maintain their ancestral knowledge, drawing on it so they can continue to live in these Amazonian forests.

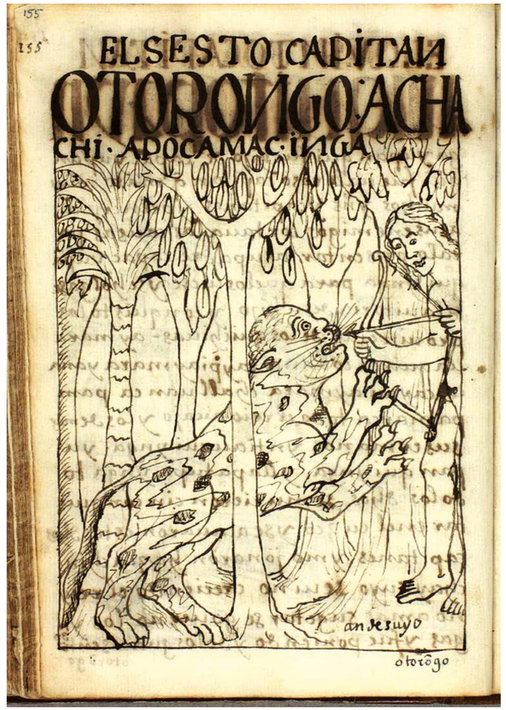
Documented studies actually began with expeditions east of Cusco by Quechua people and Spaniards. Although almost all failed or were annihilated, these early efforts give us an idea of the landscapes they encountered. The first geographic explorations reported in scientific publications came in the late 19th century, with the rise of the rubber trade, and launched what could be called the age of scientific exploration of Manu.

In the 1970s, nearly a century later, this area became known as a place where nature was at its most exuberant, giving rise to basic studies of the flora, fauna, climate and native populations within it. These studies formed the basis of hundreds that would follow, and those that continue to appear even today, renewing our knowledge with the use of sophisticated equipment and cutting-edge technology. To speak of research in Manu National Park is to speak of the history of this territory, of its incomparable scenery and its inhabitants, explorers and investigators.

Although their accumulated knowledge has never been written or printed in an encyclopedia, the native people who dwell in Manu can answer the most obscure questions about this Amazonian forest. Their knowledge of medicinal plants, ecology, animal behavior, economy and many other matters are indispensable for their everyday life and are crucial for enabling them to live in and with the forest. Manu National Park protects these populations from external threats, such as loggers and illegal miners.

For the physical and cultural survival of the indigenous communities and the park, and to combat other dangers now present in Amazonia, such as mercury pollution, oil spills or the extraction of non-renewable resources, it is vital to guarantee the continued protection of this area and to ensure that the work is done jointly with the local indigenous people.

In the traditional Matsiguenka community, there is no separation between work and leisure time, and the extended family often lives together.



«The sixth captain, Otorongo Achachi Ynga, or Camac Ynga, apu», by Felipe Guamán Poma de Ayala, *Nueva Corónica y buen gobierno* (1615).

The first studies and geographic explorations of the Manu territories

The first hand-drawn maps of these watersheds came with the Spanish conquest of the area, which was motivated not by investigation, but by ambition and the drive to evangelize the «infidels» of the region.

In 1536, Hernando Pizarro commissioned Pedro Anzúres, better known as Peranzúres, to travel to the land of the Chunchos, east of Cusco. In *The Spanish Conquistadores* (1934), Frederick A. Kirkpatrick writes that the expedition failed because the explorers had entered a forest full of swamps, rain and hardships, where they never saw the sun, devoured the flesh of their horses, and ultimately disappeared. Reference to another remote expedition is found in Fernando Santos–Granero´s *Etnohistoria de la Alta Amazonía: Siglo XV-XVIII* (1992), where he recounts how Pedro de Candia traveled to the headwaters of the Madre de Dios River, along what the explorer Juan Álvarez Maldonado years later would call the Manu River.

These expeditions, and others that followed, always ended with deaths and attacks by the indigenous inhabitants, who most likely acted in defense of their lands, assuming that the foreigners intended to rob them of their resources. The geographic explorations that revisited the courses of rivers and the locations of places identified by the first Spanish explorers began in the mid-19th century. By then, they depended on instruments such as compasses and sextants, along with the tenacity characteristic of committed and adventurous explorers.

It was the paper, *An Exploration of the River Purus* (1866), by W. Chandless, that corrected the idea that the Madre de Dios River was a tributary of the Purús River. The conditions under which these trips were conducted have been described in detail by Clements Robert Markham in *The Still Unexplored Parts of South America* (1877), where Markham recalls his participation in an 1866 expedition to the Madre de Dios River:

The first explorers entered a mystical, unknown world, a pure wilderness, shaped for millennia by the «will of the land».

Impressive buttress roots are common in the Amazon. They are long, relatively narrow extensions of the trunk and may be several meters tall. These structures are proven to aid in the absorption of water and nutrients and increase the area of gas exchange.

William Chandless (1829 - 1896), a British explorer of the Amazon. On one famous expedition, he reached the Purús River, adjacent to the Manu River system.

Sir Clements Robert Markham (1830 - 1916), a British geographer and explorer who led many expeditions around the world. He led one expedition on the Alto Madre de Dios River and recounted the scarcities and difficulties suffered along the way.

«I was then very young, and with no resources, without followers, without food and without shoes».

These travels enabled explorers to correct geographic routes and to compose the first documentation of the flora and fauna of the area. Thanks to the work of entomologist Fred. C. Bowditch in the area of Callanga, in 1911, the leaf beetle *Desmogramma callangaensis* became the first biological species scientifically described for Manu National Park.

Studies in Manu in the 20th century

In the 1960s, at the initiative of various Peruvians, many efforts were made to protect this area. Once it was established as a national park in 1973, many researchers were drawn to work there, whether because of the magic it exuded, its incredible scientific potential or its relatively pristine state.

One of them was John Terborgh, who at the time was a professor and researcher at Princeton University. Terborgh was already familiar with various protected areas in Peru, including the forests of Sira, but all of those places had been constantly impacted by the presence of human beings. He wanted to conduct a long-term study of ecological mechanisms in a primary forest, and for that he needed a place like Manu, where human impacts were minimal, the primary forests were hundreds of years old, and animals did not flee in panic when they sensed a human presence.

The expedition occurred in 1973, when Terborgh set off for the Manu River with Grace Russell, Robin Foster, Catherine Toft, the Brokaw family and Klaus Wehr, a resident of Atalaya who served as boatman and guide. They reached the place that would later become the Cocha Cashu Biological Station. This rudimentary station had been built, some years before the park´s founding, by the Frankfurt Zoological Society and the Forest Management Department of La Molina National Agrarian University (UNALM).

One of the ideas for its use was proposed by Kai Otte, a German student who was studying the imposing black caiman (*Melanosuchus niger*). The plan was for researchers such as Otte and others from UNALM to be able to use it for their projects once they completed their studies. Even Manuel Ríos, the legendary UNALM professor, participated in the construction of the first facilities. Unfortunately, the prohibitive costs of transportation from Lima to the biological station — which required travel by plane, truck and boat — kept the idea from reaching fruition at that time.

The Cocha Cashu Biological Station

In 1973, Boca Manu was a hamlet of little more than five houses, inhabited by settlers and indigenous people, where the only items for sale were bottles of beer and sugar cane alcohol. It was there that Robin Foster lost half of his botanical samples because of a «small» error in communication. Foster had collected botanical samples all along the Alto Madre

de Dios River, and upon reaching Boca Manu had packed them carefully and placed them in plastic bags with alcohol to preserve them until he returned from Cocha Cashu. Upon returning, he discovered to his horror members of one of the Boca Manu families had thought the samples were wet and had opened the bags to let them air. Of course, the alcohol evaporated and the samples succumbed to the humidity of the jungle.

Anxious to reacquire some of those samples, Foster collected as much as he could around Boca Manu. Above all, he had in mind a plant that he was sure was a species new to science. The Brokaw family volunteered to search for it, and in exchange, the researcher offered to name it for them. That is how one of Manu´s most charming plants was collected again — a species now known as *Styloceras brokawii*, in honor of the Brokaw family.

After that trip came many others. Terborgh began numerous studies in Manu that are still under way, and which have made the Cocha Cashu Biological Station a world-class research center. Hundreds of foreign and Peruvian students still travel to the station and produce a large number of publications about the ecology of the place. This, according to Pitman and other researchers, in *Volume and geographical distribution of ecological research in the Andes and the Amazon, 1995-2008* (2011), makes Cocha Cashu one of the most-studied tropical forests on earth.

Five New World Primates and its influence on tropical research.

The early studies were mainly exploratory, revealing the richness and biodiversity of the place. Based on numerous primate studies that began in 1976, as well as many years of work, in 1983 Terborgh and Russell, along with Charlie Janson, Debbie Moskovits and Barbara Bell, published one of the books most often consulted by tropical researchers: *Five New World Primates*. This work paved the way for numerous long-term studies of the behavior and ecology of various primate species in Peru´s southeastern Amazonia. Another key part of Terborgh´s research are the permanent field plots. The first, the famous

Styloceras brokawii.

«Trail 3» plot, was established in 1974. It includes one of the four majestic mahogany trees (*Swietenia macrophilla*) growing along the station´s trail system. This field plot, which now covers four hectares of vegetation, has been the site of various projects, such as studies of fruiting and seed fall over more than 10 years and the effect of defaunation on tropical forests.

Over the years, Terborgh and his team established more than 30 vegetation field plots in the Madre de Dios region, which are still used to monitor tropical forest dynamics. Some are now monitored by organizations such as RAINFOR (the Amazon Forest Inventory Network) and TEAM (the Tropical Ecology Assessment and Monitoring Network).

Drone view of the Cocha Cashu Biological Station, showing the kitchen, main building, Francis Boyssut laboratory and solar panels mounted on rafts on the lake.

Thanks to funding provided by Terborgh, the biological station was expanded and improved in the 1980s. The trail system was also expanded and now covers more than 52 kilometers, providing access to various habitats around Cocha Cashu. Two of the most important people in this restructuring process were Manuel Sánchez and Klaus Wehr.

Sánchez, a carpenter and field assistant, built various facilities, including the office and the old main house. Wehr established much of the trail system. As the station´s boatman, Wehr continued working in various lodges in the park for many decades. His house can be seen in the town of Atalaya — a small home, with a shed and a lovely view of the river, where hundreds of students, tourists and travelers have camped before setting off along the Alto Madre de Dios.

Species lists and long-term ecological studies

The first wave of researchers compiled the initial species lists and launched long-term ecological studies. Catherine Toft published the first list of amphibians for Manu in 1973; it was then expanded by Lily Rodríguez and John Cadle in 1987. In 1978, studies of terrestrial mammals began under the direction of Louise Emmons (better known by Cocha Cashu researchers as the «cat lady»).

Emmons worked with Terborgh and John Fitzpatrick to draw up the first list of terrestrial vertebrates in Manu. Emmons and Terborgh also conducted one of the most comprehensive study of the ocelot (*Leopardus pardalis*), thanks to Emmons´ work in Cocha Cashu during 18 months between 1982 and 1985. Later, Bruce Patterson, of the Field Museum of Chicago, and his outstanding team of Peruvian and foreign researchers expanded that list for the entire Manu Biosphere Reserve.

Widely known for its bird diversity, Manu has also been the site of various ornithological studies. The first were conducted by Terborgh, Fitzpatrick, Nina Pierpont, Charles Munn, Scott Robinson, the highly esteemed Ted Parker and many other researchers. These scientific studies, along with the range of bird sightings in the area, led to the compilation of the first list of the park´s birds, which helped catapult Manu to fame as one of the world´s greatest birdwatching destinations.

Many Peruvian researchers entered the park as principal investigators or field assistants. During the 1970s, both financing and support for students from Peruvian institutions were minimal. Even so, Mariella Leo was able to study the *Cebuella pygmaea* monkey, Lily Rodríguez conducted one of the most complete studies of amphibians in tropical forests, and Beatriz Torres investigated the striking hoatzin (*Ophisthocomus hoazín*).

Over the decades that followed, this trend intensified, and many students and local assistants trained in the «classrooms» of the Cocha Cashu Biological Station. Many of them completed their bachelor´s, master´s and/or doctoral degrees, and many have left their mark on global research in their fields.

Botanical collections

Knowledge of an ecosystem´s flora is one of the principal foundations of all ecological investigation. Robin Foster was one of the researchers who collected botanical samples in nearly every corner of the biosphere reserve. The first were near the Manu River during his first visit, in 1973. By then, according to Francis Macbride in *Flora of Peru* (1937), there were already collections for the area of Tres Cruces and Kosñipata, made by Cusco botanists Fortunato Herrera and César Vargas, and by Augusto Weberbauer and F. W. Pennell. None had been recorded for the Manu River.

After this first collection, Foster and his countless collaborators — including the fondly remembered journalist Bárbara D´Achille — documented the flora of Manu in various places inside and outside of the national park. They reached such remote places as the mouth of

Biologist Louise Emmons with an Indigo snake, *Drymarchon corais*.

Researchers outside the Cocha Cashu Biological Station, including Robin Foster, Betsabé Guevara, Klaus Wehr, Erasmo Guerra, Manuel Sánchez, John Terborgh, Charlie Janson, Wilfredo Tagle, Norma Jara, Washington Loayza, Edgar Pando and Carlos Calderón.

Ecologist Robin Foster drying botanical specimens.

Library in the Francis Boyssut laboratory at the Cocha Cashu Biological Station. This is one of the most complete libraries on tropical biology and ecology.

The Francis Boyssut laboratory is named after the former station manager who disappeared on a swim, possibly attacked by a caiman.

the Sotileja and Fierro rivers. Documents and first-person accounts of this work can be found in the Cocha Cashu library, in the herbarium of the Museum of National History in Lima, and in the herbarium and on the web site of the Field Museum of Chicago. The digital archives contain not only photos of the herbarium specimens, but also guides to the plants and images of live plants. Foster´s contribution to knowledge of the flora and the ecology of the biosphere is one of the most valuable legacies for Peruvians and researchers from around the world.

Recognition is also due to Alwyn Gentry, who in 1978 developed collections along the Kosñipata road and, later, in Cocha Cashu. His untimely death left a great void in the world of botany, but his legacy lives on in his famous book, *A Field Guide to the Families and Genera of Woody Plants of Northwest South America* (1993), which remains one of the fundamental texts of tropical ecology.

Many Peruvian and foreign botanists now work in the area. They continue to collect data in remote and known places in the biosphere, discovering new species and enriching botanical knowledge.

Other research programs in Manu

In the early 1990s, the Biological Diversity in Latin America Project (BIOLAT) established a research program at the Pakitza ranger station to assess various taxonomic groups. As part of that program, Foster established permanent field plots, Terry Erwin conducted entomological studies with an emphasis on beetles, and other researchers from various places focused on taxonomic groups such as birds or mammals.

Peruvian students participating in the «Field Techniques and Tropical Ecology» course sponsored by the Zoological Society of San Diego studying the map of the trail system at the Cocha Cashu Biological Station.

A tropical ecology student climbing the largest *Ceiba pentandra* at the Cocha Cashu Biological Station in 2000. This tree can be circled by 18 people, and its crown towers above all the other trees. It was partly destroyed during a thunderstorm, when lightning mutilated part of the crown.

Researcher Francis Boyssut with a red-bellied titi monkey (*Callicebus toppini*), which was caught in late 1999 to be fitted with a radio collar as part of his PhD research. It was then freed to join its troop so scientists could study it in its natural environment.

Terry Erwin fogging in Pakitza to study beetle diversity during the BIOLAT project. This work fundamentally changed ideas about the number of species on the planet.

The Frankfurt Zoological Society, under the direction of Christof Schenck and Elke Staib, began a program to monitor the giant otter in 1990. That launched one of the most successful conservation and environmental education programs in the area; it would later expand to include other species and encompass all of Peru. It is also important to mention the contribution of anthropologist Glenn Shepard, who conducted a long-term study during that decade of the culture of the Matsiguenka indigenous communities within Manu National Park.

Anecdotes and memories of a marvelous place

During these initial phases of studies, entering Manu was very difficult. The scientists had to take enough food and equipment for several months. First they bought provisions in Cusco, then they traveled by cargo truck for two days or more along a rutted, unpaved road. In Shintuya, they hired a boat to take them to the station. The trip took three or four days. Once they arrived at their destination and the boat left, the researchers were cut off, with no means of communication or transportation for two or three months. Solar panels and batteries did not exist, so there was no electricity. These inconveniences, however, were unimportant once they entered the incomparable forest of Manu.

There was neither internet nor electricity in Cocha Cashu. Those would not arrive until the first decade of the 2000s. In 1980, a radio was acquired for emergency communication, but not until the middle of that decade were solar panels installed to provide some electricity. Because of the distance and the cost of transportation, few people traveled to and from the area around the park. Despite these «inconveniences», however, dozens of researchers journeyed into the place to study one of the most biodiverse corners of the planet. Accidents and health problems were handled by the scientists and staff, creating bonds of camaraderie and deep friendships.

That spirit was evident on the day of the tragic death of researcher Francis Boyssut, an anthropologist and doctoral student from the University of California, Davis. Boyssut was studying Toppin´s titi monkeys (*Callicebus toppini*) and spent long field seasons in Cocha Cashu. In April 2000, there were only two field assistants at the station with him, Amy Porter and Jean Paul Sallat. Boyssut returned from the field after dark, as always, and took his customary dip in the lake. He had always bathed there, as had all the students and researchers until then. But that night, something terrible happened: Boyssut disappeared in the lake, leaving his clothes on the shore. Speculation is that he was attacked by a hungry caiman, but no one has ever really known what happened.

The other people heard nothing over the noise of the kerosene stove. It was only when Boyssut did not appear for dinner that they realized something was wrong. They searched tirelessly all night. They contacted the park rangers and people in Boca Manu. They even called Terborgh in the United States, using the satellite phone. For weeks, every effort was made to find him, but the search was fruitless.

Francis Boyssut left a deep void in the family of Cocha Cashu, where he is remembered for his extreme dedication to science, and especially for his love of nature and his extraordinary knowledge of the forest.

All of these details and events, which are never published in theses or scientific papers, are living memories of this remote, magical and invaluable place.

The consolidation of Manu and the current crisis of funding for ecological studies

By the end of the 20th century, Manu National Park was recognized as a bastion of tropical ecology research. The Cocha Cashu Biological Station, the site of hundreds of published studies, was famous worldwide.

It would be ideal to mention all of the researchers who worked in Manu National Park at one time or another and contributed to knowledge of these tropical forests, but unfortunately, space limitations make that impossible. Suffice it to say that a review by José Antonio Ochoa (unpublished data) confirmed that more than 2,000 studies from Manu had been published as of 2012. About 150 of them are doctoral dissertations. A more precise estimate comes from the Web of Science scientific database, which indicates that 52 scientific articles about Manu National Park have been published in the past two years. Three of them, with data from field plots near the Manu River and some dissertations, appeared in prestigious journals such as *Nature* and *Science*.

All of this, of course, has drawn international media attention to Manu. PBS (Public Broadcasting Service) and National Geographic from the United States, the BBC of England, Panamericana Television in Peru, and NHK of Japan have produced documentaries filmed in this paradise and featuring some of the researchers mentioned here (Shepard, Terborgh and Sherman).

Also outstanding was the work of Bárbara D´Achille, the famous journalist from *El Comercio*, who wrote about the park´s biodiversity, and whose many journalistic works were compiled in the book, *Uturunkusuyo. Perú: parques nacionales y otras áreas de conservación ecológica* (1996).

With all of this audiovisual and print coverage, the research helped solidify Manu National Park´s international reputation and make it a world-famous tourist destination.

It is also necessary to note, however, that the number of studies conducted in Cocha Cashu declined beginning in the 2000s. Although this could be due to various factors, including competition from other biological stations, one of the main reasons undoubtedly is the decrease in sources of funding for field studies in tropical forests.

Until 2006, for example, the budget for Cocha Cashu was completely covered by scientists´ funds through research fellowships that they obtained to conduct their field work. From the 1980s until the first decade of the new millennium, a doctoral student had more opportunities for research fellowships for long-term ecological studies. Changes in the global economy and in the orientation of research have caused this funding to decrease or dry up altogether.

Field research and natural history studies are no longer priorities for most institutions. As a result, research interests are channeled toward other disciplines, such as computational studies or data analysis. Since 2011, Cocha Cashu has hosted only four master´s and doctoral students. Long-term projects have decreased or disappeared for lack of funding. The only long-term projects still under way at the biological station are being conducted by RAINFOR and the TEAM Network, with monitoring of the field plots established by Terborgh. The TEAM Network is also continuing to monitor terrestrial vertebrates in the park, an effort that began in 2011.

Although funding for the two monitoring networks continues to shrink, it is hoped that these activities will continue, because these long-term monitoring studies are vitally important for understanding ecological processes in tropical forests.

View of the main house at the Cocha Cashu Biological Station, which was renovated and expanded in 2015. During the rainy season, the lake water reaches the door of the main house. In 2003, the waters of the lake and river covered the floors of the houses.

Challenges and possibilities for research in Manu in the 21st century

In 2004, satellite internet was installed for the researchers and staff of the Cocha Cashu Biological Station, significantly improving communications, logistics and access to research material. After decades during which letters arrived only when a boat docked at the station, communication with the outside world is now much easier.

Since the early 2000s, other scientific centers have been established in the Madre de Dios region. The Amazon Conservation Association opened the Los Amigos River Biological Station and later the stations at Wayquecha and Villa Carmen. Other organizations, such as CREES (Conservation, Research & Education towards Environmental Sustainability), opened research centers and promoted volunteer activity to encourage conservation and research in the Manu Biosphere Reserve.

These stations, which are strategically located and easily accessible and have ideal infrastructure, have increased studies along Manu´s elevation gradients and in little-explored areas outside of the park.

Finally, in 2011, after 40 years under John Terborgh´s administration, the San Diego Zoo Society took over management of the Cocha Cashu Biological Station under an agreement with Peru´s National Service of Natural Protected Areas.

Manu National Park today

Ours is an age of great scientific advances, high-speed computers and electronic devices that can reach places where access would have been impossible just a few decades ago. Now there are smartphone apps that help identify species, record sounds and take photos anywhere. There also are laboratories capable of deciphering the genetic, functional and metabolic characteristics of large, small and microscopic organisms.

Using new technology, vegetation is monitored with LIDAR images. It is also possible to install digital camera traps with infrared sensors, monitor animals using satellite sensors, and analyze data using complicated mathematical models and state-of-the-art computers.

The new researchers in Manu now have incredible advantages for conducting their projects: besides cutting-edge technology and the unequaled legacy of collections from past decades, they have access to various historical data for their comparative studies and to hundreds of scientific papers that will help them understand the history of these tropical forests.

Although the technological advances of the 21st century represent a giant step for scientific investigation, we are forgetting to continue the basic study of the natural history of our environment. The same can be said of the natural history of these tropical forests.

Nowadays, according to the study, *Natural History´s Place in Science and Society* (2014), by J.J. Tewksbury and colleagues, taxonomic collections have decreased worldwide, and the teaching of natural history has declined.

In his paper, «The Impending Extinction of Natural History» (2002), David Wilcove — another alumnus of Manu´s classrooms — reminds us that neglect of and a shortage of financing for natural history courses will cause a true scientific disaster. Funding is not channeled toward these types of studies. Field trips have been reduced, and with them, appreciation for and knowledge of nature.

How can anyone understand a tropical forest without exploring its ecosystems and learning from the different organisms that interact in it? The diversity and complexity of nature cannot be ignored. Manu National Park calls us to remember that nature is complex, and that the basic study of the natural history of these forests is the cornerstone of more detailed studies.

Camera trapping has become an important method for monitoring larger animals. Several studies have been conducted in Manu.

Modern science and natural history are complementary, not mutually exclusive. This is demonstrated by the scientists who have worked in Manu National Park, where direct contact with the forest brings them face to face with a world that is impossible to observe through satellite images or touch through a drone.

Some argue that most of the exploratory work was done years ago, and that there are now sufficient data to enable us to understand tropical forests. That is not true. Many recent studies, which conflict with conventional scientific thinking, are based on observations of natural history. There is much to be discovered and investigated, and the new generations of researchers — Peruvian and foreign — need the funding, support and facilities to continue to conduct responsible studies inside and outside of the protected areas.

It is necessary to once more encourage field research, long-term monitoring and studies of natural history. The conservation of our ecosystems depends, ultimately, on all of us. Tropical forests are still largely unknown.

In Manu National Park, which is one of the most-studied places on the planet, new species of animals and plants are still discovered each year. In 2013, the Peruvian scientists Alessandro Catenazzi and Rudolf von May published a new list of amphibians of Manu, with surprising results: with 287 species, the park claims the title of the most biodiverse place in the world. In addition, a study by Shepack and other researchers, published in 2016, announced the discovery of a new frog species (*Pristimantis*) in the national park.

These investigations, which are based on the natural history of these forests, on exploration and intensive field work, form the foundation for studying the effects of climate change, population genetics, the mechanism of biodiversity or new diseases.

These tropical forests are still mysterious; everything has not yet been discovered, and much remains to be investigated. Let us hope that Manu National Park will continue to harbor hundreds of researchers, students and others who are interested in nature, and that this eagerness to understand and investigate will never disappear.

Pristimantis toftae, named for Catherine Toft, one of the first female researchers to work in Manu.

Chapter 5

Emblems of conservation: the Big Five of Amazonia

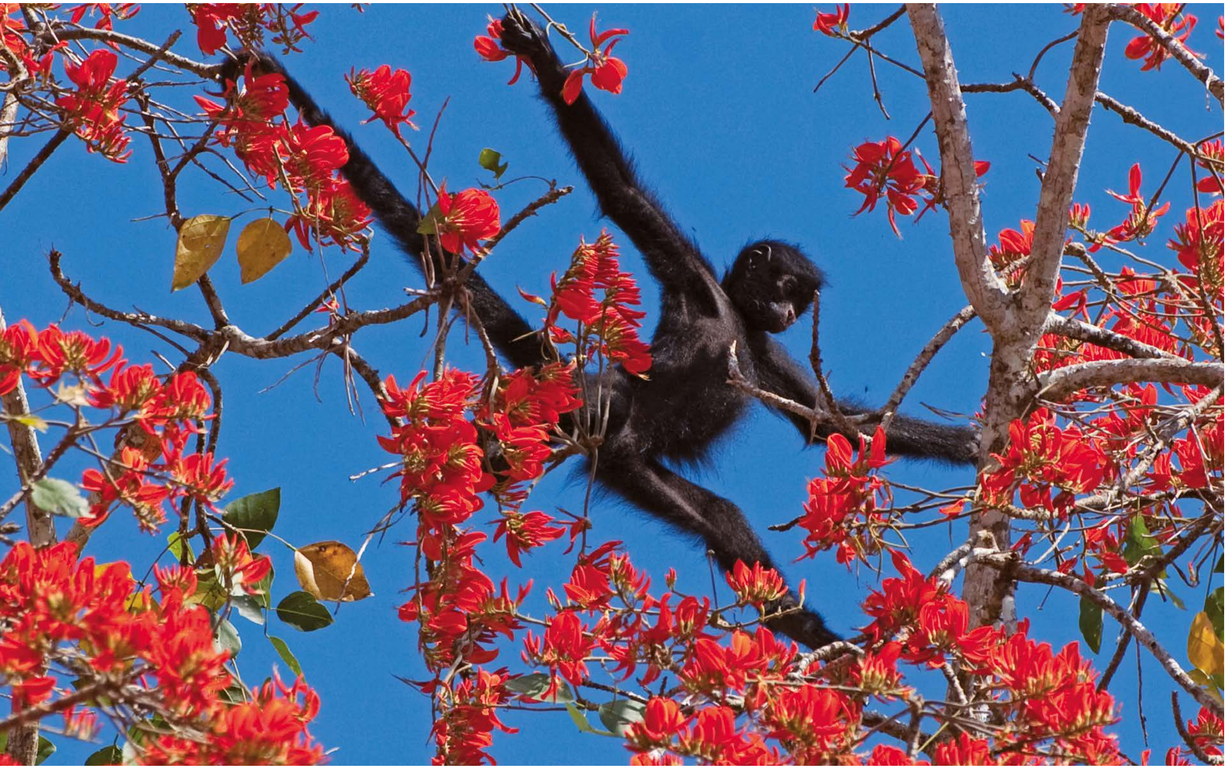
Christof Schenck

Africa is famous for being home to five of the most prized species in the animal kingdom. They are known as the Big Five. The elephant, rhinoceros, cape buffalo, lion and leopard are the members of this league of extraordinary animals.

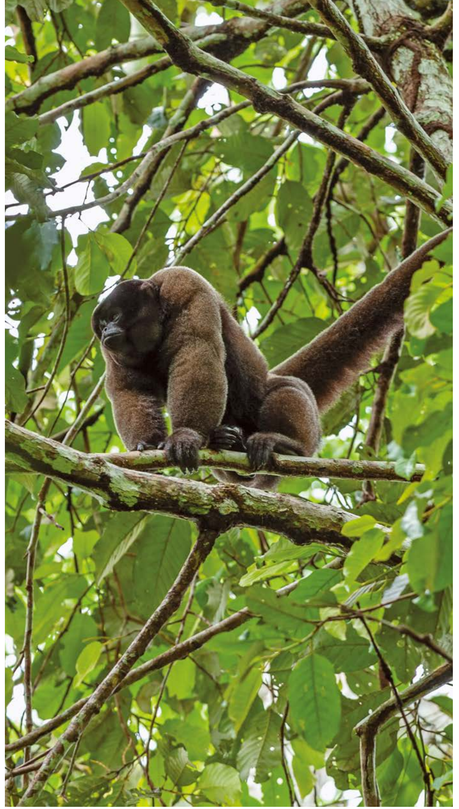
The Big Five was the expression used by 19th century hunters to classify species that were difficult and dangerous to hunt: animals whose horns, hides and fangs were prized as trophies. Later, the Big Five became the targets of bloodless safaris by tourists and photographers, leading to a new category of outstanding natural reserves. These animals need huge expanses of land and virgin ecosystems to ensure their long-term survival under natural conditions. The reserves that are home to the Big Five must therefore provide thousands of square kilometers of wilderness and species richness.

Unlike the African savannah, it was impossible for the tropical jungles of South America to become the El Dorado of big game hunting. The rivers and forests were largely impenetrable and had never been used that way, and there were few animals suitable for trophy hunting. In addition, most South American countries had freed themselves from colonial

Manu is home to the red howler monkey (*Alouatta sara*), yet the systematics of howler monkeys and the various species and subspecies is not fully clear.



Bearing only one offspring every two to four years, spider monkeys reproduce slowly. Their presence is a sign of an intact ecosystem, as overhunting easily leads to extinction of the species.



Woolly monkeys have relatively large territories of more than 10 square kilometers. They are listed as endangered on the Red List of Threatened Species.

powers more than 100 years before those of the African tropics, thus avoiding the establishment of colonial big-game hunting of European or American origin.

This raises intriguing questions. Which species might represent the Big Five of Amazonia today? Are there species that create prestige for an area, that tourists would travel around the world to see? Are there species that could act as symbols – what conservationists call «flagship species» — representing and promoting the value of the area to the world?

Decisive factors

Lets start with size. From the outset, theres a surprise: animals in the South American tropics rank last in body size compared to the megafauna of other continents. Of our closest relatives, the primates, howler monkeys, spider monkeys and woolly monkeys are the largest of the 15 monkey species found in Manu. Their weight, however, which ranges from seven to 10 kilograms, is just one-tenth of the weight of an adult male chimpanzee and only one-twentieth of a gorilla´s 160 kilograms.

Howler monkeys may not be large, but they certainly are loud. And how! Anyone who has heard them — and any visitor to Manu undoubtedly has — will never forget their acoustic prowess. Noisy, but small: the primates probably don´t qualify for the Big Five.

If monkeys cannot offer an ideal candidate for the list, what about the large herbivores? South American tapirs (*Tapirus terrestris*), for example, are impressively heavy: they can tip the scales at 250 kilograms. Interestingly, the females may weigh as much as 100 kilograms more than the males. The genus *Tapirus* has lived on Earth for more than 20 million years. Its diet consists of more than 300 plant species, giving it an important ecological function as a seed disperser. The tapirs´ paths, meanwhile, lend structure to the forest. In many places around the world, megaherbivores are considered landscapers because of their feeding behavior, which influences species diversity and the structure of entire ecosystems.

The giant anteater, a toothless insectivore, is part of the Amazon´s megafauna. Including the long bushy tail, it can exceed two meters in length.

Tapirs occur in low population densities and their reproduction rate is low. This makes them very vulnerable to overhunting.

More and more studies show that the loss of these key species causes a cascade of changes that impoverish ecosystems and make them more vulnerable to disturbance. Tapirs are not abundant, and they are predominantly nocturnal. That´s not good news if the idea is to view these archaic-looking herbivores. However, because they are good swimmers, and can even dive, these compact animals with prominent noses prefer flood-prone areas, which makes it possible to see them at a distance during a long boat trip through the national park.

Tapirs may be spotted resting on a sand bank in a meander or swimming in the Manu River. They are more likely to be seen at night when they visit salt licks, called colpas, to ingest important minerals. Manu Wildlife Center, a lodge in the park´s buffer zone, is an excellent place to see them. As the largest terrestrial animal in the jungle, the tapir clearly deserves a special place in the Big Five league.

Spectacled mountaineers

The next candidate, the Andean bear (*Tremarctos ornatus*), is larger than the tapir although not as heavy. Adult males can weigh as much as 175 kilograms, while the females, weighing up to 100 kilograms, are much smaller. Standing on its hind legs, at two meters tall, the male towers over most humans.

The light patches on the head and neck — which contrast with its black fur and often ring the eyes — gave it another popular name: spectacled bear. Because those patches range in color from whitish to red, villagers around Manu Natural Park have given the bears their own nomenclature in Quechua.

Yuraq mat´i refers to the bear with whitish patches, while *Puka mat´i* refers to those with reddish spots. *Yuraq mat´i* is small and more docile, and is happy to eat corn. *Puka mat´i* is

Every Andean bear has a unique pattern of colored fur on its face and throat. These patterns can be used to identify individuals and thereby determine population size and density.

more aggressive and sometimes attacks cows. These distinctions have not yet been scientifically supported, however, and despite the differences in coloring and behavior, subspecies have not been defined.

As their name indicates, Andean bears live throughout the Andes, the longest mountain range in the world. Their huge range of distribution extends from Venezuela, in northern South America, to Bolivia and northern Argentina. These bears like the cloud forests of the rainy Andean slopes at elevations above 1,000 meters. That is where the saturated air from the lowlands hits the steep Andes, losing humidity as it rises.

Accumulated precipitation from torrential rains or even drops of mist can exceed seven meters. Despite the harsh climatic conditions, the region is affectionately known as the «jungle´s eyebrow». The climate is constantly humid, but terribly cold at certain elevations, although sunny days bring searing heat. The flanks of the Andes are marked by steep, sometimes nearly vertical, slopes. Over millions of years, mountain streams carved deep ravines in the mountain range and gradually molded them.

The forest covering the cliffs does not rise far above the soil, although the plants appear to be connected and intertwined. From a soft, dense carpet of mosses and ferns grow gnarled trees draped with bromeliads, lichens and orchids. Landslides are frequent, and after such an occurrence, decades pass before climbing plants cling to the rocks again or the wind carries seeds with a little soil to fissures, allowing the uprooted forest to close again.

Any animal that lives here must be a good climber and have dense fur that sheds water easily. Omnivores have a clear advantage here, because traveling long distances in search of a special meal takes time and is not easy; it is much better to eat everything available. It also helps to be solitary, as this sensitive ecosystem could not feed large herds or groups.

The Andean bear is well equipped to inhabit this area. It is the only South American bear and the only survivor of the genus *Tremarctos*, which originated more than seven million years ago. Its dense, shaggy fur protects it against inclement weather, its strong claws give it a good grip, and four-legged locomotion is unquestionably the best option for steep terrain.

The bear is not an epicure; it eats whatever it can. To date, more than 300 food plants have been identified as part of a diet that — consisting of 90% bromeliads and cacti, depending on the region and season — could otherwise become monotonous.

The bear concentrates on the tastiest and most nutritious parts of the plants. Like most bears, Andean bears also like fruit, although they don´t turn up their noses at bamboo shoots or orchid flowers. Bears rarely feed on rodents, snails, gastropods, insects or birds because they are difficult to find and catch. From studies of bears equipped with radio collars, we know that they sometimes travel just a few hundred meters a day, while at other times they may cover 15 kilometers or more.

A female´s territory encompasses approximately 34 square kilometers, while the male´s is about five times that size. The bears are not particularly territorial so their domains often

The Andean bear´s diet consists of more than 300 plant species, including bromeliads, which are abundant in the species-rich cloud forest.

overlap, and it is not unusual, for example, for one solitary bear to encounter another near fruit trees or a corn field.

Like many herbivores, the Andean bear is also an important seed disperser. When it excretes undigested seeds, it also adds fertilizer to poor soil with little humus, providing them with optimal growing conditions. Even in their fur, the bears transport many seeds that propagate trees, shrubs, ferns and orchids.

An animal that can thrive under the rugged conditions of the steep, humid slopes of the Andes can easily adapt to other places, and it is not surprising that the Andean bear has not only a large range, but also the ability to populate diverse biotopes. These bears are able to descend to tropical lowlands at 250 meters and climb to snow-capped mountains at more than 4,000 meters. They love cloud forests with abundant precipitation, often more than 1,000 millimeters a year, although they may also roam through deciduous dry forests where rainfall is no more than 250 millimeters a year.

Protecting the bear benefits everyone

Despite their versatility, Andean bear numbers are naturally low, and are decreasing because of human impact. In the 80,000 square kilometers of their area of distribution in Peru, an area equivalent to the U.S. state of Maine, the population is estimated at 5,700. The total in South America must be less than 25,000 bears. Because of the decreasing population and the gradual loss of habitat, the International Union for the Conservation of Nature (IUCN) Red List classifies it as a threatened species.

Bolivia, Colombia and Peru are home to the largest populations of Andean bears. Protected areas such as Manu National Park and Biosphere Reserve are extremely important for its survival. It is rare for a protected area to include an altitudinal gradient like Manu´s that provides the bear with such a wide range of habitats.

Protecting the Andean bear goes beyond species conservation. Its home in the cloud forest is particularly rich and boasts an extraordinary number of endemic plant and animal species, which are found nowhere else on earth.

The eastern flank of the Andes plays an important watershed role, while the dense forests are a key carbon sink. The loss of forest causes landslides on slopes in the rainy regions, which threaten to bury roads and villages. Approximately 15% of the tropical forests are cloud forest, and they are at grave risk of destruction because deforestation is particularly serious in this area.

The danger facing the «eyebrow of the jungle» is visible in the area around Manu National Park, where towns are expanding and new roads are creating access to other regions and markets. Farming and ranching on hilltops and in valleys, and logging and coca cultivation in the lowlands, all drive an increasing loss of the incomparable Andean forests. Fires are also lethal, caused by farmers who seek to both clear forest and release a burst of nutrients in fields for crops. These fires frequently race out of control, especially during the dry season, and end up exterminating the complex ecological communities of the Andean hillsides.

As we can see, times are increasingly tough for the Andean bear. Despite its size, charismatic appearance and uniqueness in South America, it never received the attention it deserved as a resident or neighbor of Manu National Park, partly because bears are rarely spotted by visitors. Furthermore, bears are often in conflict with local farmers, as they are attracted

Andean bears are excellent climbers and important seed dispersers, scattering plant seeds that cling to their pelt and spreading them through their excrement.

Rare, shy and often nocturnal Andean bears are seen once in a blue moon. Scat and tracks confirm their presence.

Camera traps are the method of choice to detect individuals and learn about distribution and density.

Once despised as a cornfield thief and livestock predator, the Andean bear is now accepted by some Andean communities as their natural neighbor, thanks to scientific data and environmental education.

to crops and livestock; if a corn field in a remote community is raided, bears often pay with their lives.

The National Service of Natural Protected Areas (SERNANP) finally declared publicly that killing Andean bears is illegal. That, however, led farmers in Otacani to capture a bear cub in 2012 and hold it hostage to demand economic compensation for their ruined corn fields. Authorities rescued the animal and threatened to jail anyone who tried a similar tactic.

A year later, under the direction of Roxana Rojas-Vera Pinto, the Frankfurt Zoological Society — in association with SERNANP and as part of the ProBosque Manu project — began to address conflicts in the upper parts of the park, with special attention to those involving Andean bears.

The questions posed as part of the strategy included: Where and why do conflicts occur? How many bears are there, and how can harm to farmers be limited? What is the best way to convert someone who sees bears as pests into someone who feels empathy for them?

Wisely, the project leader hired several young people from communities around the park as project assistants. Not only did they have extensive local experience and the ability to endure the harsh climatic conditions, but they were also enthusiastic about the scientific tasks, such as mounting camera traps and looking for bear tracks and other signs. Gradually their respect and admiration for their large, shaggy study subjects grew, and they took that respect and admiration home with them when they returned to their communities.

Upon closer examination, it became clear that the bears were not guilty of all damage to cornfields. Sometimes the culprits are rodents, such as the mountain paca (*Cuniculus taczanowskii*), or flocks of parrots that strip the cobs of corn. Research also determined that other crops, such as the traditional Peruvian cape gooseberry or *aguaymanto* (*Physalis peruviana*), are less affected by bears and may even fetch higher prices than corn in the market. The timid bears also tend to avoid fields located near a community. This indicates that better agricultural practices alone could significantly reduce conflicts.

The case is somewhat similar for cattle: a bear that has fed on a cow or calf did not necessarily kill it. The bears eat carrion, and cattle may die of disease or accidents on the rough terrain. Pasturing rights still exist in some regions of the park, and not surprisingly, conflicts have been more frequent in those areas.

While farmers complain of the loss of calves, park guards blame them for damage to fragile vegetation trampled or uprooted by their cows. In the highland of Tres Cruces, as part of a pilot of the ProBosque Manu project, the cows that were pastured in the park were purchased and all pasturing rights were revoked in 2014. The price paid as part of the deal was substantially higher than the market price, making it very attractive for the farmers. As a result of that agreement, there are now fewer conflicts, and the farmers are proud of their contribution to the park´s protection.

An extensive public relations campaign in various communities gave the Andean bear an additional boost. Games, theater, coloring books and talks showcase the bears as impressive

but vulnerable neighbors of which people should be proud. Children are especially receptive to these activities and messages, particularly because the program brings more variety to life in the Andes, which can sometimes be monotonous.

Besides raising awareness, providing environmental education and reducing conflicts, these activities can promote alternative sources of income. As part of the project, the quality and production of textiles and *aguaymanto* increased. It is fascinating to see all that can be achieved in the Andean zone of the Manu Biosphere Reserve thanks to the bears!

The Andean bear is certainly a candidate for the Big Five, but unfortunately, few people will ever see one.

According to researcher Rojas-Vera Pinto, her own Andean bear sightings in the past three years have been so rare that they can be counted on the fingers of one hand. Twice, they lasted just seconds. Her longest observation was half an hour and that, of course, was while the bear was enjoying a remote cornfield.

Giant otters

The giant otter is the next candidate for the Big Five list since, as its name indicates, it is notable for its size. Giant otters really are giant. With muscular bodies measuring two meters in length, from the tip of the nose to the tip of the tail, they are the largest of the world´s 13 otter species.

Along with the jaguar, puma, black caiman and anaconda, the giant otter is one of the largest predators in the Amazonian lowlands. But giant otters are now scarce, and they are classified by the IUCN Red List as «endangered». In the Convention on International Trade in Endangered Species, the giant otter is listed in Appendix I, which states: «They are threatened with extinction and CITES prohibits international trade in specimens of these species».

Inhabiting pristine rivers and oxbow lakes or c*ochas* with abundant fish, giant river otters are perfect biological indicators — species that reflect the state of the environment. Human activities also encroach on their habitat, however, as rivers are the main transportation arteries in Amazonia. The sensitive otters cannot tolerate intensive boat traffic, and overfishing quickly robs them of their food supply.

The rivers are also contaminated with toxic substances dumped by humans, such as the mercury used for gold mining. Mercury impacts fish, and while there are no studies yet of its effects on giant otters, the heavy metal is known to interfere with reproduction, cause deformities, lead to cerebral malfunctions and weaken the immune system. Because the giant otters feed on fish, they are very likely to be affected by this pollution.

One matter of great concern is that high concentrations of mercury have been found in catfish species in the national park, even though the nearest miners were operating 200 kilometers downriver. Mercury apparently accumulates in the tissues of these long-lived, migrating fish, which then transport it to unpolluted regions such as Manu National Park.

An ideal biological indicator must not only react quickly to changes in the environment, but should also be «easy to read» — in other words, changes in its demographics or behavior must be visible. The giant otter meets all of these requirements. As an aquatic species, it can be observed in rivers, streams, lakes and swamps where data collection is easier and visibility higher than in the dense forests.

Giant otters have a visible «fingerprint» – the throat! Using this throat pattern to identify individuals, scientists have been counting otters in Manu for nearly 30 years and have followed some throughout their entire lifespan.

Once hunted excessively for their pelts, giant otters survived only in remote places. Finding a pelt today is very rare. The trade has long been banned, and killing otters is a severe offense.

Otters are also diurnal and, like the Andean bear, each animal is individually recognizable. The distinctive markings of otters, known as «throat patterns» appear only under the chin, but are nonetheless easy to see and photograph. This allows otter numbers to be counted and makes long-term monitoring of individuals possible. The Frankfurt Zoological Society has been doing this in the national park for more than a quarter of a century.

Through this work, researchers discovered that the largest population in the entire Madre de Dios region lives on the Manu River. The annual counts held since 1990 have recorded between 41 and 75 individuals when more than 20 lakes or *cochas* were included in the survey. The upper courses of rivers serve as refuges for the river otters, while large lakes are their preferred homes.

There they live in larger groups and raise more cubs. The Madre de Dios River once offered the best living conditions for otters, but human activity led to their eradication in most parts of this river system. More than a Garden of Eden, therefore, Manu may be a last refuge for the river otter.

Social and playful, giant river otters enchant anyone who sees them. They are a sensational attraction and very popular with tourists and tour operators. Besides being biological indicators, they are also an ideal flagship species. For decades, an environmental education program has told the story of Pepe, the giant otter, in a coloring book, and has greatly increased local appreciation both for otters and their habitat.

The otters´ popularity with tourists was such that disturbance became a serious factor that reduced their reproductive success. This led to a series of measures to enable visitors to observe the animals without disturbing them. These included the construction of observation posts and the controlled use of a catamaran for viewing.

The success was resounding: the likelihood of seeing giant otters increased considerably and their reproductive rate returned to normal. Much of the credit is due to Manu National Park managers, first for taking the research teams´ results and suggestions seriously, and second for conscientiously implementing protective measures that sometimes put them in conflict with the interests of tourism operators.

Over the years, the giant otters have become icons of the intact jungle. This has also occurred with wolves in the forests of North America and Europe; those animals became the symbol of wilderness, representing the idea that humans should not dominate everything and must leave room for large predators. The same can be said of the giant otter of South America. And one of its names in Spanish — wolf of the river — fits perfectly for that.

How giants become giant

Although both the terrestrial wolves and the wolves of the river hunt in packs, unlike its terrestrial namesake, the water is the otter´s element. Its long, wide tail is an excellent tool for propulsion, supported by an especially flexible spinal column, short but strong legs, and the web-like membrane between its toes. In the water, river otters move like lightning and are extremely agile.

As predators, the otters easily outcompete the caimans, which lived in tropical waters for millions of years before otters evolved, and which also hunt fish. The otters are faster and more effective, and their hunting strategies are different. While the imposing reptiles are energy savers, otters are high-performance machines. Agile and quick, they also have a high demand for food. A giant river otter eats about four kilos of fish a day, comparable to a man eating 10 kilos of meat in the same time period.

Another obvious characteristic is that unlike most Amazonian mammals — which are small, nocturnal and mainly solitary due to the scarcity of nutrients and high competition — giant otters are diurnal and live in groups. Even close relatives, such as other otter species or mustelids, prefer solitude. Why, then, are giant otters the exception to the rule?

First, the water is not a hospitable environment for mammals and it is generally cold; body heat is transferred in water 25 times as fast as in the air. Moving in the water expends a great deal of energy. Unlike seals, river otters lack an insulating layer of fat and must depend solely on their dense fur.

If heat loss is likely to be a problem, large body size is preferable. The larger the animal, the greater the surface-to-volume ratio and the lower the heat loss. A large motor requires a great deal of fuel, however, and fish eaters can enjoy the luxury of large size as long as there is a high density of fish. In the lakes formed by large rivers, that density is, in fact, unusually high.

In addition, the waters of the Amazon, at more than 28 degrees, are actually quite warm. That gives the giant river otter a clear advantage over its European relatives, which must hunt in frigid waters. Giant otters, for example, can dive more often and stay underwater longer because their energy balance more easily remains positive.

The giant otters´ exceptional size has another advantage: it excludes them as prey for other large predators, including the black caiman. Other animals also prefer not to tangle with the brave and agile river otter. That leaves them free to take advantage of daytime

visibility to hunt, unlike many other mammals which must seek the protection of the night. Giant otters also are rarely alone. The high density of fish makes it possible to satisfy even groups of 10 in areas of just one square kilometer. And besides offering protection, living in a family has allowed them to develop ingenious hunting strategies.

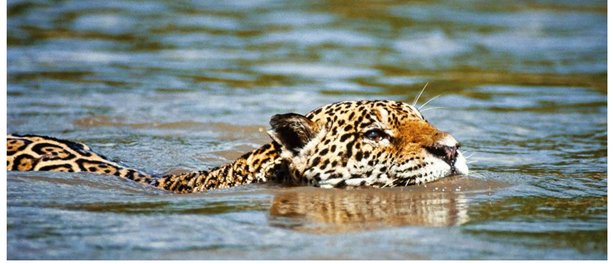
Indigenous people living in tropical forests have never hunted giant otters. To those inhabitants, the otters were neither meat nor fish, and were therefore considered inedible. They also were not interested in their pelts, which were useless in the tropical climate. That contrasts radically with high society in the western world in the middle of the last century. There the pelt of the giant otter was considered prime material for luxurious fur coats, the value of which exceeded even that of spotted felines.

Their curiosity, family spirit and air of superiority made the giant otters easy prey once their pelts became popular, and nearly caused their extinction a few decades later. Not until an international ban on the trade was established did this lucrative business collapse. Unfortunately, during the preceding three decades, some 24,000 pelts had been exported from Peru alone.

The population of giant river otters never fully recovered from that tragedy. Although otters survived and increased in remote regions, their habitats continue to shrink. Human activity, such as colonization of the jungle, agriculture, logging, gold mining, dams, and oil and gas exploration, has a huge effect on the development and reproduction of giant river otters.

It is only in places where otters hunt like dolphins and bask in the sun on fallen logs that the tropical world is still healthy. A small but relatively stable population of giant otters in Manu National Park is witness to that.

Giant otters eat fish almost exclusively. They hunt together, but generally do not share their meals.



Jaguars are relatively common in Manu and might outnumber giant otters by a factor of 10. Unusual for a cat, they love water.

Finalists and winners

The penultimate candidate for the Big Five list is a guaranteed winner. If one of Africa´s Big Five is a large, spotted feline, the South American jaguar is its rival. Stockier than its African relative, the jaguar is the only large cat in the region.

What a powerful animal! Strong legs, a solid skull and a beautiful fur that, like that of the leopard, can be almost completely black. Its bite is simply phenomenal: twice as strong as that of a lion, and the most powerful of all the felines. Not only can it fracture a turtle´s shell, but it can kill its prey by crushing the skull.

Its weight varies drastically, from 36 to 158 kilograms, depending on the region. The lightest ones are in forested areas such as Manu National Park. Jaguars love the water. On sand or pebble beaches, they stalk turtles, caimans or capybara. Swimming in lakes or even the Manu River is nothing to them.

There are various candidates for the last of the Big Five, of which five stand out: First is the black caiman (*Melanosuchus niger*), a huge super predator that measures five meters in length and can weigh up to 400 kilograms. Unfortunately, it has been heavily hunted in many places and is extinct in others. Manu is home to a good number of them, and it is not unusual for park visitors to spot them.

The big cats are at the top of the food chain. Their disappearance can trigger trophic cascades, leading to a shift in species composition and ultimately to the change of entire landscapes.

The second is the capybara (*Hydrochoerus hydrochaeris*), the world´s largest rodent. Measuring up to 1.34 meters from the tip of its nose to the base of its body, and weighing nearly 90 kilograms, it is almost a giant guinea pig. In fact, the capybara belongs to the same family, *Caviidae*.

The anaconda (*Eunectes murinus*), third on this list, is one of the largest snakes in the world. The female, which can measure up to five meters in length and weigh as much as 90 kilograms, is larger than the male. There are reports, however, that a nine-meter anaconda was once killed.

The giant anteater (*Myrmecophaga tridactyla*) is also large, measuring as much as two meters if its shaggy tail is included. Like the giant river otter, it is larger than many humans. It is also a specialist in devouring ants, with an impressive record of as many as 35,000 a day.

What the jaguar is on land and the giant otter is in the water, the harpy eagle (*Harpia harpyja*) is in the air. The last candidate is the only representative of its genus and is considered the strongest bird of prey in the world. Its talons are as large as the claws of a grizzly bear. The females weigh twice as much as the males, reaching nine kilograms, and the bird can carry a monkey or other prey that weighs as much as the harpy does. Like all top predators, the harpy eagle needs a lot of space and extensive pristine forests to live.

These inhabitants of Manu are all big — the black caiman and the anaconda may grow as long as five meters. The capybara is the world´s largest rodent and can weigh as much as 90 kilos.

It is no surprise, then, that Manu National Park managers chose it from the start to grace the park´s logo. As a large, charismatic animal, the harpy eagle could create sympathy for protective areas.

A final selection could designate the tapir, Andean bear, giant river otter, jaguar and harpy eagle the Big Five of Amazonia. Mainly, though, this overview is meant to emphasize the crucial importance of Manu as an extraordinary refuge for some of the largest, scarcest, most demanding and most impressive animal species.

In that, beyond a doubt and with the highest distinction, Manu National Park merits the gold medal among South America´s national parks.

These rare and extremely powerful birds of prey are the symbol of the Manu National Park.

The harpy eagle takes its name from Greek mythology. Harpies were birdlike demons of the storm, with a woman´s head and wings.

Chapter 6

The people of Manu and their cultural diversity

Miguel Macedo and Johny Farfan

The Manu Biosphere Reserve is a place of high cultural diversity. This is underscored by the existence of at least six different languages and various kinship systems, both patrilineal and matrilineal. It is also reflected in the varied tasks and activities of the groups of farmers, hunters and gatherers who produce technologies and handicrafts characteristic of the area, such as Yine ceramics, Matsiguenka baskets or Harakbut arrows.

It is important to understand that the culture of any human group is not reduced to its language, but comprises various characteristics, including knowledge, spirituality, technologies, arts, customs and human relationships. Together, these aspects give a people its identity. Because culture is the response of a human group to its environment, to ensure its survival, it is not surprising that an area of tremendous ecological and biological richness, such as the Manu Biosphere Reserve, is associated with a high degree of cultural diversity.

Matsiguenka people living inside Manu National Park still hunt with bow and arrow.
This makes overhunting very unlikely, whereas using shotguns can easily lead to local extinction of species.

Yomibato is the native community closest to the heart of Manu National Park. Its inhabitants are Matsiguenka and still maintain their traditional lifestyle.

The number of Matsiguenka people living inside the national park is still relatively low, but the growth rate is high. This poses challenges for the future.

Cultural differences are more marked in territories with different ecosystems. For example, culturally, Amazonian indigenous populations differ more from Andean groups than from one another. Because languages, beliefs and customs vary from people to people, however, there is wide cultural diversity among Amazonian indigenous peoples, although there also are certain common characteristics.

Cultural diversity is positive for humanity. Different cultures have different ways of managing natural resources and relating to the environment. These forms are the result of thousands of years of interrelationship with the environment and offer valid alternatives for appropriate management of the resources that contribute to sustainable development.

In emblematic places such as the Manu Biosphere Reserve, where nature has maintained its natural character, value is placed on the knowledge of many plant and animal species that have curative properties or serve as food, and which have not been recognized by western science. The reserve´s cultural diversity therefore is also a treasure and a strength.

The different peoples in the Manu Biosphere Reserve

The following ethnic groups have a relationship with the Manu Biosphere Reserve: the Matsiguenka, Nanti, Yora, Harakbut, Yine and Quechua, as well as settlers. We will examine their characteristics and their differences.

The Matsiguenka

An indigenous group in the Arawak ethnolinguistic family, the Matsiguenka have two communities inside Manu National Park: Tayakome and Yomibato. Both are located in the upper part of the Manu River basin and have annexes: Maizal, for Tayakome, and Cacaotal (Sarigueminíke), for Yomibato. The annexes are smaller villages that are related to the main communities, and which are seeking recognition as native communities.

The park is also home to Matsiguenka people in isolation and initial contact, who travel along the Abaroa, Mamería, Maestrón, Piñi Piñi and Amalia rivers. Outside of the area are the native communities of Shipetiari and Palotoa Teparo, neighbors of the eastern part of Manu, which do not use natural resources in the protected area because they are outside of the park boundaries.

Historically, the Matsiguenka are known to have maintained trade relations with the Incas. The Incas established outposts in Amazonia in areas close to Matsiguenka territory, such as Paucartambo, Tono and Marcapata. Because there is no evidence that the Incas demanded tribute from the Matsiguenka, however, the relationship between the two groups is assumed to have been strictly one of trade.

In 1650, the Matsiguenka were contacted by the Jesuits, who took advantage of the encounter to gather the indigenous people into their missions in the area. Toward the end of the 19th century, pressure from migration into Matsiguenka territory intensified because of the increased value of quinine and rubber. The indigenous people suffered contact with outsiders, which caused a sharp demo-

graphic drop. The main cause of death was exposure to diseases to which the Matsiguenka had not developed biological immunity.

After 1900, the Dominicans took over evangelization in the region, establishing the Chirumbía mission in 1902, and later the missions of Koribeni and Timpía in the Urubamba River Valley.

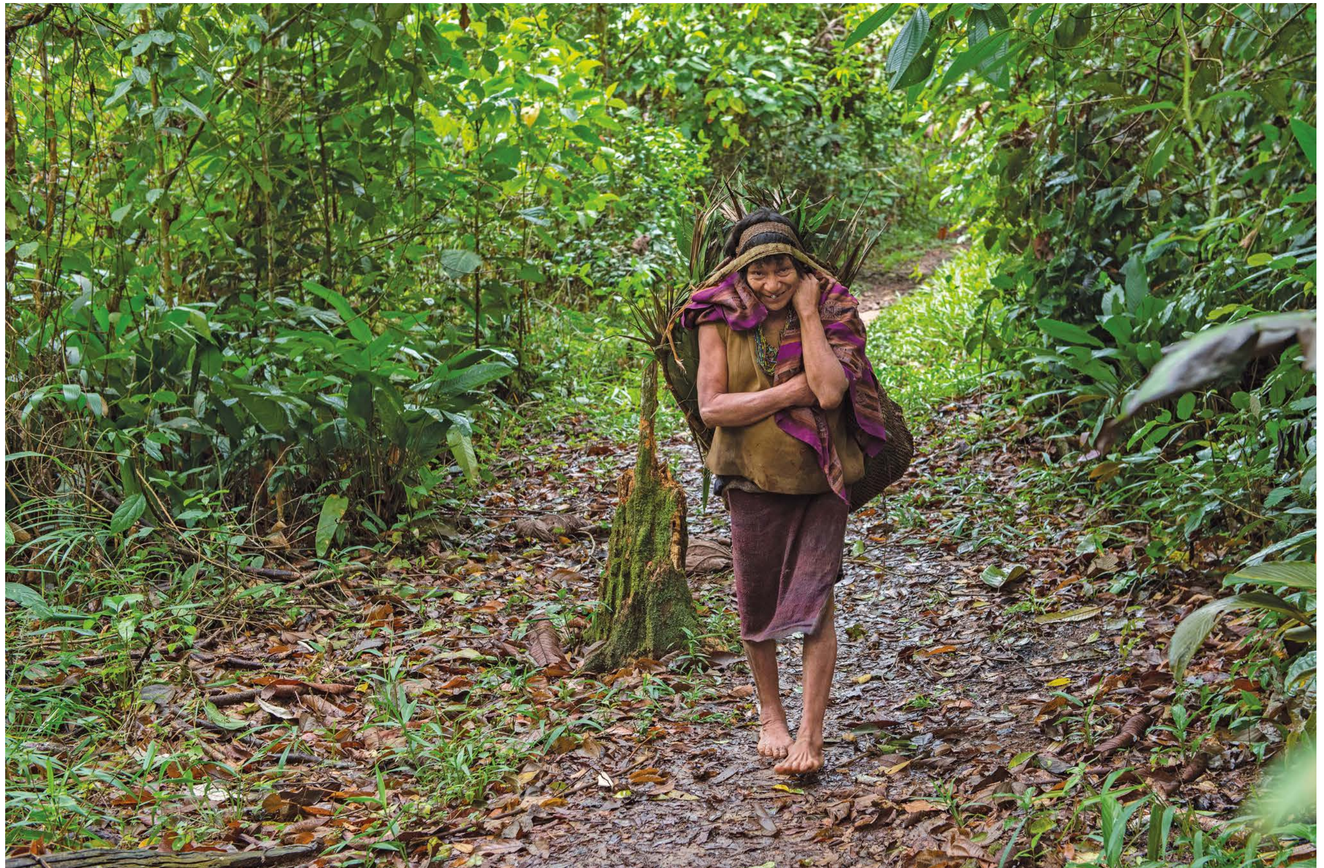
In the 1950s, with the arrival of the Summer Institute of Linguistics (SIL) in Peru, the native community of Tayakome was established. The institute´s intention was to evangelize indigenous groups by translating the Bible into different languages. Missionaries from the institute entered into contact with the Matsiguenka of the Sotileja, upper Manu and Cumerjali rivers and relocated them to the community of Tayakome.

To win over the indigenous people, they gave them weapons and ammunition in exchange for animals and hides. This changed their lifestyle from nomadic to sedentary, making them dependent on outside resources (such as medicines and other goods) and changing their relationship with nature.

Everything changed when the area was designated a reserve in 1968. The Peruvian government evicted the SIL, and a large part of the community´s population also left. In 1978, a group of families from Tayakome established Yomibato near the headwaters of the stream of that name (also known as the Quebrada Fierro). Some years later, in the 1990s, an isolated group and some of the original residents of Tayakome established the native communities of Shipetiari and Palotoa Teparo.

Since the 1980s, the Matsiguenka territory has been the site of natural gas exploration and production, because it overlaps one of the most important natural gas fields in the Camisea River basin.

The Matsiguenka´s social organization is based on multiple cognatic kinship groups scattered in different settlements. People are classified by two relationship types: consanguinity and affinity. This division allows highly dispersed marriages that significantly expand the network of family ties.



Historically, the Matsiguenka traded with the Incas. They continue to follow a traditional lifestyle.

One of their main economic activities is agriculture. Their principal crops include cassava, taro, sweet potatoes, corn, peanuts and bananas. They also hunt, fish and raise small animals. The community of Shipetiari also engages in forestry, while Tayakome and Yomibato have launched a tourism business through the Casa Matsiguenka, a multi-community enterprise, as have Palotoa and Shipetiari.

Collaboration between the Matsiguenka and the park administration improved with the hiring of some community members as park rangers. This encouraged the Matsiguenka to support the work of researchers at the Cocha Cashu Biological Station and strengthened ties with other people involved in the management of Manu National Park.

The Nanti

Like the Matsiguenka, the Nanti belong to the Arawak ethnolinguistic family. Historically, they have been known as Kugapakori, a name they accept, which in Matsiguenka means «killer of people» or «savage». The Nanti live in the Kugapakori, Nahua, Nanti and Others Territorial Reserve (RTKNN), which borders Manu National Park to the west, as well as inside the park.

There currently are three Nanti communities on the upper part of the Camisea River and the central part of the Timpía River: Marankiato, Montetoni and Sagondoari.

The Yora, also known as Nahua, lived in isolation until they were contacted during exploration by the Shell Oil Company in 1984, with devastating consequences.

The native community of Montetoni was established in 1992 by a Matsiguenka teacher named Silverio Araña Gómez, who settled in the area with some Nanti families that were in initial contact. Marankiato and Sagondoari were established by people who migrated from Montetoni. So far, none of the communities has received a land title or formal recognition as a native community. The Peruvian Ministry of Culture says it has registered 54 families in Montetoni, for a total of 237 villagers.

The Nanti of the RTKNN use resources within a fairly wide radius. Their main economic activities are small-scale swidden agriculture, hunting, fishing and gathering forest products. The crops they sow most frequently are cassava, sweet potato, pineapple, barbasco, cotton and tobacco.

The Nanti are in initial contact, which implies that they have little relationship with outsiders and are vulnerable to various diseases. A cold, for example, could be fatal, especially to children and elderly people.

The Yora

The Yora, who were formerly known as the Nahua, belong to the Pano ethnolinguistic family. The Pano groups consist of a series of relatively homogeneous sub-groups that mainly live between the Purús and Yurúa rivers. The name Nahua is a suffix in the Pano language that means «people who are strange or different», and has been given to them more because of how other people identify them than how they identify themselves.

The Yora live along the Serjali River in the RTKNN. They used to travel regularly through Manu National Park. There currently is only one Yora community, Santa Rosa de Serjali, located in the Serjali River basin inside the RTKNN.

The Yora lived in isolation until 1984, when they were contacted by missionaries and by workers from the Shell oil company. The contact was traumatic, and a large number of people — especially children and elders — died because they lacked defenses against an outbreak of flu that resulted from their contact with outsiders. The Yora were forced to request aid and were assisted by both the Sepahua mission and the SIL. This did not prevent the decimation of the population, however, and half the Yora — 300 of a total of 600 — died.

According to the Peruvian Ministry of Culture, Santa Rosa de Serjali now has about 285 inhabitants. During the 1990s, it was not uncommon to see them in the park, both in the community of Tayakome and around the Cocha Cashu Biological Station. These visits, however, no longer occur.

Their main economic activities are small-scale swidden agriculture, hunting and fishing. Their main crops include cassava, bananas, sweet potatoes, a yam known as *sachapapa*, sugar cane, beans and rice. In recent years, because of their interaction with outsiders, the Yora also have begun to work for other people to earn an income. These activities take place not in Manu National Park, but in the RTKNN.

Some indigenous people who live near Manu National Park extract trees commercially, which has limited this resource. Alluvial gold mining in the Alto Madre de Dios River (bottom left) is a serious risk. This type of mining is expanding alarmingly.

The Harakbut

Belonging to the ethnolinguistic family of the same name, the Harakbut are an indigenous people made up of various small, differentiated groups, including the Arakmbut, Huachipaeri, Arasaeri, Toyoeri, Sapiteri, Pukirieri, Kisambaeri and others.

The most numerous group are the Arakmbut or Amarakaeri, who are dispersed among various native communities. One is Shintuya, which is inside the Manu Biosphere Reserve, in the buffer zone of the park. Queros and Santa Rosa de Huacaria are two other native communities belonging to the same people, which border Manu. The former has mainly a Huachipaeri population, while the latter includes Huachipaeri, Matsiguenka and migrants from the Andes.

The Harakbut were contacted by Dominican missionaries in the mid-20th century. They were first settled in the mission of San Luis del Manu, located at the confluence of the Manu and Alto Madre de Dios rivers, and later in the current native community of Shintuya. Their social organization is determined by seven clans, which are interrelated by marriage and exchanges. The consanguineal family includes all people who belong to the blood clan, while affinity kinship refers to the other clans.

The main economic activities of this indigenous group are small-scale agriculture (especially cultivation of cassava, pineapple, corn and banana), fishing, hunting and gathering. It is important to note that commercial logging has become less frequent in recent years because of a scarcity of resources. Besides these activities, some families in Shintuya and Queros also engage in small-scale ecotourism.

Another activity, which is more intensive in communities along the Colorado, Inambari and Madre de Dios rivers, is small-scale gold mining, which has seriously contaminated their rivers and territory. Communities where mining is done include Puerto Luz, San José del Karene, Boca Inambari, Barranco Chico and Masenahua. Mining does not occur in the communities neighboring Manu.

The Yine

In the buffer zone of Manu National Park are two communities of this indigenous group, which also belongs to the Arawak ethnolinguistic family: Diamante and Isla de los Valles, both in the Alto Madre de Dios River basin.

The Yine came into contact with Franciscan missionaries in the mid-17th century. The encounter was not peaceful, and some Franciscans were killed. Although missionary activity subsided around the time of independence, it was renewed during the rubber boom era, when the Yine served as labor recruiters for rubber barons. This was the period of their greatest territorial dispersion.

The Yine are matrilineal and matrilocal. This means that both their descent and their place of residence are determined by their maternal lineage. The Yine base their kinship on the social distance between individuals, and marriage is therefore a way of increasing family ties. They also develop ritual kinship relationships or *compadrazgo*.

Their main economic activities are farming, fishing, hunting and gathering. The most common crops are cassava, bananas, rice, corn, sweet potatoes and a yam known as *sachapapa*. Logging tends to be another activity of communal importance, although it has gradually diminished as commercially valuable trees have become scarcer.

The Quechua

The Andean Quechua belong to the Quechua ethnolinguistic family. They are peoples who have lived for millennia in the Mapacho River basin around Paucartambo. One of their settlements, Callanga, inside Manu National Park, has recurring problems because of its

Part of Manu National Park is Andean. Quechua people live in the Mapacho Valley, an area known as Antisuyo in Inca times.

location and the lack of services in the area. In recent years, at the request of some of its residents, assistance was provided to relocate it to a more accessible place.

The Quechua arrived here as part of the expansionist policy of the Inca Empire. The area where they live, formerly known as Antisuyo, is characterized by cultivation of coca, which is of vital importance to these communities. The current location of Paucartambo was the gateway to this region. With the Spanish conquest, the territory was broken up into estates where sugar cane and coca were produced, under a system of colonial grants known as *encomiendas* and *repartimientos*. These estates eventually became large farms. With the agrarian reform initiated by General Juan Velasco Alvarado in 1969, those farms became peasant farming communities known as *comunidades campesinas*. The Quechua people have remained in the area ever since.

Quechua social organization is based on communal working of the land. Relationships of kinship and reciprocity are of great importance to them. The obligations created by this form of organization, in which a reciprocal relationship known as *compadrazgo* is extremely important, have enabled them to live in diverse ecological niches, giving them access to a greater variety of resources. They are patrilineal and patrilocal. Marriage, for them, is a way of strengthening relationships among people who are socially distant from one another.

The main economic activities in the Quechua communities are agriculture and livestock raising. They domesticated a large variety of crops, notably potatoes and corn. Cattle are the animals with the greatest commercial value and economic importance, but they also raise small animals for family consumption.

Settler or colonist communities

Most people who have migrated to this area came from the Andean highlands. They settled in the buffer zone of the national park, in the cultural zone of the Manu Biosphere Reserve, specifically in the districts of Fitzcarrald, in the province of Manu (department of Madre de Dios), and Kosñipata (province of Paucartambo, department of Cusco).

These groups, which have lived in Amazonia for some decades, mainly engage in agriculture and the extraction of natural resources, coca cultivation and illegal logging.

The process of migration toward Manu originated mainly in the regions of Puno, Apurímac and Cusco. It began in the 1940s, with the construction of the road from the cities of Cusco and Paucartambo to Shintuya, Itahuanía and Nuevo Edén. The migrants built a number of settlements in the area, notably Patria, Pillcopata, Salvación and Boca Manu, as well as others in the watersheds of the Yavero, Lacco, Kosñipata and Alto Madre de Dios rivers.

In many cases, depending on the number of years of residence, these populations maintained kinship relationships with their places of origin and also conserved their customs, festivals and languages.

In adapting to the new ecosystem in which they live, the settlers engaged in economic activities that were harmful to the environment. It is vital to work with them to mitigate the impact on their surroundings. Their main activities include agriculture (they grow cassava, bananas and cacao, among other things), logging in areas near the Cordillera Azul National Park, raising cattle and keeping small animals. To a lesser extent, they also engage in commerce and tourism activities, and they occasionally hunt and fish, but only for family consumption.

Finally, it is important to mention the harvesting of timber from the park. During the rainy season, when the water levels in the river rise and, for strictly natural causes, trees are swept away by

The people who have settled around Manu are mainly migrants from the high Andes who make their living from farming and extracting natural resources. One of the most common activities is coca cultivation. Coca leaves dry in the streets of Patria, in Cusco´s Paucartambo province.

Some Matsiguenka women still wear traditional clothing and ornaments, such as the horizontally striped *cushma* and the nose ring called a *koriki*.

In Manu´s native communities, fishing is an activity in which women and children participate, unlike hunting, which is done only by men.

The family is the foundation of the community´s production systems.

the water and gathered by settlers near the mouth of the Manu. This collection is the only legal harvesting of timber from inside Manu National Park.

Indigenous communities inside Manu National Park

Residents of the communities and settlements inside Manu have a special relationship with the forest and use natural resources in traditional ways. This is true of the communities of Tayakome and Yomibato, and the settlement of Callanga. Let´s take a closer look at their key characteristics.

The native communities of Tayakome and Yomibato

The Matsiguenka community of Tayakome and its annex, Maizal, currently have a population of 46 families, totaling 270 people. Yomibato and its annex, Cacaotal, have 365 inhabitants in 64 families. In the past 30 years, the population has increased at an annual rate of 4.8%.

This population increase occurred mainly for two reasons: the first is migration by Matsiguenka people living in isolation around the headwaters of the Cumerjali and Fierro rivers; the second is the existence of health services, which have decreased the infant mortality rate.

In its early years, Tayakome had a landing strip that enabled the SIL to operate there. Nowadays, the two communities are accessible only by river, a journey of between one and three days from the park entrance.

Since the park was created, there has been no clear policy about the indigenous population. The park was created to protect the environment in an area that is the traditional territory of a large number of Matsiguenka people. That is why the communities of Tayakome and Yomibato are located in the park´s special use zone. In that area, they are allowed to use resources in traditional ways — farming, hunting and fishing — but on a small scale, and they cannot sell the resources.

Meanwhile, the national park has played an important role in avoiding and resolving the types of socio-environmental conflicts that exist in other parts of the country. Its role in protecting large expanses of forest has kept illegal extractive activities at bay. It is one of the few places where, despite pressure on the natural resources, it is still possible to find large populations of primates that are classified as endangered.

The well-conserved forests have enabled the Matsiguenka to continue using their natural resources in traditional ways. They are even able to supplement their diet by hunting animals, including primates, with bows and arrows.

This contrasts starkly with the situation in the settler villages and native communities outside the park. In those places, because of greater pressure from hunting and the use of more effective weapons, such as shotguns, it is increasingly difficult to find wildlife.

There is another important factor as well: the Matsiguenka have domesticated a variety of plants. According to a study by the Frankfurt Zoological Society, this enables them to produce 21 varieties of cassava and 64 other plant species with their traditional family farming practices.

The Matsiguenka who live in these communities have extensive knowledge of the behavior and biology of the various species of fauna in the forest. This knowledge not only enhances their strategies for finding food, but is also evident in the seasonal nature of activities such as hunting (which is more intensive in the rainy season) and fishing (which they do more frequently in the dry season).

Hunting is also closely related to their beliefs. The Matsiguenka avoid hunting deer for spiritual reasons, and they do not eat the heads of the animals they hunt, so as not to offend the spirits of the animals and out of fear that the spirits could strip them of their hunting skills.

The Matsiguenka traditionally use barbasco (*Lonchocarpus* sp.) for fishing. Barbasco is a poison that immobilizes the fish and stops their respiration, making it easier to catch them. This technique, employed by both men and women, is used more intensively during the dry season (May to September), when the water level in the large rivers is low and the water is clear and calm.

Fishing with bow and arrow is done exclusively by men. It is done all year, mainly in clear water and in places such as lakes and the meanders of rivers. Nowadays, thanks to traditional techniques combined with the use of fishhooks and nets, they are able to fish more effectively.

In the Matsiguenka cosmovision, there is a relationship of energy exchange between humans and game animals. For the Matsiguenka of these communities, the first beings to inhabit the earth were humans, and later, for various reasons, some were turned into various species of animals. The integrated view of nature and culture shared by the Matsiguenka and other Amazonian peoples does not draw a clear distinction between the forest and the community: once human occupation ends, the forest returns to its natural state.

A study by the Instituto del Bien Común (IBC) in 2016, using maps of deforestation in the Amazon, showed that indigenous territories and protected areas have lower levels of deforestation than other land in Amazonia. This means that indigenous people do less harm to the forest than migrants and people in areas where extractive activities are carried out.

Nevertheless, the process of establishing settlements, population growth, the introduction of new hunting equipment and, possibly, the impact of climate change have modified indigenous communities´ consumption patterns. This increases their pressure on natural resources and makes them a risk to biodiversity in the natural area.

More intensive fishing and hunting, as a result of population growth, along with the change in extraction methods and the possible effect of climate change on seasonal patterns and the rise and fall of the rivers have caused a significant change in the diversity and quantity of fish. In Yomibato, not only are the fish decreasing dramatically, but the distances from the communities to hunting grounds are growing, affecting the communities´ food security and shrinking the populations of large mammals that are hunted for food.

For the conservation of Manu National Park and the future of the Matsiguenka communities, it is crucial to adapt the park´s conservation goals to take into account the changes in the communities of Yomibato and Tayakome. The growth of these populations will not only have a greater impact on natural resources, but it will also create greater demand for services such as safe drinking water, sanitation, electricity and transportation. It is also necessary to keep in mind that access to these services is more difficult because of the distance between the communities and the nearest towns or cities.

Similarly, it is crucial that the communities have clarity about their goals and desires for the future. This requires strategies that will enable them to prioritize activities that contribute to community welfare, that are sustainable over the long term and in harmony with the environment.

Considering these priorities will allow the communities — in coordination with park management, indigenous organizations and other partners — to identify public and private technical and financial resources that could contribute to two goals: processes that lead to an integral improvement in their quality of life, and productive activities that offer an alternative to the unsustainable extraction of forest resources.

It is important to emphasize these participatory processes and encourage reflection about them, because although there have been many initiatives in the area, none has had a long-range vision or had been based on sustainability.

Hunting is the main source of meat for indigenous communities.

There are many reasons for this, including that they were not based on the communities´ desires, but on ideas from people outside the Matsiguenka community. They therefore lacked the backing of the Matsiguenka population, or they were supported for only a short time.

Both the director of Manu National Park and the Frankfurt Zoological Society promoted the direct and active participation of the Matsiguenka communities. As a result, a life plan was developed for the native community of Yomibato. This document, which was drafted with community participation, will contribute to the design of a road map to sustainable development for Yomibato. It will also help follow up the joint efforts of the Frankfurt Zoological Society, Manu National Park and the communities to promote food security, a better quality of life and conservation of biodiversity.

Callanga

Callanga is the only settlement of Andean people inside Manu National Park. «Kallanqa», the Quechua word from which the community´s name is derived, means «it will always exist», «it always will be» or «it always must be», according to linguists and long-time local residents.

Although the Callanga River watershed is part of the Kosñipata watershed, access routes link it more closely to the district of Challabamba. Approximately 35 families, totaling about 150 people, live in the area. Because the settlement is geographically isolated and access is difficult, it has little support from outside organizations.

During colonial times, Callanga was an estate that produced coca and livestock. In the early 20th century, the area also became known for producing sugar cane alcohol. Archaeological ruins in the area hint at an earlier occupation. The traditional Andean occupation appears to have been related to the Matsiguenka populations, which later retreated towards the Mamería River.

Until about 15 or 20 years ago, the Matsiguenka visited Callanga regularly. The gradual increase in coffee cultivation attracted new families to the area. The estate passed from owner to owner until Manu National Park was created. This coincided with the collapse of the company that had been managing the farm at the end, and with a wave of migration to the zone from nearby Andean communities such as Chimur, Lambrapata, Lali and Ccorimayo.

The population continued to increase until the 1980s, when growth stalled because of the difficult location and lack of access to basic services. The residents of Callanga have complained constantly about this situation and the difficulty of obtaining property titles because of the overlap with Manu National Park. Because of this, a group of residents has expressed willingness to be relocated to other areas to gain access to health care and education.

This is not an easy problem to solve. In recent years, the park and the Frankfurt Zoological Society have received written requests from various residents of Callanga seeking voluntary relocation. Based on these requests, the National Service of Natural Protected Areas and the Frankfurt Zoological Society have offered options for relocation to more accessible areas.

An analysis of the voluntary relocation process is needed to determine whether it has been successful and to address any problems that have arisen in implementing it. Nevertheless, it is essential to maintain the relocation strategy and continue with the rest of the families in Callanga. This would be the best way to improve their quality of life and strengthen the conservation of natural resources within Manu National Park.

The work of the Frankfurt Zoological Society in the Matsiguenka communities of Manu National Park

The Frankfurt Zoological Society is implementing various projects that benefit the native communities of Manu. These initiatives have provided an opening for dialogue between the Matsiguenka and the national park, which will serve as a base line for improving

The Qurqurpampa ranger station is the point of entry to the farming settlement of Callanga, which is still a day´s walk away.

the communities´ quality of life. Participatory efforts are under way with the residents of Tayakome and Yomibato to gather updated information about the state of the natural resources they use for their livelihoods.

A preliminary report indicates that fishing in the Matsiguenka communities of Manu National Park results in the use of about 60 species. Large species, such as the gilden catfish (*Zungaro zungaro*), gilden catfish (*Brachyplatystoma cf. rousseauxii*), shovelnose catfish (*Pseudoplatys punctifer*) and granulated catfish (*Pterodoras granulosus*) are fished with hook and line, mainly in the Manu River.

The species caught in small streams and lakes, with bow and arrow or nets and barbasco, are the spotted small mouth (*Prochilodus nigricans*), various species of catfish known as *sucker catfish* (*Hypostomus* sp., *Sturisoma* sp.) and a variety of small catfish (*Pimelodus sp., Pimelodus cf. Tetramerus, Pimelodella sp., Rhamdia* sp.). The primate species hunted most often are the brown woolly monkey (*Lagothrix lagothricha*) and black spider monkey (*Ateles chamek*).

Other species, such as the red howler monkey (*Alouatta sara*), large-headed capuchin (*Sapajus microcephalus*) and Toppin´s titi monkey (*Callicebus toppini*) are eaten less frequently. The terrestrial mammal most frequently hunted is the lowland paca (*Cuniculus paca*). Other hunted species include the brown agouti (*Dasyprocta variegata*), collared peccary (*Pecari tajacu*) and various birds, including quail, curassow and guans.

Ismael Vicente, a Matsiguenka man who lives in Yomibato, says the climate has changed. More than 20 years ago, precipitation was distributed more evenly and there was a marked change of seasons. In those days, when people fished with barbasco in the Yomibato River, they caught huge numbers of fish, including large species such as the catfish known as *doncella cayonaro*. Nowadays, Vicente says, the rain comes in short, torrential downpours, the dry season lasts longer, there are more people in the community, and although people fish with barbasco more often, they catch fewer, smaller fish.

Tools that could help design strategies for sustainable resource use are emerging from planning for the communities´ future and should translate into measures for improving hunting and fishing over time. These include monitoring of wildlife diversity, composition and abundance, and studies of hunting patterns.

The communities are already proposing ideas for the conservation and management of their resources. First, however, it is important that they understand the problems and solutions that interconnect their priorities with the goals of Manu National Park. This is reflected in the life plan drawn up by the residents of the community of Yomibato.

Between 2013 and 2017, an extensive participatory study of natural resources in Manu National Park´s Matsiguenka communities was conducted by the Frankfurt Zoological Society.

Matsiguenka field assistants, both men and women, played a key role in gathering information and monitoring their own resources.

During community meetings, monitors and participating families were chosen and annual progress reports were presented.

Indigenous peoples in isolation within Manu National Park

Luis Felipe Torres

The territory that is now Manu National Park historically has been occupied by various indigenous peoples. Until the late 19th century, the Manu River and its tributaries were inhospitable areas of rough terrain where few western explorers had ventured. Today, thanks to the national park, it is home to one of the largest concentrations of isolated indigenous people in the world.

Survivors of the rubber boom

The expedition by the Peruvian rubber baron Carlos Fermín Fitzcarrald in 1893, in search of a passage between the Ucayali and Madre de Dios watersheds, opened the floodgates to the rubber economy in that part of Peru. The booming trade would have devastating consequences for the indigenous people in the region.

The rubber trade in Amazonia was one of the most perverse economic booms in world history. Rubber camps spread throughout the Amazon forests, reaching remote locations never before visited by non-indigenous people. The indigenous people in those lands were taken captive and forced to work in the camps under slavery conditions. Those who resisted usually were killed. Others fled to headwaters and the most remote corners of the forest.

The survivors of this tragic episode of history are among the indigenous populations that inhabit the Amazon forest today. Only since 1974, when Peru´s Native Communities Law took effect, have some of their territories been recognized as native communities, areas designated by the government for the use of the families inhabiting them. Often, however, they are far smaller than the areas traditionally inhabited by their populations.

While these government structures were being adjusted, some groups kept their distance, taking refuge in the most remote and inaccessible parts of the forest, where they survived and maintained their cultural practices, avoiding contact with outsiders.

These groups are now called «indigenous peoples in isolation» or, more colloquially, «uncontacted peoples». They are considered some of the most vulnerable populations in the world, for two reasons. First is their lack of an immune response to common diseases, and second is their lack of understanding of how western society operates, which puts them at risk in any contact with outsiders.

Isolated tribes have no regular contact with the modern world and some even don't know metal. They live as an integral part of the tropical ecosystem, remaining only in remote parts of South America.

In the near future, this chapter of human history — in which people live as part of ecosystems, without dominating, shaping and transforming them — could be closed forever.

Indigenous Mashco Piro camps spotted on an overflight of the Las Piedras River in Alto Purús.

Groups of isolated people are known to exist in parts of Peru, Brazil, Colombia, Ecuador, Bolivia and Paraguay. In Peru, the rights of these isolated peoples were legally recognized in 2006, in Law No 28736. This law establishes the government´s obligation to protect their territories and guarantee their right to decide voluntarily if they want to establish contact with wider Peruvian society. Recognition of their territories and establishment of territorial reserves for the exclusive use of these peoples were key to guaranteeing their right to territory, health and self-determination.

In retrospect, at a time when the very existence of these isolated groups was invisible and unacknowledged by the government, the establishment of Manu National Park in 1973 was a crucial step in the protection of their territories.

Today, Manu National Park lies at the heart of a mosaic of protected areas of Amazonian forest covering more than 80,000 square kilometers in the Ucayali and Madre de Dios regions. It is also one of the places with the highest concentration of isolated indigenous people in the world. We know it is inhabited by at least two indigenous peoples, the Matsiguenka and the Mashco Piro.

Although they are very different peoples and do not understand each other´s languages, both belong to the Arawak linguistic family. Protecting these groups´ territories has become one of the main goals for the area.

Besides Manu, the territory occupied by these peoples includes the Madre de Dios and the Kugapakori, Nahua, Nanti and Others territorial reserves; the Mashco Piro and Murunahua indigenous reserves; Alto Purús National Park; the Purús Communal Reserve; and the Megantoni National Sanctuary.

The Matsiguenka

The Matsiguenka people occupy the Urubamba and Alto Madre de Dios watersheds in Peru´s southern Amazon region. Most live in native communities. Those who remain in isolation inhabit the forests of Manu National Park, the Megantoni National Sanctuary, and the Kugapakori, Nahua, Nanti and Others Territorial Reserve.

The settlements of these isolated groups consist of *malocas*, traditional dwellings occupied by extended families. They generally build one to five *malocas* and clear small fields to feed their families. Agriculture for family consumption is a vital activity for the Matsiguenka. They grow various crops, especially cassava, banana, a palm known as *pijuayo* and a yam known as *sachapapa*.

They take advantage of the abundance of resources by hunting, fishing and gathering forest products. The forest provides them with the materials they need — bones, clay, fruit, leaves, wood, bark, stones, fiber and resins are indispensable for medicine, ritual spaces, building, tool making and fashioning garments.

Some of these families also have obtained metal tools, through occasional contact with other Matsiguenka families that have a more permanent relationship with wider society.

Matsiguenka families in isolation maintain various relationships among themselves, through kinship and exchanges, including warfare. They migrate, with a pattern of semi-nomadic settlement in which they periodically move to new places. This movement is tied to the productivity of the soil and availability of plants and wildlife, as well as to demographic patterns or tensions with neighboring groups.

Villages of Matsiguenka people in isolation have been spotted in the park during monitoring overflights. They can be seen because the construction of *malocas* and preparation of open clearings in the forest that are visible from the air. They are currently monitored using satellite images. Their presence has been recorded in the western part of Manu National Park, along the Piñi Piñi and Palotoa rivers and their tributaries, and to the north and northwest, along the upper parts of the Manu River and its major tributaries, such as the Cumerjali, Sotileja and Little Manu rivers.

In April 2016, 15 indigenous people who were living in isolation inside the park appeared in the native community of Palotoa Teparo, which is also inhabited by Matsiguenka people. The new arrivals told of a jaguar that had attacked and killed an entire family. Terrified, they had fled from the place where they lived. For the Matsiguenka, however, a jaguar that killed that way could not be a mere animal. Rather, it was a being operating under the power of dangerous and vengeful human spirit.

The people of Palotoa were welcoming and concerned. In a classic display of Matsiguenka generosity, they gave the newcomers food and clothing. But that generosity had tragic consequences, because the new arrivals immediately began to suffer from respiratory ailments that they had acquired through the exchange with the community. Isolated indigenous people face a great risk when they come into contact with outsiders because they are highly vulnerable to even the most common illnesses. Fortunately, the emergency was handled quickly and effectively by the Regional Health Department of Madre de Dios and no members of that group died.

Matsiguenka families in Yomibato, a community inside the park, also receive regular visits from isolated families living along the upper reaches of streams. These encounters underscore

the delicate task of protecting the integrity of isolated peoples and the importance of having health teams prepared to respond to emergencies.

The Mashco Piro

The Mashco Piro indigenous people occupy a territory covering several thousand square kilometers. Their population is estimated to be at least about 1,500 people.

In Peru, they migrate through Manu National Park, Alto Purús National Park, the Purús Communal Reserve, and the Murunahua and Mashco Piro indigenous reserves, and the Madre de Dios and Kugapakori, Nahua, Nanti and Others territorial reserves. In Brazil, they travel through the Mamoadate Indigenous Land, the Kampa and Isolated Peoples Indigenous Land in Envira, Chandless State Park and the Acre River Ecological Station. In Manu National Park, they are concentrated along the Pinquén River and along tributaries on both sides of the Manu River.

Unlike the Matsiguenka, the Mashco Piro live exclusively from hunting and gathering forest products. These 21st century hunter-gatherers live in family groups that travel over immense expanses of forest.

The lack of agriculture is not common among indigenous people in the region. It probably responds to the need for a highly nomadic life as survival strategy. Their constant movement keeps them from being easily located and is consistent with their state of isolation. This lifestyle is therefore inseparable from their social, cultural and economic characteristics.

Experts disagree about the origin of the name «Mashco Piro». The term «Mashco» has been used since colonial times to refer to Amazonian indigenous groups on the Ucayali River. Later, in the first decades of the 20th century, Dominican missionaries also used it to refer to isolated indigenous people in the Madre de Dios and Manu watersheds. The term «Piro» is the old name for a people linguistically related to the Mashco Piro, who now call themselves Yine.

A report by Zacarías Valdez Lozano, one of the explorers who accompanied Fitzcarrald on the expedition in 1893, tells of groups of «Piro» and others whom they called «Piro-Mashco» in the headwaters of the Manu River. It is thought that both groups may have been related to today´s Mashco Piro.

The Mashco Piro have a special characteristic: they are extremely silent as they move through the forest, and for decades they have managed to live unnoticed by western society. Nevertheless, park rangers and other local residents have known of their presence in Manu National Park for a long time. Their presence was confirmed through various events that occurred after the official establishment of the park, with the construction of the first ranger stations.

The first occurred in the mid-1980s. Three Mashco Piro women appeared across from the Pakitza ranger station and made contact with the rangers, who called them the «three Marias». The women appeared to have separated from their group because of internal tensions. Because of the similarity between their language and Yine, they were taken to the native community of Diamante. Two of the «three Marias» still live near the Pinquén River. The oldest died a few years ago.

At around the same time, an expedition by a group of Yine people from the community of Diamante encountered a group of Mashco Piro in the forest and decided to ambush them. They captured a child, whom they took back to their community, adopted and baptized with the name Alberto Flores. Flores formed a family and adapted to his new life in Diamante, where he still lives.

The «three Marías», as they are called, separated from their Mashco Piro group in the 1980s.
Two still live in Manu National Park.

Occasional incidents such as these were local indications of the constant presence of the Mashco Piro. It was a series of recent events in Manu National Park, however, that drew national and international attention to one of the world´s most enigmatic indigenous groups.

Are isolated people coming out of the forest?

Beginning in 2011, after having remained hidden in the forest for decades, a Mashco Piro group was seen on the banks of the Alto Madre de Dios River. It was unusual for them to appear on the beaches. In fact, it was very strange. Boatloads of local passengers and tourists visiting Manu began to see them more frequently, taking photos that appeared in the media. People around Manu were interested in and curious about them and attempted to establish contact.

A key figure in this story was a resident of Diamante, Nicolás «Shaco» Flores. Because he spoke the Yine language, which the Mashco Piro could understand, «Shaco» was able to establish a relationship with them and provided them with tools and other items on various occasions. Other villagers and missionaries also had encounters with this group, and provided them with food and other objects.

But contact that had begun peacefully gradually escalated. Interactions with isolated indigenous people are unexpected and can be dangerous. «Shaco» himself is an example. In November 2011, while he was walking to his field to gather cassava, he was killed by a Mashco Piro arrow to the chest. Months earlier, a park ranger was wounded in the back by another Mashco Piro arrow while at the Pusanga ranger station. He survived, but the station had to be closed after the incident. Leonardo Pérez, a young man from the native community of Shipetiari, was not as fortunate. He was shot in the heart with an arrow that measured 1.80 meters. The shot came from the forest, and he died instantly.

In recent years formerly isolated people have been appearing in larger numbers. They are seen along various river systems in areas where there are settlements, for reasons still not fully understood.

These events highlight the hazards of encounters with isolated indigenous people under certain circumstances. In other watersheds, members of this and other groups have made sporadic contact with Yine people living along the Las Piedras and Tahuamanu rivers. These encounters probably are largely motivated by the desire to obtain useful items (metal tools, ropes or cultivated foods). Most, however, continue to avoid contact with people outside their own group.

Protecting their territories and establishing steps to be taken in case of contact, to ensure the survival of these peoples, is perhaps one of the greatest challenges for management of these Amazonian areas.

The Ministry of Culture is responsible for establishing guidelines for the protection of indigenous peoples in isolation and initial contact in Peru. For Manu National Park, this task is coordinated with the National Service of Natural Protected Areas, which oversees the park.

Coordination at the regional and local level is also extremely important, as is accompaniment of indigenous organizations and support from non-governmental organizations. Protecting isolated indigenous peoples in Manu National Park requires the combined efforts of various government agencies and the participation of civil society.

This will make it possible to protect one of the most biodiverse territories in the world for these inhabitants, who often are invisible, but who are best able to take care of themselves.

The voice of the Matsiguenka

Ingrid Chalán

The Alto Madre de Dios River was calm, and predictions were that the Fierro, a winding stream that becomes a river during the rainy season, would be navigable. There would be no need to push the boat, we thought with relief. But it didn´t work out that way. The jungle is rarely accommodating. Not only did we have to push the boat, but we had to carve out a path, hacking tree trunks with machetes, camping by the light of infinite stars, and, on the fourth day, walking five kilometers to reach our destination: Yomibato, the largest and most remote Matsiguenka community in Manu National Park.

«Thanks to the park, we have many animals to eat. We can go into the forest to hunt», says Paulina Coshante, age 40. The mother of eight children is one of the matriarchs and leaders of Yomibato. As one of her daughters plays with her pet, a tiny spider monkey barely two months old, Paulina adds, «If we didn´t have ranger stations here, we could have been invaded by loggers long ago, and the animals would have been exterminated». The matriarch was referring to outsiders who arrive and spark confrontations, putting them at risk.

Although they know little of the intricate economic and political issues that threaten them, the Matsiguenka know that the protection of Manu National Park is critical, and that they could not live without the jungle. Accustomed to living in the forest, they can differentiate plants, recognize snakes, walk with feet that understand the earth, and use the bow and arrow with precision. Their adaptation to some of the ways of the outside world, however, has been more complicated.

The words of José Luis Vicente, a youth leader in Yomibato, hint at this. Speaking of his experience working outside the community, he says that «when friends from Boca Manu see machis, they approach us and tell us: you´re going to work and earn some money. But in the end, they deceive us and don´t pay».

Pauline puts it more succinctly: «If I want to eat cassava, I have to buy it. And if I don´t have money? It´s not like living here, because if I didn´t have cassava, I´d go visit another family and they would give me some. In Puerto Maldonado, no one gives you anything». In Yomibato, the principle of reciprocity persists: for you today, tomorrow for me.

The tenuous technology of Yomibato

Women and children who gather, men who hunt, clans that live together in the same tropical forest that sees them come into the world and leave it. The indigenous people of Yomibato have rudimentary technology, minimal clothing and scant opportunities. A

Yomibato has a multi-grade primary school, where children in six grades study in a single classroom with one teacher.

Yomibato had 364 inhabitants in 2016, with a sharp population increase. The community must sustain this fast-growing population.

Although Matsiguenka youth from Yomibato can attend secondary school in their community, many families choose to have their children study in Boca Manu, a few days away by boat.

Young people who attend the secondary school in Boca Manu live in the student lodge called «Maganiro Matsiguenka», which was built and equipped jointly by Manu National Park, the Municipality of Fitzcarrald and the Frankfurt Zoological Society.

large proportion of the men have left Yomibato and know other cities because they have gone «to work». Family is the priority for those who return, but they also seek greater communication with that other world.

José Luis explains with humor, «My children and my wife come first, then what I want. A radio — I would buy myself a radio. But if I don't buy clothing, blankets or plates for my family, can they possibly eat the radio?» The women´s priorities are more closely tied to basic needs. For Miriam, José Luis´s sister, «What´s important are clothing and soap», and now that the school year has begun, «also school supplies for my daughter, because theyre asking us for them now, and we dont have any. The first thing we need is the notebook».

Despite its remote location, there is limited access to education and technology in Yomibato. Some trappings of the modern world have already reached this distant corner of the country. There is only one cable television in the entire community, and four clans have DVD players. They like action movies best, regardless of the original language or whether they have subtitles.

Wilson, one of José Luis´s brothers, adds, «I finished high school and have stayed here, but the community has begun to change. I see that the children are doing better; they don´t drop out along the way. Once they finish their studies, they must have jobs so they can meet their needs».

More importance is being placed on education. In Yomibato, primary and secondary schools are under construction, using cedar and chihuahuaco wood from the area. The spacious classrooms will be able to hold the 173 students currently in the community.

Wilson compares his life with that of his children: «If wed had what they have, we would be different. We would be able to express our demands, write our documents and stand up for our rights. With all these advances, our children are acquiring new knowledge, learning better in school. When they finish, it would be good if the people who come to work here aren´t from other communities, but are the same ones who moved away from here».

Although the community has a multi-grade high school, some adolescents attend high school in other communities, such as Boca Manu or Shintuya. Outside of the community, both the conditions for studying and the quality of education are better. The students are accompanied by tutors and receive daily meals, and there is lodging for students who must live there during the school year.

This tends to distance children from their family environment. Parents notice a generation gap, as Paulina has with one of her younger sons: «I´m worried about Armando. He is only 13, and he already has a partner. He is living in Cacaotal. He has become rebellious, and he talks back to me. I would like him to keep studying. If he were an adult, fine, he could do what he wants with his life, but he´s still a boy».

The present and future of the young Matsiguenka of Yomibato

Indigenous youth face a world that is different from that of their parents. That can be either positive or negative. With nine children, it is clear to Paulina´s sister-in-law that the families´ high fertility rate can be a problem: «I´m worried that my children will have as many children as I have».

Wilson, meanwhile, thinks that «it´s easy to have children, but it´s not easy to support them. You also have to educate them. If my son wants to have a wife when he´s 18, he can, but first he should study and learn to work, so he can support them». The number of children, however, is relative for Wilson, who now would prefer to have «up to five or seven children».

The most successful young people from Yomibato finish technical school. There still are just a few, and if they succeed, they generally leave their community and do not return. Many adults agree that their children should return to raise their families and strengthen their community.

«My daughter has finished high school and is working here as a teacher. But she doesn´t like to participate in meetings. I would like her to be here, to help translate, to answer questions», Paulina says of Roxana, one of her older daughters, who is the new pre-school

teacher in Yomibato. José Luis adds, «I´d like them to become professionals. I´d like them to leave, but also to return. For example, Jesús was born here. He studied and came back as a nurse technician. I´d like to thank him for doing that, for taking care of our community».

Jesús Shumarapague is the prodigal son of Yomibato. At 22, he is still single and childless. His mother, like any other mother in the community, asks him for grandchildren, but Jesús says it is too soon. He studied in Puerto Maldonado and knows life can be different. There are more choices, other paths. For that reason, Jesús does not plan to stay in his community for long: «My parents are happy. They tell me: just stay here. I tell them I am going to leave again. They tell me not to, that this is what I´ve studied for».

Is it possible to provide jobs for young people who return? Does Yomibato have a source of employment that could meet their demands and expectations? How can the professional needs of these young people be reconciled with the need for development in a community that awaits their return?

Jesús, one of those who left to get a better education, had the support of the community: «They support you when you need it. When I was studying, I nearly dropped out because I didn´t have money. The community and the Casa Machi helped me pay. That made it possible for me to finish the last year. I always talked with my father by radio. He spoke with the community, and they offered to pay a little. I am grateful to them».

The Casa Matsiguenka is a lodge located in the park. It is a community enterprise that receives income from lodging and the sale of handicrafts. For young people like Jesús, however, what the community offers is not enough, and the decision to stay is not an easy one: «Some young people want to return, but many see the situation in the city and compare. There is more publicity there, more technology. Here, there´s nothing».

The young people who attend high school outside of Yomibato and later go to the cities for specialized education have brought an air of change. As Jesús puts it, «Little by little, Yomibato has to change. It lacks many things. For example, it should have what Boca Manu already has — telephone, cell phones, internet».

The aspirations of other young people and the hopes of their elders show how Yomibato, at the crossroads of the traditional and the modern, gradually is forging its own path.

The ancestral and the modern

This adventure, which lasted just eight days, felt like a trip back in time. The Matsiguenka, with their rugged but intense features and traditional lifestyles, make it seem as though time stands still in Yomibato. It was long enough to see how the ancestral and the modern try to converge in a protected space. The new situations that the next generations will face pose challenges for these communities in transition and for the administration of Manu National Park.

Although their ancestral ways and customs persist, the Matsiguenka live in the here and now, and it is difficult for them to imagine the future. «How can I know what will happen? When my children are my age, I´m sure I´ll be dead», Paulina says when we ask. When we insist, she, who is Jesús´ mother, relents and adds, «My mother never studied. I only finished primary school, and now my children are in high school. One of them has studied a technical career. So my grandchildren will be more professional». It will take four generations for Yomibato to make that leap in time.

Wilson goes further, and his answer reveals one of his deepest desires, which is also a way of imagining a better future for Yomibato: «How good it would be if in the future, the director of the park were one of ours, someone from the community, someone who understands the situation».

Many of the Matsiguenka people in Yomibato come from headwaters kilometers away and are considered to be in initial contact. They come so they can trade products, receive health care and send their children to school.

A conversation with John Terborgh,
Tropical ecology researcher

Interview by Dagmar Andres-Bruemmer

Dr. Terborgh, do you remember the first time you were in Manu? Can you tell us a little about that experience?
The first time was in August 1973, the very month it was signed into law as a national park. I visited the Cocha Cashu Biological Station, and on my first day, I saw not one, but many spider monkeys. More remarkable, they didn't flee in terror at the sight of me; rather, they came closer to get a better look. Nearly every day, we met herds of peccaries and pairs of currasows in the forest, not to mention legions of monkeys, macaws, guans and toucans.

Do you consider Manu exceptional?
Manu stands out as exceptional because nearly everywhere one can go outside the national park has become what we call an «empty» forest — a forest depleted of its animal inhabitants. Biologically, these forests are sick, because they are severely deficient in the animal services that are crucial to perpetuating the forest. This includes seed dispersers and pollinators, even the dung beetles that bury seeds and return nutrients to the soil. Now I know that the wildlife of Manu is not extraordinary; it is normal. It is what one should find and would have found across the entire Peruvian jungle at an earlier time, before human hunters began to drive irrevocable change.

Since your first visit, you knew about the Matsiguenka community of Tayakome. Could you tell us what it was like then?
My first real field season in Cashu was in 1974. At that time, all the park's contacted Matsiguenka, about 115 in all, were already living in Tayakome. The community had been founded a decade earlier by missionaries of the Summer Institute of Linguistics, who had brought several families of Matsiguenka from the lower Urubamba Valley to populate the community. They urged them to contact other Matsiguenka living up the tributaries of the Manu and to concentrate them at Tayakome, where they could receive education and be converted to Christianity. The villagers of Tayakome were supplied with shotguns and ammunition by the missionaries, in return for skins and pelts, which the missionaries then sold to help pay for their operations.

Nowadays, the situation of the indigenous communities is substantially different. If you agree with that, could you tell us how much it has changed?
Just yesterday I spoke with Benito, the Matsiguenka teacher at Yomibato. I asked him how large the community had become. There were now 60 families, he announced, adding up to a total of 364 residents. I was stunned. Yomibato was founded in the 1970s with only a handful of families, and now there are 60! The story of Maizal is similar. It was founded by three families at around the same time, and now there are 15, a five-fold increase. Counting the founders as generation one, Maizal now adds several new members every year to generation four, the great-grandchildren of the founders. Overall, the number of communities has expanded from one at the time of the park's inauguration to four at present, the fourth being Cacaotal, a new settlement between Yomibato and Tayakome. All this has transpired in just 40 years. I don't want to think what the situation will be in another 40 years.

Would you say that the Matsiguenka population can still be considered part of the ecology of Manu?
The appropriate answers to that question could be that the natives are «part of the ecology», «have always been there» and «live sustainably without harming the ecosystem». These may be feel-good answers, but unfortunately, they are wrong. When people wear clothes, have axes and chainsaws, drive motorboats, communicate via two-way radio, and now, increasingly, cell phones and computers, and watch television, how can we consider them «part of the ecology?» They are no more part of the ecology than you or I. And as for living sustainably, how can exponential population growth be sustainable?

So do you think that Manu is different now in the areas with settlements?
In 2012, my wife and I and several colleagues made a trip far up the Manu river to the mouth of the Sotileja River, a right-bank tributary originating in the Andes. The territory lies two days' journey above Tayakome, in one of the remotest areas of the park. We spent most of a month visiting lakes, starting with Cocha Sotileja and slowly working back downstream toward Tayakome. The silence was deafening. The usual clamor of the monkeys and birds was not to be heard. We trekked extensively from the river's edge back into the interior without seeing a spider monkey, a peccary or a *paujil* (curassow). It was *déjà vu*, the empty forest I came to Manu to escape. And we were two days upriver from the nearest settlement. If what we found is typical, and I have no evidence to the contrary, a huge empty forest occupies the heart of the park, encompassing Maizal, Tayakome, Cacaotal, Yomibato and a wide peripheral zone surrounding them all.

What is your final assessment of the situation?
As the Matsiguenka population continues to grow, doubling approximately every 20 years, the empty forest will expand in proportion. In another 20 years, there will be twice as many families hunting over twice as large an area. What will be left of Manu's famous wildlife then? The answer will depend on what actions are taken to manage the situation and what agreements can be reached with the native population.

Watching television in the deepest reaches of Manu. This can change the culture faster than decades of missionary efforts.

Interview with Julio Ricardo Cusurichi,

President of the Native Federation of the Madre de Dios River and Tributaries (FENAMAD)

Interview by Hauke Hoops

What does Manu National Park mean for you and for FENAMAD?
I am passionate about conservation. Manu is of paramount importance for us and for our brothers who live in the park. Our position as FENAMAD is that this conservation area, protected as a national park, must ensure the life of our brothers. We can´t forget that these are their ancestral territories, from the time before the park was created. That´s not understood, and we have to work on that in order to reach agreements. Instead of isolating or limiting rights, it´s necessary to understand that this is a matter of the survival of a people, the Matsiguenka people.

What is most important about the park for your organization and the park´s inhabitants?
It´s not just a matter of the park, but also of the communities´ territories. You find biodiversity in Manu, but you can´t talk about biodiversity without talking about all the beings that live there. Manu National Park is famous worldwide, so we take its enormous importance for granted. It´s necessary to address issues related to indigenous peoples and communities, biodiversity and their relationship to climate change.

What do you think is the most appropriate way to conserve that biodiversity in the future?
One mistake made by government systems has been to think only of conservation. That isn´t working. The best way to continue conservation is with indigenous peoples´ active participation. To protect that biodiversity, it is imperative that the people who inhabit the area are the ones who safeguard and manage it, with no restrictions on their rights. Our dream is not only to have shared management of natural reserves, but also to apply that model to other protected areas where indigenous peoples live.

One important issue seems to be the coexistence of the communities and the biodiversity. What should be done in Manu National Park to make that possible?
I think there should be zoning. The disastrous experience of mining and illegal logging speak for themselves. In that regard, having a national park is a big advantage. The ideal would be to have a territory managed by the indigenous peoples under a special regime and with their own administrative procedures.

Does FENAMAD currently have specific projects for the national park?
Not specific ones, but we are focusing on solutions to various problems. The indigenous peoples who live there have new demands. For example, they need better food security. It is imperative to work with the regional government to find alternatives that are compatible with the biodiversity. The population is growing in Yomibato and Tayakome, and their two annexes have asked to be registered as communities. Although predictions vary and depend on the models used to calculate them, it is estimated that by 2040, there will be 2,500 people, and by 2080, because of exponential growth, we will reach 13,000. It doesn´t really matter if there are 2,500 or 13,000; those numbers are equally complicated for Manu if there´s not a management model.

One purpose of this book is to seek solutions for addressing these troubling high population growth rates. What do you see as the best way to address this problem?
If nothing is done, it will become a time bomb. It is urgent to seek alternatives — it is our responsibility as scientists and people. It clearly is not possible to stop the growth of the indigenous population. Our duty, then, is to promote and make people understand the need for an alternative type of work that doesn´t involve logging or other illegal activities. That is one of the biggest problems, and if it is not addressed now, it will continue to grow. Later, the villagers will be the ones who have to deal with the consequences.
We have talked with some Matsiguenka women about family planning, but it´s difficult, because it´s a sensitive issue for their culture. No one can impose a way of life on them. We have to keep looking for solutions. If we do nothing, the villagers lose, and we lose, too.

What do you think of the road that the regional government is building to link Edén with Boca Manu? How does your organization view it?
The road is important to FENAMAD, but the organization is proposing an integral development program for the communities in the area. The experience of the Interoceanic Highway must help us think about this. When it was being built, we talked with President Alan García. We told him it was all right, but only if there were projects that would strengthen the entire area along the highway.
For that reason, FENAMAD now proposes a comprehensive program for the area, including legal recognition, a proposal for property, strengthening the system for protecting uncontacted indigenous peoples, providing basic services, and seeing how Manu National Park and the Amarakaeri Communal Reserve can be strengthened.
If they are going to propose a road, a comprehensive study is indispensable. For FENAMAD, the road is important, but the underlying issues must be addressed. For that reason, we are already in talks with the regional government of Madre de Dios.

Do you agree with the large number of Matsiguenka park rangers currently working in the park? They are estimated to make up about 50%.
That is very good. I would like it to reach 100%, because it is the territory of the Matsiguenka people. We will continue to work for more inclusion of indigenous peoples. They know the territory, speak the language, have conserved the area. I have the impression that SERNANP understands this.

Is there anything you would like to add about FENAMAD´s plans?
We are trying to provide legal security with an integral territory for the indigenous peoples. We know the government isn´t going to want to do that, but we will fight to grant them the rights they deserve. To do that, we will seek support from partners. We will see how institutions respond and how we can reach an agreement that is beneficial for the indigenous peoples and for Manu National Park.

Education in the Matsiguenka communities of Manu National Park: Experiences and Challenges

Johny Farfan

In the 1980s, during the administration of Fernando Belaunde, the Peruvian government established schools in Manu National Park´s Matsiguenka communities. There are both pre-schools and primary schools in Tayakome and Yomibato, as well as in their annexes, Maizal and Cacaotal. In 2013, a secondary school opened in the community of Yomibato.

It is a great challenge for the government to provide quality education to these communities. The two main problems are the difficult access to the settlements and the lack of teachers who speak the Matsiguenka language. If the majority of the teachers do not speak the language, they will not fully understand the culture or the students´ relationship with their environment, or what it truly means to live inside a national park. Furthermore, education in these communities must meet three important goals: (i) to support and foster the students´ cultural identity; (ii) to impart knowledge that will enable them to participate fully in national society; and (iii) to develop an understanding that balances development with conservation of the environment in which they live, and which helps them understand the importance and benefits of living in Manu National Park.

The Frankfurt Zoological Society´s contribution to the education of children and teenagers in these communities is to facilitate access to secondary education and promote their development into adults who can manage and guide their communities in the future, if they so desire. The establishment of a Matsiguenka boarding school in the town of Boca Manu is designed to meet these objectives. Boca Manu is the closest town to the communities of Yomibato and Tayakome and their annexes, Cacaotal and Maizal, and 19 secondary school aged Matsiguenka children from those communities are currently studying at the boarding school. The boarding school provides them with lodging, food, clothing and, most importantly, tutors and guides who not only reinforce what the students learn in the classroom, but also help them preserve and develop their cultural heritage.

Young Matsiguenka women live in the student lodge in Boca Manu. Additional support and guidance is necessary when different cultures meet.

Cocha Cashu is one of the lakes farthest upriver in Manu National Park. It is reserved for research.

Chapter 7

Protecting paradise

John Flórez and Juvenal Silva

After years of work and responsible planning, there is no question about the Peruvian government´s commitment to managing protected areas and strengthening official support for them.

One concrete example was the creation of the National Service of Natural Protected Areas (SERNANP) in 2008, a government agency within the Peruvian Ministry of the Environment. SERNANP, which replaced the National Institute of Natural Resources, which had been established in 1992, is responsible for managing and establishing technical criteria for protected areas nationwide.

One of SERNANP´s main goals is to conserve biodiversity, promoting the development of protected areas through the sustainable use and participatory management of resources that benefit humanity.

There currently are 76 protected areas under government management through SERNANP. Together they make up the National System of Natural Areas Protected by the State, which includes 17.26% of Peru´s territory (194,567 square kilometers), an area about twice the

List of natural areas protected by the state

PROTECTED FOREST
01 Aledaño a la Bocatoma del Canal Nuevo Imperial
02 Alto Mayo
03 Pagaibamba
04 Pui Pui
05 Puquio Santa Rosa
06 San Matías San Carlos

HUNTING PRESERVE
01 El Angolo
02 Sunchubamba

NATIONAL PARK
01 Alto Purús
02 Bahuaja Sonene
03 Amotape mountains
04 Azul Mountain Range
05 Cutervo
06 Güeppi-Sekime
07 Huascarán
08 Ichigkat Muja-Cóndor Mountain Range
09 Manu
10 Otishi
11 Río Abiseo
12 Sierra del Divisor
13 Tingo María
14 Yanachaga - Chemillén

NATIONAL WILDLIFE REFUGE
01 Udima Cloud Forest
02 Laquipampa
03 Villa Marsh

COMMUNAL RESERVE
01 Airo Pai
02 Amarakaeri
03 Ashaninka
04 Chayu Nain
05 El Sira
06 Huimeki
07 Machiguenga
08 Purús
09 Tuntanain
10 Yanesha

NATIONAL RESERVE
01 Allpahuayo Mishana
02 Calipuy
03 System of Islands, Islets and Guano Rocks (*)
04 Junín
05 Lachay
06 Matsés
07 Pacaya Samiria
08 Pampa Galeras Barbara D' Achille
09 Paracas
10 Pucacuro
11 Salinas y Aguada Blanca
12 San Fernando
13 Tambopata
14 Titicaca
15 Tumbes

LANDSCAPE RESERVE
01 Nor Yauyos-Cochas
02 Sub Cuenca del Cotahuasi

HISTORICAL SANCTUARY
01 Bosque de Pómac
02 Chacamarca
03 Pampa de Ayacucho
04 Machupicchu

NATIONAL SANCTUARY
01 Ampay
02 Calipuy
03 Colán Mountain Range
04 Huaylla y
05 Mejía Lagoons
06 Tumbes Mangroves
07 Megantoni
08 Pampa Hermosa
09 Tabaconas Namballe

RESERVED ZONE
01 Ancón
02 Bosque de Zarate
03 Chancaybaños
04 Huayhuash Mountain Range
05 Illescas
06 Ancón Hills
07 Landscape Reservation Cerro Khapia
08 Río Nieva
09 Santiago Comaina
10 Sierra del Divisor
11 Yaguas

(*) State protected natural areas without numbers in the map are part of the System of Islands, Islets and Guano Rocks.

size of Portugal. Taking another European country for comparison, only about four percent of Germany´s land area is under similar protection.

A significant number of protected areas have been established in Peru. Of the total of 209 nationwide, 17 are managed by regional governments, while 115 are private initiatives.

SERNANP has made significant strides in the management of protected areas since its creation. They have different levels of management, as well as master plans that have facilitated appropriate administration. They also are backed by a series of regulations that safeguard the country´s natural heritage and govern the use of natural resources — locally, nationally and internationally — in collaboration with civil society.

Perhaps most important are the solid teams in the protected areas, especially the park rangers, who silently, selflessly and honorably safeguard the integrity of the country´s natural resources, often without the recognition they deserve.

United for conservation management

Of all of Peru´s protected areas, the most emblematic is unquestionably Manu National Park. Although understanding of its importance for local populations was weak at the beginning, various civil society organizations and government agencies have become involved in its development and management, inserting it into the region´s social and economic network with very positive results.

Since 1973, the year it was officially established, Manu has had a defined organizational structure like other protected areas, in which the highest authority is the park manager. This person guides and supervises the park, and also often serves as the local representative of the Peruvian government. In the most remote and isolated parts of Peru, this person may be the only government official.

In the national park organizational chart, the team that accompanies the park manager and implements directives consists of specialists, park rangers and administrative staff. Manu currently has three specialists in the different units (tourism/environmental education; research/GIS/monitoring; oversight/natural resource management), a secretary, 26 official park rangers, and four volunteer park rangers from local communities.

Participatory management and meeting objectives

According to Article 19 of Peru´s Natural Protected Areas Law (Law No 26834), policy guidelines and strategic planning are specified in the Master Plan for Natural Protected Areas, which is the highest-level document for guiding and planning national, regional and private protected areas.

The master plan defines the basic strategy for management and development of the protected area. It addresses the best tactics for meeting objectives and resolving problems related to the protection and sustainable use of natural resources. SERNANP is responsible for approving the plan and adapting it to changing needs, based on a review every five years.

One of the most beneficial and effective mechanisms for meeting the objectives set for Manu is participatory management. This consists of combining the valuable efforts of local populations — both Andean and Amazonian — with those of public and private stakeholders.

Peru´s National Service of Natural Protected Areas (SERNANP) protects 76 natural areas, equivalent to 17% of the country´s land area. Vast wilderness areas not shaped by humans are becoming rare. Manu National Park ranks near the top in size, biodiversity and wilderness.

Management Committees bring together the various organizations that participate in safeguarding and supporting protected areas. The committee for Manu consists of 90 organizations, including communities, private enterprises, NGOs and others. It is currently headed by the mayor of the province of Challabamba, who was elected for a two-year term. The mayor of the district of Fitzcarrald currently serves as vice president (for a term from 2017 to 2019).

Although this committee is an important manifestation of public participation in Manu´s management, it has no influence in decision making and does not actually co-manage the park. It has made significant progress in the number of members, development of proposals and participation in planning and support for the park. Its functions now include creating venues for consensus building, channeling the voice of local populations and helping to resolve conflicts.

A natural space for the world

Manu National Park is located in southeastern Peru, on the eastern flank of the Andes Mountains and the western edge of the Amazon basin, in the departments of Madre de Dios and Cusco. It was created in 1973 to encompass 17,163 square kilometers, a legally established area that remains in effect.

Activities allowed in designated areas of the park are tourism, recreation and scientific research, but the extraction of natural resources and modifications to or transformations of the natural environment are prohibited.

Manu is Peru´s third-largest protected area. Over the years, it has received national and international recognition on various occasions. In 1977, the United Nations Educational, Scientific and Cultural Organization (UNESCO) made it the nucleus of a biosphere reserve. In 1987, UNESCO declared it a World Heritage Site, in recognition of its extraordinary universal value and its enormous importance — natural and cultural — as common human heritage.

These honors also pose a challenge for the Peruvian government, at different levels. One is the development of the neighboring communities, which, because of regulations governing the biosphere reserve, have been unable to develop sustainable economic activities that safeguard the area´s ecological value. Unfortunately, not only has small-scale agriculture increased in recent years, but road construction has made the national park´s biodiversity even more vulnerable.

Addressing threats

Because of Manu´s strategic location, its managers have been able to monitor and address the diverse threats to which the park is exposed. Manu is flanked by various protected areas: Alto Purús National Park, the Megantoni National Sanctuary, and the Madre de Dios and Kugapakori, Nahua, Nanti and Others Territorial Reserves, which together help protect 473.8 kilometers of its border. This means that 58% of its perimeter is «protected» by these other protected areas.

The areas of greater pressure are in the buffer zone to the southeast and west of the park, in the Kosñipata and Mapacho valleys. These are the places where the largest number of people have settled in still-growing communities and towns.

Spaces and patterns of occupation and resource use are not planned or managed as an integral part of a wider context, and local and regional government officials do not consider the integration of the national park and its surroundings a priority.

The park manager and conservation partners therefore must often build and consolidate relationships with the institutions responsible for managing the surrounding landscape. They do this through formal processes, coordination and information about the protected areas and their buffer zones, taking advantage of mechanisms created by law to help avoid conflicts. This often leads to land-use planning, regional and municipal development, or a response to the effects of climate change.

According to the most recent master plan (2013- 2018), the threats of greatest concern for Manu originate outside of the park. These are hunting, logging, efforts to contact isolated indigenous people, the bioaccumulation of mercury, lack of regulation of tourist activity, the absence of intercultural criteria in native communities, drug trafficking and the expansion of agriculture. If these activities occurred inside the park, they would be punishable under Peruvian law.

If the threat occurs in the buffer zone, however, it requires special treatment that safeguards the conservation of the park. In other words, although SERNANP cannot control what happens outside the park, any action or measure taken in the buffer zone requires the agency´s binding opinion.

Participatory monitoring and oversight

In 2016, SERNANP approved guidelines for participatory monitoring and oversight in protected areas. The purpose was to allow civil society participation in monitoring and its support in oversight. This effort involved various people and groups, including park rangers (volunteer and community rangers), interest groups, organized monitoring groups, interested individuals and NGOs.

The places established for beginning patrols generally are the ranger stations. These are permanent infrastructure, far from population centers, which house rangers in protected areas.

Manu National Park currently has eight ranger stations, as well as a sub-office in Villa Salvación, in the province of Manu. Over the years, these sites have moved, depending on the threats that emerged both inside and outside of the park. The following are the ranger stations located from the most remote Amazonian area to the most distant corner of the Andes:

The **Pakitza** ranger station («harpy eagle» in the Matsiguenka language), is not just a ranger station: the park rangers and managers consider it a «test of courage» for everyone who begins working there. New arrivals spend their early years at Pakitza. It is a completely isolated place, where conditions in the past were extreme.

In the 1980s, there was no radio for communication and only very sporadic contact with other people. The only visitors were park staff who arrived periodically with food, fuel and equipment for those working there. Between those occasional visits, rangers could spend months living in contact only with nature. The vocation of those who truly wanted to become park rangers was strengthened in Pakitza.

Many tell how Pakitza sparked their passion; it not only made a profound impression on their lives, but they still work there today. Of course, there are others who never want to see Pakitza again.

The **Limonal** ranger station is close to the entrance to Manu, some 20 minutes by boat from the town of Boca Manu. It is close to the Pinquén River, one of the best-known watersheds in the area, which is famous for the amount of cedar logged there at one time. In the 1990s, heavy pressure from loggers led to the construction of a ranger station close to the confluence of the Pinquén and the Manu rivers.

When the pressure was considerably reduced, Limonal was relocated to the park entrance. Now it is the place where visitors register and tourism is controlled.

Thanks to studies and evidence that show it to be part of a corridor for people in isolation, the entire watershed is considered a strictly protected area. The relocation of this ranger station from the Romero River to its current site at Limonales was the result of the withdrawal of loggers and the beginning of the official organization of tourism activities that had already begun in the park.

The **Santa Cruz** ranger station originated at the old Palotoa station. Because of its location close to the road that connects the small town of Villa Salvación with Santa Cruz, Palotoa was attractive to loggers. This prompted the construction of a ranger station to control illegal logging, and Palotoa was born.

Over time, and as the native community of Palotoa Teparo became established, the decision was made to dismantle that station and install the current one in Santa Cruz, along the access road leading to the community of Shintuya. This is where park rangers now begin their journey to the Manu River, carrying all the supplies they need to support their companions and carry out their work.

The **Pusanga** ranger station was the base for controlling illegal activities along the banks of the Alto Madre de Dios River and for awareness-raising and environmental education in the native community of Diamante. In 2011, however, groups of isolated people appeared between the Yanayacu and Pusanga rivers. After two tense encounters with isolated people, park ranger Jesús Queme was wounded by an arrow. In compliance with regulations regarding indigenous people in isolation and initial contact, park personnel withdrew from the area and the ranger station was closed.

The **Tono** ranger station, in the watershed of the same name, is a difficult area because of ongoing problems with illegal loggers. As a result, it has been built and moved three times.

The first was built inside the park. Later it was moved outside to the buffer zone, eight kilometers from the edge of the park, along the access road to the farms bordering Manu. In 2016, it was moved again to the park boundary in an effort to eliminate logging that was encroaching on and sometimes occurring inside the park and to combat coca production in the area.

Although coca leaves were cultivated in that area centuries ago by the Incas for ritual use and for health and work, today some residents produce illegal derivatives. That has begun to transform the region.

This sector of the park also includes the Piñi Piñi watershed, where there are Matsiguenka populations. The relationship between the Matsiguenka and the native community of Santa Rosa de Huacaria led to the construction of a ranger station.

Patrolling rivers, operating ranger stations and working with communities are key tasks of Manu's rangers. Park director John Flórez (in bottom left hand photo) manages key national and international assets.

30 years of tradition: The pride of stakeholders in «their» national park is reflected in the annual birthday celebration, complete with a parade by park rangers. Indigenous inhabitants travel from distant villages to participate in this event.

Handcrafted products bearing the Manu Biosphere Reserve brand can generate income for residents and neighbors of the national park.

Trees that float down the river and out of the park are used by boat builders in Boca Manu. This is some of the most eco-friendly wood in the world, as no tree is cut by humans.

Later, after local residents tried to move into the park, an agreement with the community and support from cooperation agencies made it possible to staff the Tono ranger station with volunteer Matsiguenka community park rangers trained by SERNANP to protect this watershed.

The **Acjanaco** and **Qurqurpampa** ranger stations are in the upper Andean zone and have characteristics completely different from those of lush, green Amazonia. Here in these highlands, the rising sun warms the palette of colors that meld into an amalgam of brilliance, color and sound.

Sunrise at Tres Cruces occurs in a natural scenario that is unique in the western part of the park. It is visited by hundreds of tourists, who consider the dawn a symbol of love and coexistence between the Andes and the Amazon. At this crest, close to the sky, pasture is in great demand, sustaining cattle that wander freely between the park and the neighboring communities.

The Acjanaco ranger station was built to avoid overgrazing. Its other purpose is to protect and regulate tourism at the Tres Cruces overlook. The Qurqurpampa ranger station also regulates the subsistence farming done by residents of Callanga, the only community of farmers here in the upper jungle.

Finally, the **Lacco** ranger station was built in late 2010. Its mission is to support Manu National Park and Megantoni National Sanctuary by controlling grazing in the Andean sector and barring the entrance of people hunting for treasure and archaeological ruins.

Work in this area focuses especially on conservation of the Andean ecosystem. Through information and activities with private landowners and nearby communities, efforts are made to avoid the burning of pastures, unplanned tourism activities in the park, and hunting of spectacled bears.

Spectacled bears, which are found in Manu, are hunted because of the erroneous belief that they prey on the cattle that graze — freely and with no oversight — around the park.

This work in some of the remotest parts of the national park has helped place the area on more solid footing. This dynamic strategy and an effective internal and institutional management model have made Manu an emblematic protected area.

Many people have contributed to the park´s protection and management over the years. They include the members of the management committee, and national and international cooperation organizations such as the Peruvian Association for Conservation and Nature, the Center for the Development of Amazonian Indigenous Peoples, the Association for Conservation of the Amazon Basin, Conservation International, Pronaturaleza, and the Frankfurt Zoological Society, which has been collaborating in Manu for more than 25 years.

How can sustainable income be generated for Manu?

Tourism in the different areas of Manu National Park and Biosphere Reserve (the tourism zones, buffer zone and transition zone) is meant to help generate sustainable income for the local population and the park.

Local people produce handicrafts, as well as *aguaymanto* (cape gooseberry), honey, pineapples, bananas, native potatoes and coffee. There is also an association of workers in Boca Manu who «fish» dead tree trunks out of the Manu River when they are washed downstream. Tourism, meanwhile, generates additional revenues for private enterprises and for SERNANP, which is used to cover part of the cost of managing the park.

Approximately 15,000 international, national and regional tourists visit the lower part of Salvación and the cloud forest each year. About 2,000 a year travel into the park via Boca Manu, a figure that reached 3,544 in 2015. Tourism plans for the Manu Biosphere Reserve are designed to ensure controlled and sustainable tourism. Although Manu´s location lends itself to conservation, the trips are expensive and time consuming.

Another challenge for the future is how to use the Boca Manu-Diamante landing strip, which could become an entryway to the park for tourists and a transportation option for local residents, not used just for emergencies. This would make it much easier for visitors to reach the various lodges in the tourism and buffer zones where concessions have been granted to private enterprises.

There is a network of trails around some of these areas, some of which even include observation towers (in places such as Cocha Otorongo and Pakitza). Cocha Salvador also has a catamaran that groups of visitors can use to approach giant otters without disturbing them. Some of these sites and lodges are marked and managed, partly or completely, by Matsiguenka people, making them an alternative for generating income.

But it is not easy for the Matsiguenka to adapt to the change from their traditional lifestyle, living from the bounty of the forest, to a more commercial one, in which they can generate a sustainable income by offering services.

All of these initiatives require not only control and oversight, but also technical assistance and education. Ideally, in the not-too-distant future, the indigenous peoples living in Manu will have access to education that enables them to complement their traditional knowledge with the educational underpinnings of Peruvian society. That is why there are now educational initiatives in Boca Manu for indigenous communities, to facilitate understanding and cooperation in the management of Manu.

Park rangers: conservation professionals

Although they usually are associated with protection and oversight of the park, the park rangers´ work is much broader and more complex. First, they are considered authorities inside and outside of their jurisdiction, and the purpose of their work is to ensure the care and conservation of the country´s protected areas.

Second, they play different management roles, including monitoring of conservation goals, conflict resolution, environmental education in primary schools, working with native and farming communities, and assisting researchers and tourists who visit the park.

Although the park rangers´ labor situation does not reflect their resource management role, especially in terms of wages and pensions, SERNANP is making a concerted effort to improve it. It has assumed responsibility for paying all personnel and has gradually increased wages despite budget limitations.

It is crucial to understand the key role played by the staff of protected areas and the enormous importance of the training plan.

Throughout these 40 years, the work of the state would not have been possible without park rangers, women and men who represent and symbolize the conservation of protected areas, who have worked tirelessly to share information, raise awareness, and engage in outreach and education.

These conservation professionals spend long stretches of time in the ranger stations. They have no set schedule: they may work more than 12 hours a day, including nighttime activities that last into the early morning hours, often at risk to their lives.

They face all their tasks, including the most hazardous, without firearms. If a situation cannot be resolved through dialogue, the appropriate authorities — such as prosecutors, police or armed forces — are the ones who must ensure that Peruvian laws are enforced.

Park rangers labor in the most complex, remote places, working with Andean and Amazonian communities, transmitting a message that is fundamental for humanity. Their commitment, courage and passion for nature make them true conservation heroes.

For many, this work has not been easy. They often received only limited training from SERNANP and had to do their best to adapt to challenging conditions in some of the most remote places in the country.

Nature tourism in Manu National Park is important for branding and showing off the park. Infrastructure consists of trails, observation towers and a catamaran for lake visits.

The park rangers of Manu National Park are friendly, attentive, reliable interpreters, willing to assist anyone and trained to resolve the most varied problems. They are competent, charismatic professionals known for their great solidarity.

Manu National Park is a unique place. Those who visit leave with it engraved on their minds and hearts. For those of us who have the good fortune to care for it and to safeguard its conservation, adjectives and recognition pale before the enormity and beauty of the natural world it encompasses.

We need only ask a retired park ranger to tell us about his experience. He would surely say that nothing in his life was as important as having served his country from the frigid highlands of Apu Kañahuay, to the moist cloud forest, the habitat of the San Pedro cock of the rock, or the Amazonian heat of the Isthmus of Fitzcarrald.

All have a fascinating story to tell. All, with pride and love, with that unique spirituality with which they fought for Manu National Park´s existence and survival, will always be willing to tell their tales.

SERNANP park rangers are the public face of Manu National Park. They are always willing to provide information.

Special patrols implemented by SERNANP and the Frankfurt Zoological Society are important for monitoring the state of the park.

A variety of bodies of water with different chemical characteristics, flow velocity and water levels contributes to the high diversity of aquatic life in the Amazon.

Manu and its surroundings

Antje Muellner

Eva sits in the living room in the girls' section of the boarding school for Matsiguenka students in Boca Manu. She is doing her geography homework, along with some of her secondary school classmates. «I can hardly believe it!» she exclaims, looking up at them. «Manu and the areas around it are bigger than entire countries in Europe or Central America. Denmark and Costa Rica are both smaller». Later, thinking aloud, she adds, «It takes me several days to travel to my community in Manu. I knew the park was big, but I never imagined it was the size of an entire country!»

Covering some 17,160 square kilometers, Manu National Park is large even by international standards. It forms a harmonious mosaic with other conservation areas, sharing long borders with some — forming single units, in some places — and connecting to others with corridors.

Alto Purús National Park and the Megantoni National Sanctuary, which are also under the direction of SERNANP, the agency responsible for protected areas, are direct neighbors of Manu, and together they form the Purús-Manu complex, a vast area whose 44,430 square kilometers make it larger than Switzerland.

Other conservation areas that are closely tied to this complex, although under different management, are the Madre de Dios and Kugapakori, Nahua, Nanti and Others territorial reserves; the Mashco Piro and Murunahua indigenous reserves; the Alto Purús Communal Reserve; and the private Los Amigos River Conservation Concession. If we consider all of these conservation areas together, the total size increases to 58,750 square kilometers.

Big is beautiful

Worldwide, protected areas increasingly resemble islands in a sea of oil palm plantations, cattle ranches and cities. The boundaries of Kinabalu National Park in Malaysia and Taï National Park in the Ivory Coast, for example, can be distinguished by the sharp boundaries between the natural habitats they protect and the surrounding land, which is degraded or under intensive cultivation.

Fortunately, that is not the case with Manu National Park. Manu is well connected with other areas, and the Purús-Manu complex, located in southeastern Peru, is unique in the world for its size and its very low human impact. The presence of indigenous people in isolation in this region is proof of its remoteness and underscores the obligation to protect it effectively against intruders.

The Purús-Manu complex is famous for its rich and abundant wildlife. A male jaguar´s home range can cover as much as 100 square kilometers, depending on prey density. Peccaries are known to roam huge distances in the forest, and a giant otter may travel more than 200 kilometers in search of a mate and a new home lake. Such species need extensive conservation areas to maintain viable populations. Large areas support the critical number of animals and are conducive to genetic mixing.

The larger the area, the more species it can support. These large expanses are an excellent barrier against species extinction from natural or anthropogenic impacts such as storms, flooding, fire, and wildlife diseases.

Another reason why size matters is that it creates space for natural dynamics on a grand scale. Rivers change course as they meander across broad plains, and as old oxbow lakes silt up, new ones form. These natural changes and disturbances are an important factor in maintaining high biodiversity.

Because of their immense size, Manu and its neighbors harbor entire ecosystems, including mountains, watersheds, cloud forests and lowland forests. They safeguard ecosystem services — such as pollination and regulation of water and climate — for the benefit of humans in the region, and they create places where wildlife can reproduce.

In these times of climate change, the Manu region plays an even greater role in biodiversity conservation. Manu National Park, along with the adjacent Megantoni National Sanctuary and nearby Bahuaja Sonene National Park, extend over wide ranges of elevation with diverse climate zones and habitats. Because of this, they provide refuge to species affected by climate change, as well as space for displaced and shifting plant and animal communities.

The two faces of natural connectivity

In the afternoon, after completing its annual census in Manu National Park, the Frankfurt Zoological Society team monitoring giant otters visited Eva and her companions. Because of their travels along the Manu River, the girls know the giant otters well. They know that individuals can be recognized by their throat patches.

Starting in small streams upriver, water originating in Manu later crosses two national borders and flows thousands of kilometers before reaching the Atlantic Ocean. What happens at the headwaters may have consequences far downstream.

Today they were surprised when Joel, the researcher who specializes in otters, said, «Imagine — a young male we call Diablo grew up in an oxbow lake near the Los Amigos River, outside of Manu, three days from here by boat. He hadn´t been seen for years, but during our last census in the park, we identified him. He leads a group of otters in Cocha Salvador and is the father of several pups. Diablo had obviously traveled deep into Manu. If we look at the map, there are more than 300 kilometers of waterways».

Wild animals neither know nor respect the borders of a protected area. They leave a safe haven because of migration, natural dispersal, high population density or harsh climatic conditions; they enter the protected area from outside for the same reasons. For their survival, it is crucial that protected areas be connected and that there be enough natural space to provide the habitats they need.

If no direct link between natural habitats is possible, ecologically responsible land management in buffer and transition zones would at least help wildlife move from one zone to another.

Compared to the huge forests of the Manu region, rivers and lakes are sparse habitats. Because they serve as transportation routes, the rivers are a bottleneck for both wildlife and humans. Connectivity turns the rivers into open channels full of things that are harmful to the park. Contaminated catfish migrate from the Colorado River and along the Madre de Dios and Manu rivers, bringing toxic mercury with them to Manu. This occurs even though there is no gold mining or mercury use in the park.

The Madre de Dios River is becoming more a barrier than a connector. Fishing nets, boat traffic, pollution, sedimentation, gold mining and intensive hunting block well-established animal migration routes. As a result, populations of giant otters and caimans run the risk of becoming isolated and suffering serious inbreeding.

In the long run, it will be more difficult to maintain the connectivity of bodies of water than terrestrial habitats in the region. Rivers are the lifelines of the Amazon, and protecting their headwaters is key for the entire system.

It is also urgent to close gaps and avoid isolated fragments of the fragile high Andes and the cloud forests along the western side of the park. There are several initiatives for a corridor. The Wayqecha and Villa Carmen biological stations along the road to the lowlands, both of which are managed by the Amazon Conservation Association, encompass 37 square kilometers and are important stepping stones for flora and fauna.

Although it covers only 272 hectares, the Pilco Grande community´s Pumataki Private Conservation Area, at the highest point in Manu, plays an important role as an additional buffer for the park. In the lowlands, the 650-hectare Manu Learning Center operated by the CREES (Conservation, Research & Education towards Environmental Sustainability) Foundation smoothly connects the park with its surroundings. Complementing these areas are several individual initiatives and tourism enterprises that have obtained properties to protect the area. Together, these areas are vital for the conservation of Manu.

Oxbow lakes can last for years or centuries, depending on the river´s topography. East of Manu, the first savannahs become visible, close to the Bolivian border.

Collaborating across borders

The importance of habitat connectivity has been recognized for many years. The concept of the Vilcabamba-Amboró Conservation Corridor, of which Manu is an essential part, was developed in the 1990s by the non-governmental environmental organization Conservation International.

Beginning in the high Andes north of Cusco, this corridor connects 19 protected areas totaling 300,000 square kilometers. The corridor is the core of the Tropical Andes Biodiversity Hotspot. Like pearls on a string, each protected area in the corridor connects with the next, forming a green band along the foothills of the Andes to the southeast, crossing the border with Bolivia and ending in Amboró National Park near Santa Cruz de la Sierra.

North of the Purús-Manu complex, just over the border with Brazil, the corridor connects with other conservation areas, including Chandless State Park (with 6,953 square kilometers), several indigenous reserves and the Acre River Ecological Station.

It is logical to think of «wildlife without borders» not only in regional terms, but also from an international perspective. Water from the Manu River crosses two national borders — Bolivia and Brazil — before reaching the Amazon. People on both sides of the borders provide

Colpa Colorado is one of the largest macaw and parrot clay licks in the world. Hundreds of birds of several species arrive daily to peck at the clay, ingesting minerals that are believed to neutralize toxic compounds in the birds´ diet.

equipment and fuel to illegal gold mining camps along the Madre de Dios River. The departments of Madre de Dios in Peru and Pando in Bolivia, and the state of Acre in Brazil, have responded by creating MAP, a tri-national initiative that takes its name from the initial letter of each of those places.

Since 2000, coordinating groups consisting of government agencies, academics and non-governmental organizations from the three countries have met regularly to exchange information and coordinate planning for development, infrastructure and research activities.

In round tables and working groups, they address common problems and discuss possible solutions. One example was a joint effort by conservationists to reduce the negative impacts of the Interoceanic Highway and strengthen opportunities for sustainable development and environmental conservation. An alliance against the proposed road from Boca Manu to Nuevo Edén and against hydroelectric dams has formed.

At the government level, Peru´s SERNANP and Bolivia´s SERNAP launched a pioneering initiative to enhance cooperation among Bahuaja Sonene National Park, the Tambopata National Reserve and Madidi National Park, which are separated only by the Heath River along the border.

Thanks to an exchange of experiences between Peru´s Ministry of Culture and Brazil´s National Indian Affairs Agency, strategies are being developed to protect indigenous peoples living in isolation. Isolated indigenous groups are known to move back and forth across the border between Peru and Brazil, and it is imperative to keep this corridor free of outside human disturbances.

Despite the many threats facing the region, such as gold mining, coca plantations, expansion of agriculture and hydroelectric dams, the outlook for Manu and its surroundings is not so negative. Unlike the tropical areas of other continents, there is a real chance for the forests of Manu and surrounding areas to survive sustainably, on a large scale, for future generations.

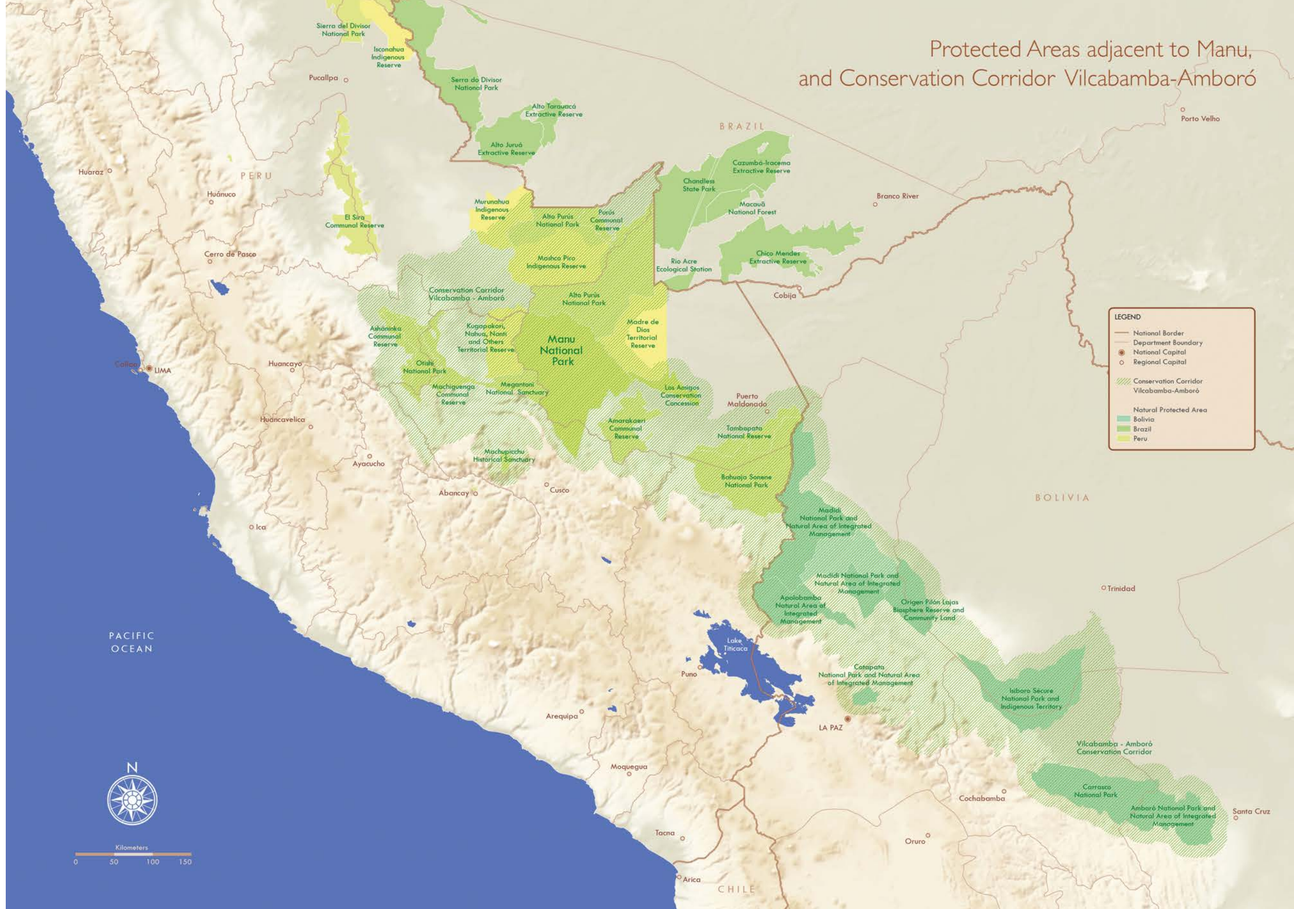
The wild bunch

Emerson, another student at the boarding school, is returning from Boca Manu to his community in Manu National Park for the school vacation. He will finish secondary school next year and is thinking about what he will do afterward. During the long trip home, he had a chance to talk with a Matsiguenka park ranger. «Could I work as a park ranger?» he asked the experienced ranger, who replied, «Youll need to learn many things and prepare well. There is much to be done, not only here in Manu, but also in the other nearby protected areas».

Manu and its neighbors form an amazing bouquet of natural areas in different conservation categories. There are government-protected areas such as national parks and strictly protected intangible areas and refuges for indigenous peoples in isolation and initial contact. Other government-protected areas allow permanent settlements and the use of natural resources under a management plan. There are also private and community conservation areas and conservation concessions.

Every area has its own cultural, tourism and biodiversity highlights. The mystical Pongo of Mainique canyon in the Megantoni National Sanctuary is outstanding. According to legend, the Matsiguenka people originated there, where the Urubamba River rushes through a deep and impressive gorge with waterfalls and rapids. Despite the hazards, traversing the rapids by boat has become a tourist attraction.

A look at a map shows that the Megantoni Sanctuary also serves as a corridor between Amazonian and Andean habitats. Nestled against Manu to the east, it extends westward



Categories of protected areas in Peru

The Purús–Manu complex and neighboring areas fall into various protection categories under Peruvian law.

National Park: Area representative of the biological diversity of the country and its major ecological zones. Provides strict protection for the ecological integrity of one or more ecosystems, wildlife and evolutionary and successional processes, as well as other scenic and cultural characteristics.

National Sanctuary: Strict protection for the habitat of a species or plant and animal community, as well as natural formations of scientific and scenic interest.

National Reserve: Area designated for biodiversity conservation and sustainable use of wild aquatic or terrestrial flora and fauna. Commercial use of natural resources is permitted with management plans.

Communal Reserve: Area designated for conservation of wild flora and fauna for the benefit of neighboring rural populations. Use and commercialization of resources permitted with management plans.

Territorial Reserve & Indigenous Reserve: Area protecting indigenous people in isolation and their traditional lifestyle; strictly protected.

Conservation Concession (private): Area of individual or private property that is valuable for biodiversity conservation; owners voluntarily establish specific conditions for use and conservation.

along the Urubamba Valley, where it connects with the Machiguenga Communal Reserve and the lesser-known Otishi National Park. The steep mountain slopes in the eastern part of the Megantoni Sanctuary serve as an important drainage boundary. All waters to the east of the ridge flow toward the Manu and Madre de Dios rivers to become part of the Madeira River system, while waters west of the ridge drain into the Urubamba River and eventually flow into the Ucayali River system.

The Pampas del Heath, west of the Heath River in Bahuaja Sonene National Park, is another special place. Here in the far southeast lies Peru´s only moist tropical savannah; most of this ecosystem is in Bolivia. This seasonally flooded open grassland of approximately 65 square kilometers contrasts with the forests that predominate around it.

Termite nests (a meter or two tall), shrubs, sedges and terrestrial bromeliads are characteristic of the landscape. Marsh deer (*Blastocerus dichotomus*) graze, and birds typical of open country, such as the grassland sparrow (*Ammodramus humeralis*) and plumbeous seedeater (*Sporophila plumbea*) can be seen. The Pampas del Heath is also the only place in Peru where the maned wolf (*Chrysocyon brachyurus*), South America´s largest canine, is found.

One of the most extraordinary places in the Madre de Dios region is the Colpa Colorado in the Tambopata National Reserve. It is the largest known macaw and parrot clay lick in the world. The steep bank of the Tambopata River is between 25 and 30 meters high there and 500 meters long. Six macaw species, including the rare blue-headed macaw (*Primolius couloni*), and 11 species of parrots and parakeets visit the clay lick.

Beginning early in the morning, they arrive in huge flocks, usually following a specific order of species, filling the air with a riot of color and raucous sound. The birds peck at the clay. Scientists believe they ingest particular minerals that may help neutralize toxic or poorly digested compounds from certain plants that are part of their diet of fruits and vegetation.

The Colpa Colorado has been featured in many nature documentaries. It is located deep in the Tambopata Natural Reserve, in a pristine and uninhabited lowland forest. There are other clay licks in the region and in Manu, but none compares with Colorado in size and bird diversity.

The following fact sheets provide a brief overview of the amazing diversity in the Purús-Manu complex and surrounding areas. Together they form an outstanding mosaic of biodiversity and wilderness, and they also are home to various indigenous peoples.

This list includes only areas exceeding 1,000 square kilometers.

Manu National Park (MNP)

Area:	17,163 km²
Established:	1973
Elevation:	280-4050 masl
Habitats:	*Puna*, montane forest, cloud forest, lowland tropical forest, riverine habitats, lakes
Permanent inhabitants:	Approx. 1,000 people (635 in Matsiguenka communities, 225 Matsiguenka in initial contact, 145 Quechua in Callanga), and an unknown number of people living in isolation
Boundary:	808 km of perimeter (473 km bordering other protected areas, amounting to approx. 60%)
Special characteristics:	High elevation range, steep gradient, includes many different climate zones and therefore impressive species diversity; also includes entire Manu River watershed

Alto Purús National Park

Area:	25,107 km²
Established:	2004
Elevation:	200 – 600 masl
Habitats:	Tropical lowland forest, bamboo forest, riverine habitats, lakes
Permanent inhabitants:	Indigenous peoples living in isolation. Approx. 600-1,000 Mashco Piro and 200 Mastanahua
Shared border with MNP:	Approx. 155 km in southern part
Special characteristics:	Largest protected area in Peru; includes the most remote and unexplored areas of the Amazon; home to isolated indigenous people and includes the Mashco Piro Indigenous Reserve; shares a long, green border with Brazil, headwaters of the Purús River and several tributaries

Megantoni National Sanctuary

Area:	2,159 km²
Established:	2004
Elevation:	400 – 4,000 masl
Habitats:	Lowland rain forest, cloud forest, riverine habitats
Permanent inhabitants:	Approx. 100 Matsiguenka people (15 families)
Shared border with MNP:	Approx. 90 km in eastern part
Special characteristics:	Largest sanctuary in Peru; headwaters of the Timpía, Ticumpinia and Urubamba rivers; the steep Pongo de Mainique canyon; name comes from *meganto*, the Matsiguenka name for the military macaw (*Ara militaris*)

Kugapakori, Nahua, Nanti and Others Territorial Reserve

Area:	4,567 km²
Established:	1990
Elevation:	300 – 1,500 masl
Habitats:	Lowland rain forest, riverine habitats
Permanent inhabitants:	Approx. 945 people in 15 Matsiguenka and Yora communities
Shared border with MNP:	Approx. 116 km in eastern part
Special characteristics:	Reserved for indigenous peoples in isolation and initial contact; includes tributaries and headwaters of streams on the right bank of the Urubamba River and many salt licks and clay licks frequented by mammals and birds

Madre de Dios Territorial Reserve

Area:	8,299 km²
Established:	2002
Elevation:	350 – 450 masl
Habitats:	Lowland rain forest, riverine habitats
Permanent inhabitants:	Indigenous peoples in isolation of the Mashco and Yora tribes and unidentified tribes (unknown number)
Shared border with MNP:	Approx. 84 km in eastern part
Special characteristics:	Exclusively reserved for indigenous peoples in isolation

Los Amigos Conservation Concession and Los Amigos Biological Station (CICRA)

Area:	1,457 km²
Established:	2001
Elevation:	200 – 400 masl
Habitats:	Lowland rain forest, riverine habitats, bamboo forest, oxbow lakes
Permanent inhabitants:	Concession staff (8 people) and CICRA staff (7 people)
Shared border with MNP:	16 km in northwestern part
Special characteristics:	First conservation concession in Peru; Los Amigos Biological Station; Los Amigos River flows through the concession

Mashco Piro Indigenous Reserve

Area:	8,161 km²
Established:	1997 / 2016
Elevation:	200 – 350 masl
Habitats:	Lowland rain forest, riverine habitats
Permanent inhabitants:	Unknown number of isolated Mashco Piro and Mastanahua people
Direct link to MNP:	Via Alto Purús National Park
Special characteristics:	Reserved for indigenous peoples in isolation and initial contact

Purús Communal Reserve

Area:	2,020 km²
Established:	2004
Elevation:	250 – 400 masl
Habitats:	Lowland forest, riverine habitats, oxbow lakes
Permanent inhabitants:	Indigenous peoples in isolation (unknown number)
Direct link to MNP:	Via Alto Purús National Park
Special characteristics:	One of the last areas in the region where mahogany is found; home of isolated indigenous people in very recent initial contact

Murunahua Indigenous Reserve

Area:	4,703 km²
Established:	1997
Elevation:	250 – 350 masl
Habitats:	Lowland rain forest, riverine habitats
Permanent inhabitants:	Approx. 120 Amahuaca people (9 families)
Direct link to MNP:	Via Alto Purús National Park
Special characteristics:	Exclusively reserved for indigenous peoples in isolation and initial contact

Machiguenga Communal Reserve

Area:	2,189 km²
Established:	1997 / 2003
Elevation:	450 – 3000 masl
Habitats;	Lowland rain forest, riverine habitats, lakes, bamboo forest, cloud forest
Permanent inhabitants:	No permanent settlement; traditional use of natural resources by Ashaninka, Kakinte, Matsiguenka, and Yine people
Direct link to MNP:	Via Megantoni National Sanctuary
Special characteristics:	Headwaters of Picha, Parotori and Miaria rivers, with pristine forests

Otishi National Park

Area:	3,060 km²
Established:	2003
Elevation:	750 – 4,185 masl
Habitats:	*Puna*, lowland rain forest, bamboo forest, cloud forest, riverine habitats and lakes
Permanent inhabitants:	Presence of indigenous peoples in isolation
Direct link to MNP:	Via the Matsiguenka Communal Reserve and Megantoni National Sanctuary
Special characteristics:	Encompasses northern points of the Vilcabamba Range; many stunning waterfalls along the Cutivireni River (Hectariato is one of the highest, at 300 meters); and Pavirontsi, the longest natural bridge in the world, forming a tunnel 70 meters high and 220 meters long

Amarakaeri Communal Reserve

Area:	4,023 km²
Established:	2002
Elevation:	300 – 2,700 masl
Habitats:	Cloud forest, lowland rain forest, bamboo forest, riverine habitats and lakes
Permanent inhabitants:	No permanent settlement; traditional use of natural resources by neighboring communities of Harakbut, Matsiguenka and Yine people
Link to MNP:	Via park buffer zone
Speciall characteristics:	Hot springs; Gallinazo waterfall from Pantiacolla mountain ridge; northern points of the Vilcabamba range; Tambo Weuk natural oil seep; various salt licks and clay licks frequented by mammals and birds

Bahuaja Sonene National Park

Area:	10,914 km²
Established:	1996
Elevation:	200 – 2,450 masl
Habitats:	*Puna*, montane forest, cloud forest, lowland rain forest, riverine habitats, moist savannah
Permanent inhabitants:	No permanent settlement; traditional use of natural resources by Ese Eja people in the park
Link to MNP:	Via park buffer zone and Amarakaeri Communal Reserve, Madre de Dios River
Special characteristics:	The only moist savannah in Peru, along the Heath River, with specific flora and fauna (Pampas del Heath); long, green border with Bolivia; largest macaw and parrot clay lick in the world

Tambopata National Reserve

Area:	2,747 km²
Established:	2000
Elevation:	200 – 400 masl
Habitats:	Lowland rain forest, swamps, riverine habitats and lakes
Permanent inhabitants:	60 people (14 families)
Link to MNP:	Via the buffer area of Manu National Park and Amarakaeri Communal Reserve, Madre de Dios River
Special characteristics:	One of the areas with greatest species diversity; well-developed tourism destination with the highest number of visitors in the southern Peruvian Amazon

Chapter 9

Prospects for the future

Marc Dourojeanni & Hauke Hoops

Predicting the future is difficult, but sometimes necessary. If you want to take urgent measures to avoid a negative outcome or plan for a less conflictive future, the challenge must be faced. Predicting the future means designing scenarios.

The easiest things to predict are trends — what will happen or how a situation will be within a particular time frame if current conditions are maintained without sudden changes, conditioned only by normal growth of the population and the increase of its economic activities. That, however, is an unlikely scenario, and rarely the most desirable.

The preceding chapters have described Manu, especially its extraordinary importance for Peru and the world. They also have examined in depth the measures being taken to conserve it. The future of Manu National Park — considering that the ideal is to protect it and keep it in its natural state, improving its conditions insofar as possible — depends on the balance between the factors in favor of that situation and those against it. The latter refer to threats hanging over the park.

Over 20 percent of the global carbon dioxide emissions leading to climate change originate from deforestation. The future of the forests determines our own future as well.

Besides its disastrous ecological impact, illegal gold mining has many social impacts, such as human settlements in the forest near Manu, which lack authorities and are characterized by labor exploitation, human trafficking and a lack of other opportunities.

The long-term future of Manu National Park (to 2050, for example), as well as other protected areas in Peru, lies between two possible extremes:

(i) The park will continue to exist, with its area and nature intact. It will continue to contribute significantly to the quality of life of Peruvians and all of humanity, with environmental and economic benefits for the local population.

(ii) The park will be reduced in size or eliminated by some political decision. If the former occurs, it will lose much of its forest and original wildlife. It will be occupied by residents who, after using the timber from the forest and exterminating the fauna, will devote the land to farming, livestock and possibly mining.

Between the two extreme scenarios lies an infinite array of less-drastic options.

The threats and their consequences for Manu National Park

The various threats and their evolution over time will determine the possible future scenarios for Manu National Park. The hazards are of various types; some are known and relatively controlled, while others are still unperceived. The challenge is to know which will predominate and how to predict their persistence. This largely depends on how political decisions and corresponding legislation favor or jeopardize the park.

Some threats could be significant, but are unlikely in the short or medium term. Others are of less relative importance, but are likely or very likely to occur. There are even some that, although of less relative importance, are occurring already and could intensify in the future. The following table shows the different types of threats:

Threat	Consequence/Impact	Probability	Importance
Universal or national threats			
Climate change	Impact on climate, flora and fauna. Displacement of species. Risk of fire	High. Already occurring	High. Little can be done to remediate it
Global conflict and possible restriction of international support	Besides its direct impact, a possible world war would reduce funding, tourism, etc.	Low	Low to high. Depends on the scope of the conflict
Changes to policies and/or legislation	Political decisions could change the size, boundaries or category	Low. Potential risk	Very high
Oil and gas operations and formal mining	Deforestation, risk of contamination, serious problems with indigenous populations	Low. Controllable risk	Moderate. Impacts can be negotiated
Roads inside the park	For example PE5S, deforestation, hunting, extraction, mining, etc.	Low. Potential risk	Very high. Would cut park into isolated pieces
Inadequate public budget and other resources. Insufficient staff and equipment	Reduces management quality. Limits effectiveness of control. Affects relationships with communities and neighbors	Very high. Already occurring	Very high. Without resources, park is exposed to all threats
Impacts on neighboring protected areas	Manu´s resilience depends on the quality of conservation of surrounding protected areas	High in case of Amarakaeri. Moderate in case of Alto Purús	High
External threat (occurring outside of the park)			
Roads around the park	Example: MD 103	High. Already occurring	Very high. Causes all kinds of other impacts
Illegal mining	Deforestation, pollution	Moderate. High potential risk	High. Not always controllable
Illegal agriculture by squatters	Deforestation	Moderate. Potential risk	High. Once established, it is difficult to remove them
Illegal crops, coca	Deforestation, corruption, pollution	Moderate	Moderate. Controllable
Illegal logging and other extraction	Forest degradation	Low	Moderate. Controllable
Illegal hunting	Reduction of wildlife population	Moderate. Already occurring	Moderate. Already occurring in upper section(spectacled bear)
Oil, gas and minerals	Pollution, deforestation, human presence	Moderate. Already occurred and could happen again	Very high
Internal threat (occurring inside the park)			
Increase in Matsiguenka indigenous population	Deforestation, hunting and fishing, exploitation of other resources, pollution	Very high. Already occurring	Very high
Increase in population of indigenous people in «voluntary isolation»	With time, could become like the Matsiguenka situation	Very high. Already occurring	High. The population of these indigenous peoples is small
Poorly managed tourism	Pollution, noise, disturbance	High. Already occurring	Low. Controllable

The illegal selective logging of high-value trees, such as cedar and mahogany, endangers the forest and is one of the main threats to the protected area.

Threats originating outside of the park

«Universal» threats include climate change and the possibility of a global conflict. In both cases, practically speaking, little can be done in Manu to avoid them or limit their negative impacts.

Because of the immense ecosystem gradient between the highlands and lowlands, climate change is an important issue for Manu. Species will migrate from one life zone to another depending on the changes that occur. If the area is well protected, it is reasonable to expect that species will not be lost.

Little can be done to anticipate a world war. A nuclear war, for example, could have direct and unpredictable impacts on the park, but even if it were not affected, it undoubtedly would stop receiving any type of international assistance for an indeterminate time. Without this support — which it currently receives, and which is crucial for park management — maintenance of Manu National Park would be much more difficult.

The most severe domestic threat would be a change, by Congress or the government in office at any point, in the legal framework for the conservation and protection of national parks. This could affect the existence, size or category of both the national park and its surroundings, eliminating or limiting the buffer zone or the protected areas around it. Although public opposition would make such a measure unlikely, the danger is still within the range of possibilities.

Another serious domestic threat is posed by roads inside the park, which cut it into isolated sectors. Both the Ministry of Transportation and the current regional government support such a plan. The construction of roads inside the park — such as PE5S, also known as the Marginal Highway — would open the door to nearly all the other threats. That would certainly mean the end of Manu National Park.

The best decision is to respect the law and avoid road construction. Although such an abuse is not very likely, if it did occur, the most urgent task would be to stop migration inside the park. It is hoped, however, that the current law will remain in place and that public opposition would make any negative change impossible.

It is more difficult to ensure that the park will always have enough funds from the national budget and other sources for effective management of the area. The current budget is inadequate, and it could be reduced further. That poses a current threat that is very serious and could become critical.

Of the external threats in the region, the strongest is the construction of roads around the park. In many cases, they are built with no oversight and no regard for legal requirements. Roads of this type are currently approaching the park, including one in the buffer zone of the Amarakaeri Communal Reserve.

The Interoceanic Highway revealed the negative impacts of roads on the park. Although officials promised to control environmental impacts and millions of dollars were invested in those efforts, six years after it was dedicated, authorities have not fulfilled that pledge.

The Interoceanic Highway has become an entryway for innumerable activities, both legal and — mainly — illegal (mining, logging, hunting, and rapid and chaotic settlement). The

most obvious consequence was the widespread, steady and well-documented destruction of the forest and the fabric of traditional society.

The outcomes have been disastrous. Not only are protective lands occupied, increasing the risk of landslides, but illegal logging has expanded and the road facilitated illegal mining, counteracting all the measures that theoretically were to stop it. Extensive areas that until recently were magnificent expanses of tropical rain forest are now completely deforested. They have been turned into pasture in which no cattle graze, land speculation is rampant, and areas that were once lush jungle now look like desert.

That is why roads constitute an enormous, almost insurmountable, risk for Manu. Traveling by car between Puerto Maldonado and Cusco along the Interoceanic Highway, it is easy to understand why so many critical voices are raised about the construction of roads in natural areas.

Although there is no evidence so far of illegal mining inside Manu, the activity is encroaching from both the Amazonian and Andean sides. The gold rush draws thousands of people from all over Peru, causing chaotic population growth. Between October 2012 and October 2016, mining deforested some 310 square kilometers, half of which were in buffer zones and inside the core zones of the Tambopata, Bahuaja Sonene and Amarakaeri protected areas.

Several places in Madre de Dios have been turned into desert wastelands, not for lack of water, but because of contamination and the use of heavy equipment. Improvised and wretched «communities» have also appeared; their shocking precariousness and the fact that they are nearly submerged in their own garbage and sewage — obviously without law and order — have turned them into epicenters of crime and disease.

Illegal mining is accompanied by pollution from mercury, a toxic metal that causes irreversible harm to human health and the environment. In May 2016, the Peruvian government declared a public health emergency because of mercury pollution in most of the department of Madre de Dios, including the districts where Manu is located.

The devastating activity does not respect the boundaries of protected areas. Since 2016, miners have invaded the core zone of the Tambopata National Reserve. Some 7.5 square kilometers were destroyed before authorities, enforcing Peruvian laws, managed to recover it with great difficulty.

The damage is severe and will take centuries to remediate. What has happened is even more tragic because Tambopata was the Amazonian protected area that had best demonstrated great potential for tourism and ecotourism, in close association with native communities. In 2016, Tambopata received more than 50,000 tourists interested in and anxious to learn about the tropical rain forest and its intact biodiversity.

Despite the latent risks for Manu, both road construction and invasion by miners appear to be controllable hazards, at least in the medium term. Of course, this will depend on how much support the national government can continue to provide.

The illegal extraction of timber and other forest products, invasion by landless farmers and coca growers, and all types of hunting are also constant risks. They continue to occur in various parts of the park, especially the buffer zone, although on a small scale. So far, they have been reasonably contained and effectively controlled. In the foreseeable future, they can be kept at bay as long as the park´s ordinary budget is maintained.

Threats originating inside of the park

Ideally, national parks would not have human populations inside of them. The case of the Matsiguenka is different, because although they were outside of the Urubamba Valley, which was their traditional territory, they were already inside the park when it was officially established. They were not the only ones. There were also other native peoples who still live there with little or no contact with wider Peruvian society.

The people who conceived the establishment of the park in the 1960s believed it was necessary to negotiate the resettlement of a small group of Matsiguenka living in Tayakome. The idea was to relocate them outside the park, but this was never done. It wasn´t even started. Instead, the village of Tayakome doubled in size, became more firmly established and, as if that were not enough, gave rise to other settlements in three places inside the park. The contacted Matsiguenka population in Manu now totals nearly 1,000 people.

Tayakome, meanwhile, has some public services and its population is in regular contact with neighboring communities, such as Boca Manu. Although some of its food comes from outside the park, and despite the prohibition on hunting with firearms, the pressure from hunting and fishing is so great that there is clear evidence of its negative impact on wildlife.

The population´s demands for more and better services, well-paid jobs and greater contact with the modern world are growing rapidly, and responding to them — within the boundaries of the park — will be increasingly difficult. Just the motorboat traffic serving the resident population causes a visible impact. The challenge for the future is to reconcile the growing needs and rights of this population with those of biodiversity conservation. That will not be easy.

The case of indigenous people in isolation is different in the short and medium term. Their presence in the park does not interfere much with the concept of strict conservation that should characterize the area. Because they are almost exclusively hunters, however, they place significant pressure on the wildlife.

The growing number of indigenous people is believed to be due, to a great extent, to pressure from loggers, miners and farmers on the edges of Manu National Park and Alto Purús National Park. Indigenous people seek refuge in these places, increasing both pressure from hunting and conflicts between different groups in isolation and between isolated groups and those settled in villages.

These confrontations occur because they are forced to share a more limited space. The consequences can be fatal. In the long run, however, after being contacted, the situation of isolated indigenous people may change and become similar to that of the Matsiguenka. For now, the park is an important additional guarantee of safety and protection for them.

One important activity, which could become a threat if poorly managed, is tourism. For the moment, according to the current management plan, it is limited to a relatively small area of the park. It is crucial to maintain and increase it, offering more and better attractions and products. This generates income and job opportunities, which should help the Matsiguenka population and other people living in the park´s area of influence (although this does not happen as it should).

But it is important to remember that tourism concentrated in a small area, either because of boat transportation or because of the need for lodging, places significant pressure on

Deforestation

Satellite monitoring shows that the Peruvian Amazon lost 15,000 hectares of forest in the first half of 2017. Manu is still intact, but threats are encroaching.

resources. Ultimately, it is a matter of striking a delicate balance. This issue, which is common to all natural protected areas in the world, requires optimal management and keen attention.

Possible scenarios

The threats do not exist in isolation; rather, they are compounded and they influence each other. As we have noted above, the possibility of road construction in or around the park is accompanied by many other threats, such as logging, colonization, hunting, agriculture and illegal mining, which translate into deforestation and contamination.

Road construction also multiplies the risk that the park could be broken up into smaller protected areas, to give people attracted by colonization programs access to land. If that were the case, it is likely that the creation of native communities inside the park would be proposed.

The lack of sufficient budget funds for effective management is a chronic problem in Manu. Resources provided by the government barely cover the operations necessary for its survival. If that situation worsens, the danger from other threats will increase. For example, expenses related to good communication and coordination with the Matsiguenka and with people around the park are largely covered by non-governmental organizations and international donations. Because this is such a delicate matter, the government should pay the costs.

Funding from those sources, however, is dramatically inadequate to provide proper assistance to the population. Few agreements with the community of Tayakome or nearby highland communities have been honored by the park, precisely for lack of funds. Attacking and solving those problems requires money for logistics, equipment and skilled personnel. This scenario, therefore, is marked by the evolution of the series of threats described here.

Right now, however, no factor is more clearly defined or of greater importance for determining the park´s future than the issue of the indigenous Matsiguenka population. On this point, it is crucial to be clear: if it is not addressed honestly and with extreme urgency, resolving it could take many years of dialogue and negotiations. In the years leading up to 2050, the Matsiguenka issue is the one that will have the greatest influence on the existence of Manu National Park as it is.

Some figures can help explain the problem:
When Manu was established in 1973, there was a single community, with a total of 114 residents. Forty-three years later, in 2016, there are four communities with about 635 inhabitants. In 40 more years, around 2050, based on a simple model of exponential growth, there will be eight Matsiguenka communities with some 2,600 inhabitants inside the national park. Following this pattern, in 2090, after another 40 years, there will be 16 Matsiguenka communities with some 14,000 inhabitants.

The only way to gradually self-limit this growth is the exhaust of the park´s resources. And these figures do not take into account the growth of the Quechua community of Callanga, in the southwestern and Andean part of Manu National Park. If this issue is not resolved, besides being a decisive factor for the park´s long-term existence, it would essentially mean an eventual change to a more permissive category — such as national reserve or communal reserve, for example — or a reduction in size to provide more space for native communities. Probably the only thing that would remain of the park would be the areas of least interest to the indigenous inhabitants and of least value for conservation of biological diversity.

That would make it difficult to keep other economic interests, such as agriculture and mining, out of the park, or what is left of the park. New land-use demarcations could also allow oil and gas companies to try to enter the area. In the medium and long term, the trend in this scenario is not promising.

If the hazard posed by these threats is not addressed, either because of a desire to continue the «ostrich policy» or because funds are not allocated to resolve the situation, the park is unlikely to survive, at least not intact. Its area will be greatly reduced and it probably will end up being categorized differently, which would lead to a large part of its forests and its biological diversity simply being eliminated.

The ideal scenario for Manu in 2050

What would be the ideal situation for Manu National Park in 2050? The short answer points to its continuity: Manu must remain whole, with its landscapes, ecosystems and biological diversity conserved as well as or better than they are now.

But that response merits a more detailed and thorough explanation. The ideal scenario should consider four basic issues: the situation of the inhabitants of the park and its surroundings; the use of Manu for scientific research and tourism; public opinion and political support; and regional territorial management.

An appropriate prediction — one that designs scenarios and helps prevent problems — portrays a national park with the following characteristics in 2050:

The Matsiguenka, the most numerous inhabitants, engage in truly sustainable management of natural resources, ensuring their food security and economic prosperity without affecting the park´s biodiversity. All or most of the population centers — cultural and educational — are located around the park, in places such as Boca Manu, where there are large native communities that are legally recognized, titled and demarcated for economic activities.

The Matsiguenka, with their customs, traditions and culture, are fully integrated into Peruvian society while maintaining their identity. They remain associated with the park through a series of activities mainly related to tourism. They produce high-quality handicrafts that are in great demand.

The local population around the park becomes integrated into the management of the Manu Biosphere Reserve. The biosphere reserve protects the core zone and encourages sustainable development activities in neighboring areas. The communities in the reserve diversify their sources of income.

The districts around the park design and implement «low-carbon» development strategies. Food for tourists and local residents comes mainly from the buffer zone, so less fuel is needed to transport it. As now, income is generated through the direct use of various resources, such as dead trees that float downriver and are used in places such as Boca Manu, where people manufacture high-quality products that have good markets.

The staff of public entities, such as park managers, consists mainly of people from native communities and other local communities.

Manu maintains its importance as the most biodiverse place in the world. This distinction is also promoted by a decrease in similar areas in other parts of the world. The healthy state of habitats in Manu is demonstrated by the recovery of the populations of key species, such as the giant otter and yellow-spotted river turtle. Inside the park, areas used for communities, agriculture and agroforestry do not expand. Thanks to monitoring

Pollution

Illegal gold mining occurs not only underground, but also in the sediments of tropical rivers. Alluvial gold mining, in which mercury is used to separate gold from sediment, turns highly biodiverse rain forest into a toxic desert.

and oversight, domestic animals are free of diseases and wildlife is protected from those diseases.

In 2050, Manu National Park is home to world-class scientific stations, like the current Cocha Cashu Biological Station. With sustainable or long-term funding, scientific knowledge of great value for development is produced there through field research. Peruvian and foreign university students can take advantage of the facilities and contact with internationally renowned researchers.

Compared to the early decades of the 21st century, the annual number of visitors to Manu National Park is increasing considerably. Thanks to the high density and the diversity of flora and fauna, visitors can observe and photograph species without disturbing them.

The current forms of tourism are 100% nature friendly. They operate within the tourism zone, as designated in the zoning of the master plan for the park and taking advantage of existing site plans. Because they are socially equitable, they provide a sustainable income for indigenous residents of the area and the local population in general. Operations use modern technology that does not produce pollution or noise, such as electric motors for boats and solar energy for lodges. Waste is recycled and food comes mainly from local sources.

Manu, ultimately, is one of the most famous national parks in the world. It has widespread local and international public support, and therefore strong political support, which defends it against any aggression. That same support allows Manu to form the heart of an immense mosaic and a biological corridor that includes a chain of protected areas in southeastern Peru that interconnect with protected areas in Bolivia and Brazil. The territorial extent of these natural protected areas and indigenous reserves is increased by more than 100,000 square kilometers.

That makes it the best conserved and most sustainably managed tropical rain forest wilderness in the world.

Key steps toward creating the ideal scenario

First is to resolve the most urgent challenges — such as that of the indigenous population living in the park — and address others that are also of concern, such as road construction inside and outside of the park boundaries. Little can be done, however, unless the park´s budget allocations increase.

Any agreement reached with the indigenous population will have a high cost, both to keep the dialogue going and to implement the accords. If a well-designed, convincing plan — which does not yet exist — is drawn up, it would be much more feasible to obtain that financing from public funds, international sources and carbon trading schemes.

Manu and the adjacent protected areas store billions of tons of carbon, and this is a benefit for which no one is paying. A detailed study with current, reliable information is crucial for future negotiations.

Several important factors are conducive to a desirable scenario that includes conservation of the park and a fair, consensus-based solution for the indigenous communities. Among them:

(i) Increasing environmental awareness among Peruvians and, although more slowly, the politicians who represent them.
(ii) Despite their limited effectiveness, the politically unpopular decisions made to combat incursions by illegal mining reveal a growing sense of environmental responsibility among Peruvian government officials.
(iii) Interest in nature conservation is also increasing among people in the department of Cusco and is growing in Madre de Dios.
(iv) Manu National Park´s international fame, which can mobilize global political pressure and attract economic resources in the form of technical cooperation and funding.
(v) The increasingly environment-oriented vision of Peru´s indigenous movement, which can contribute to conservation solutions inside the park and elsewhere in the country.
(vi) Collaboration among government agencies responsible for indigenous and environmental issues.
(vii) The professionalism and energy of park rangers and officials throughout the protected area´s history, as well as that of the hundreds of scientists whose work constitutes an extremely useful reference archive for the defense and development of the park.
(viii) Climate change, which is a very serious threat, can also offer an exceptional opportunity for financing through payment for fixing carbon in forest biomass, soil and subsoil.
(ix) The growing role of intact nature in creating sources of income, such as tourism and organic products that do not lead to deforestation. This could result in tangible economic incentives for park maintenance and benefit the people living in and around Manu.

Tourism is one of the best ways to create sources of sustainable income and improve the outlook for the future. It is important to keep in mind that Cusco is not only the entryway to the Inca city of Machupicchu, but is also one of two starting points for those who want to experience the wonderful diversity of Manu.

With approximately 427,000 inhabitants, the city of Cusco received two million tourists a year in 2014 and 2015. The tourist route for these visitors is becoming more and more diversified. They also visit the Apurímac River canyon (with the condor overlook in the community of Chonta), the snow-capped peak of Ausangate, and the Mountain of Seven Colors (in Vinicunca). Currently, only a small portion of those tourists go to Manu National Park.

Over the medium and long term, there is great potential to be developed in a master plan to attract more tourism to Manu. This plan should contain a transparent mechanism to guarantee the labor and economic benefits to which local communities and indigenous peoples are entitled.

Open dialogue between non-governmental organizations and the government is crucial for meeting future challenges. One feasible option for combating one of the greatest threats might be to negotiate the resettlement of the Matsiguenka population, on the basis of free, prior and informed consent. They would be given an area neighboring the park, large enough and with the same or better characteristics, in which to develop fully, without the limitations imposed by the compelling need to preserve the park´s biodiversity.

Options such as one or more native communities or a communal reserve are available outside the park. There is room to do this, but without open discussion and solid consensus that convinces local residents, it will be very difficult to bring such an idea to fruition.

This, of course, requires that the government and other interested parties be willing to allocate economic resources and land to a resettlement program. This has been done with great success on two occasions, in Iguazú National Park and Grande Sertão Veredas National Park in Brazil.

The other option — already attempted unsuccessfully — is to negotiate a limit to both the growth of the Matsiguenka population and its dispersion and activities within the park. Earlier efforts failed mainly because of a lack of resources, which led to the park´s failure to comply with the agreements.

Implementing this option implies various requirements: concentrated technical assistance for ecologically friendly production of food and other necessities; good opportunities for

high-quality education for children, young people and adults inside and outside of the park; the creation of attractive and diversified jobs; and a significant improvement in health and sanitation services, recreation, etc. Although it appears difficult, when there is willingness and a political decision, it becomes feasible. International support can make a significant contribution to success.

Although climate change could have dangerous consequences for Manu, the park and its surroundings can also mitigate impacts thanks to their ability to capture and store carbon. Climate change is predicted to result in a drier climate, even in Manu. Practically speaking, other than having a well-trained team of forest fire fighters, little can be done to control its effects.

The decision to create a desirable scenario is, above all, political. Its cost is perfectly feasible in the current economic context. Peru currently receives hundreds of millions of dollars to protect its forests and limit the effects of deforestation on the climate. A small part of that amount would be enough to resolve all the challenges, combat the threats and create a positive scenario.

Ultimately, it is Peru — especially the southeastern region, which is home to so many cultural and natural wonders — that must decide whether the model to be followed is that of tiny Costa Rica, which achieved it with much less natural capital. The other option is that of Costa Rica´s neighbors, such as Honduras or El Salvador, which allowed themselves to be dragged into difficulties. They are now besieged by unemployment and crime in a devastated landscape, where protected areas have been invaded, degraded, contaminated or eliminated, and where indigenous people have been relegated to indigence, without hope for a decent future.

What happens with Manu will determine the fate of all the natural heritage in that region of the country. And precisely for that reason, it is worth fighting to maintain it. Although the current trend is not the desirable one and the risks are great, there is still time to create much more favorable scenarios for maintaining Manu National Park´s natural and cultural heritage.

Achieving an optimal scenario means recognizing that the biodiversity and ecosystems the park encompasses, as well as the indigenous people who live there, face the same threats. Ignoring that will resolve nothing. Nor is it helpful to point fingers and lay blame. It is vital to continue to identify options and, in that transitional space, to take coordinated, consensus-based actions to implement solutions.

The rain forest generates half of the region´s rainfall through evaporation. If the forests of Manu are not protected, the region´s climate will change dramatically and the global atmospheric CO_2 load will increase significantly.

A conversation about Manu National Park with Jörg Ranau,

Ambassador of the Federal Republic of Germany in Peru

Interview by Hauke Hoops

Ambassador Ranau, you visited Manu National Park last year. Could you share some of your impressions and feelings with us?
I visited Manu in November 2016. It was a very special trip, impressive from beginning to end. As soon as I entered the park, I felt as though I were in another world. During the experience, you have to relax, to become accustomed to this new place, to observe the animals in the trees, and above all, to appreciate the entire park and the forest in all their grandeur. Seeing, feeling, being present in this world changes the way you think about the needs of the entire planet. It was an exciting and necessary trip that I am not going to forget. I am happy to have had the chance to go there with the Frankfurt Zoological Society.

Why is the German government supporting biodiversity conservation in the world, and why specifically in Peru?
We know that biodiversity is a necessity for the survival of nature and for our own survival. It´s true that we also have parks in Germany and we do everything possible to safeguard nature; but there are other countries, such as Peru, where there is much more nature that is untouched by humans. Because of its different regions — the highlands, the coast and the Amazon jungle — Peru is one of the 10 most biodiverse countries in the world. Our commitment is to help it maintain that. Supporting Peruvians in this process is also a way of helping all people, because we believe it represents a global commons. I think the German government´s idea of collaborating with Peru in maintaining biodiversity is very important.

What does this support entail and what are the main objectives?
Peru is a very large country. It is difficult to provide support everywhere at once. We do so in certain regions. We help protect nature, but we also realize that people must live in those places, with nature. One of our goals is that they use forest resources sustainably and outside of protected areas such as Manu National Park. We would like people to be able to find work without having to migrate far from their homes.

It is important to support and promote the creation of a green, formal, clean economy in which, for example, people can take advantage of the forest with sustainable forest management or with timber plantations that make degraded land productive again. A timber industry can also be established that way. Another of our goals involves training for young people in this area. In short, we seek to contribute to the conservation of nature and enable people to live in it.

What are the main threats to Manu National Park and the areas around it?
Traveling to Manu, you can see caimans in their habitat. Someone could easily think that they are a threat. For Manu, however, they pose no danger. We humans are the real problem. We are the threat, but we also can be part of the solution. We have to protect Manu. There is illegal mining and illegal logging around the park. Our mission is to help keep both the illegal miners and illegal loggers outside of the park. And while we´re talking about threats, it´s also necessary to understand that the people involved in these activities must have other livelihoods. I think it is a good idea for people living near Manu to use the timber that floats down the river and to be able to live sustainably from that. It is necessary to give them that stability. Outside of the protected areas, we are also protecting land titling.

How can financial sustainability be achieved for Manu and similar areas?
Although tourists tend to contribute to the financing of these types of parks, there are not many in Manu. It is an isolated area that makes it a difficult tourist destination. It´s easier in other parks. For that reason, I believe Manu should also have long-term government subsidies. With regard to maintenance, I would say that the most feasible thing is to focus on the work and development of the people living in the areas around Manu. This would be more viable and sustainable than development initiatives within the park itself.

Is it necessary for Germany to provide long-term support to Peru?
I would say yes. Not only for the country´s development. In its agenda through 2030, Germany is committed to overall sustainable assistance for other countries and regions. That is also true of the fight against climate change agreed to in Paris during COP 21. This is an obligation not just for some nations, but for all. Peru is a country affected by climate change, in which it is crucial to develop sustainable systems for nature and for the welfare of the people. That is the challenge for Peru in the future, and also for other countries like ours, which have more resources.

Does the embassy currently have specific projects that support Manu National Park?
There is a small project in Boca Manu with the support of the Frankfurt Zoological Society and the Sarastro Foundation. It is a school for children from the indigenous communities inside Manu. Because they lack machinery and the possibility of learning trades appropriate to the area, we are going to support them with equipment and tools that will help them learn carpentry. It is indispensable to get an education at the school in Boca Manu, but it is also crucial to learn practical and useful skills in case they decide to return to their villages or go work in some other place.

Is there anything else about Manu that you would like to highlight?
Yes, I´d like to highlight two things that we should all recognize. First, the terrific work of the SERNANP park rangers in the protection of Manu and the service they provide to tourists or people interested in visiting the park. And second, the research on fauna and flora that is being conducted in the park, which provides us with an unequaled basis for its sustainable management and its conservation.

Epilogue

Avecita Chicchón
Director of the Gordon and Betty Moore Foundation´s Andes Amazon Initiative

The first time I talked with Christof Schenck and Elke Staib, scientists from the Frankfurt Zoological Society, was in the El Califa restaurant in Puerto Maldonado. Richard Piland, an expert on tropical agriculture, and I had just arrived in Madre de Dios to work with local organizations on participatory planning for conservation.

It was the early 1990s, just after Alberto Fujimori closed Congress, when there was still a sense of uncertainty throughout Peru because of the impact of the Shining Path and the Túpac Amaru Revolutionary Movement, two subversive groups that had unleashed violence and incalculable destruction in the name of revolutionary social change.

Despite the violence, however, the four of us spoke with great optimism about all that could be done in the Peruvian Amazon. As we savored *dorado ceviche* and heart-of-palm salad, Richard and I listened with amazement to the preliminary results of the study of giant otter ecology that Christof and Elke were conducting, which would help support arguments for the protection of the lakes and riversides of Manu and its surroundings.

At the time, as director of Conservation International, Peru, I had already begun the task of compiling information and bringing together the efforts of various individuals and organizations for the future creation of Bahuaja Sonene National Park. The prospects for paving the Interoceanic Highway were remote, and gold mining did not appear to be such a serious threat. We thought, for example, that it would be enough to adopt the efficient use of retorts (an apparatus for distilling and recycling the mercury used to amalgamate gold) to manage the impact of gold mining, thus minimizing pollution and protecting miners from the mercury vapor.

Much water has flowed through the rivers since then. True, new protected areas were created in southeastern Peru, in the departments of Madre de Dios, Cusco, Puno and Junín, while the Manu Biosphere Reserve gradually gained greater recognition inside and outside of Peru as one of the planet´s jewels of biodiversity.

Manu became not only a refuge of biodiversity, but also a refuge for indigenous peoples in voluntary isolation, especially when the Camisea gas project began in the Urubamba River basin northwest of Manu National Park. Manu is of incomparable ecological and cultural importance, a place where it is still possible to observe spider monkeys, night monkeys and giant otters that do not flee at the sight of humans. A paradise. Facing threats, but a paradise still. Recent efforts to consolidate the conservation of the Purús and Tambopata arc, with Manu at the heart of the corridor, are an important example of the emphasis that must be placed on making protection compatible with development.

In recent decades, we have learned that it is not enough to create protected areas, because we do not want islands of well-conserved ecosystems surrounded by destruction. The gradual deterioration beyond the boundaries of protected areas affects their edges and causes slow degradation within the protected area. Since Fujimori, Peruvian officials have established development patterns oriented toward the free market, with an emphasis on large-scale investment, which generates revenue for the country but does not solve the basic needs of local populations or incorporate the value of the natural capital found in the rich jungle ecosystems.

All of this affects Manu´s long-term viability. First came gas in Camisea, then the paving of the Interoceanic Highway, which connects Madre de Dios with Brazil, and the paving of the highway to Cusco. The legal and illegal economic flows of products from the jungle must be better controlled in order to conserve the rich biodiversity of the southeastern Peruvian Amazon.

The social crisis and the environmental impact of alluvial gold mining in Cusco and Madre de Dios is incalculable. The contamination of rivers with mercury now deprives local inhabitants of the abundant basic protein found in fish. In the 1990s, we never would have imagined that in the future we would not be able to eat *dorado ceviche* in El Califa because of the mercury. Nor would we have imagined that gold would be the cause of the suffering of so many people trapped in mining under modern forms of slavery.

Nevertheless, there are signs of change. A new generation of researchers and conservationists is contributing in various ways to help our society move toward conservation-based development.

The researchers in Cocha Cashu have not forgotten that understanding natural processes and their responses to change is fundamental. Scientists who study climate change and geographic systems help us understand how to monitor adaptation processes and the impacts of natural resource extraction. Social science researchers and communication specialists help us better understand human behavior and translate science into policies with effective messages disseminated through channels that go beyond the written word.

We must also recognize that Peru has a government with greater capabilities and a better-informed public. Peru also has ratified international treaties that require us to comply with the provisions of the Paris climate agreement, the Convention on Biological Diversity, the Minamata Convention on Mercury and the global Sustainable Development Goals. It is our task as citizens to ensure that these commitments are met, to ensure better development for Peru.

We are facing a new dawn. A few years ago, Richard, our two children (who were small then) and I camped at Tres Cruces in Manu National Park. From a distance, I heard Samuel ask Natalia, «Do you believe in God?» A little surprised, she said, «Why do you ask?» Samuel answered, «Because of the stars, the mountains, the birds, so much beauty». I see Natalia and Samuel today, with all their plans for the future, and once more I have hope in humanity.

About Frankfurt Zoological Society

Frankfurt Zoological Society (FZS) is an international conservation organisation based in Frankfurt, Germany. FZS is committed to preserving wildlands and biological diversity in the last remaining wilderness areas on the planet.

The Society was substantially shaped by the famous German conservationist, filmmaker and zoo director Professor Bernhard Grzimek. At the end of the 1950s Grzimek launched what has since become a comprehensive conservation programme consisting of some 30 projects dedicated to the protection of outstanding wilderness areas and national parks in 18 countries.

FZS is active in biodiversity-rich areas in central and Eastern Europe, in East Africa, in central South America and in Southeast Asia. In terms of habitats the main focus is on the great savannah, forest, wetland and mountain areas. The main emphasis in Europe is on wilderness development in Germany and the conservation of pristine habitats in the Balkan states, Ukraine, Belarus and Kazakhstan. The Society´s project countries in East Africa are: Tanzania, DR Congo, Zambia, Zimbabwe and Ethiopia. The project areas in Southeast Asia are located in Sumatra and Vietnam.

The second largest conservation commitment of FZS lies in South America: the Andes to Amazon Conservation Programme in Peru. For almost three decades FZS has been supporting the Manu National Park as well as adjacent protected areas.

The Frankfurt Zoological Society has been protecting large wilderness areas for more than six decades. The organization´s focus is on Eastern Africa, where its zebra striped aircrafts stand for FZS´ long-term engagement.

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Photo gallery

Cover and pages 54-55
Loaded with sediments, the Manu River meanders through the dense floodplain forests. Cut-off meanders form clear water oxbow lakes that are extremely rich in aquatic life.
Charlie Hamilton-James

Pages 4-5
Untouched, unexplored mountain chains lead from the Andes to the Amazon.
Daniel Rosengren

Pages 6-7
With thousands of species Manu offers a unique insight into the secret life of plants.
Daniel Rosengren

Pages 8-9
The macaws are Manu´s flying crown jewels. Rare or even extinct in many places, they are frequently spotted in the national park.
André Bärtschi

Pages 10-11
Amazonian forests are exceptionally rich in biomass, but the soils are usually poor. Most nutrients remain in the living system.
André Bärtschi

Pages 14-15
The Tres Cruces overlook offers a spectacular view at sunrise.
André Bärtschi

Pages 22-23
Snaking across vast floodplains, the Manu River has created various oxbow lakes, each of which is a unique and dynamic ecosystem.
André Bärtschi

Pages 28-29
The view from the Acjanaco ranger station at 3,490 m. A layer of fog forms when hot, humid air from the immense Manu lowlands reaches the Andes.
Daniel Rosengren

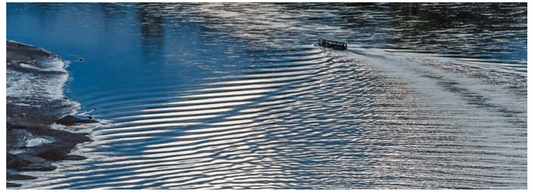
Pages 36-37
From a jetty at the shore of Cocha Salvador, visitors can embark on a catamaran tour to observe birds, caimans and otters.
☎ Daniel Rosengren

Pages 42-43
Manu National Park and its surroundings boast various colpas, where a variety of mammals and birds, such as these macaws, enrich their diet with minerals and micronutrients.
☎ André Bärtschi

Pages 70-71
For the Matsiguenka, rivers are an essential part of life, as travel routes and as a source of protein in the form of fish.
☎ Daniel Rosengren

Pages 114-115
Nutrients are so poor in the rain forest that butterflies approach turtles, such as this yellow-spotted river turtle (*Podocnemis unifilis*), to sip their eye liquid for the salt it supplies.
☎ André Bärtschi

Pages 122-123
Sand-colored Nighthawks sleeping on their day roost. Research by Martha Groom in Manu has shown that they parasitize at their mixed nesting sites with terns and skimmers. The larger species defend the colony, whereas Nighthawks remain lazy.
☎ Daniel Rosengren



Pages 134-135
The Madre de Dios river provides the only access into the Manu wilderness, which — fortunately — has remained free of roads.
☎ André Bärtschi

Pages 142-143
The bed of the Amazonian rivers changes constantly. The powerful flow of water and sediment carves shorelines and creates new islands and beaches.
☎ Rob Williams

Pages 160-161
Giant otters have a real sense of family. Older siblings even act as babysitters.
☎ André Bärtschi

Pages 170-171
The indigenous word jaguar means: «The one who kills with a single leap». The solitary stalk-and-ambush predator has an exceptionally powerful bite, exceeding even the force of a lion´s jaw.
André Bärtschi

Pages 206-207
In Yomibato, boys and girls fish. This is an important source of protein for rain forest dwellers.
Daniel Rosengren

Pages 214-215
View of the school at the center of the indigenous community of Yomibato. Education is key for development. The challenge is sustainability.
Daniel Rosengren

Pages 232-233
In a world where artificial light pollution has become widespread, the view across Manu from the Andean overlook at Tres Cruces reveals an unspoiled wilderness.
Rob Williams

Pages 248-249
The Pampas del Heath are the only tropical wet savannahs in Peru. Their flora and fauna is very distinct from that of the surrounding forest.
Daniel Rosengren

Pages 274-275
Small rivers and creeks cut through a symphony of green. An epicenter of evolution leading to highest species diversity is found under this canopy.
Charlie Hamilton-James

Page 276
Time for a ball game in Manu´s indigenous village. These children´s grandchildren might have a very different life.
Rob Williams

Page 288
Leafcutter ants carry more than 20 times their body weight to supply their underground fungal gardens.
Daniel Rosengren

Page 296
The indigenous artwork of the Matsiguenka is a product of their culture and of Manu. Conserving nature, ultimately, is a cultural task and decision. Manu depends on all of us.
Christof Schenck

Authors´ bios

PhD. Christof Schenck studied biology in Tübingen and Freiburg and holds a doctorate from the University of Munich. He is the author of various books, notably *Die Wölfe der Flüsse* (1994), *Ein Platz für wilde Tiere* (2008) and *Riesenotter – die letzten ihrer Art* (2013). With his wife, Dr. Elke Staib, he lived in Manu National Park for three years, studying and developing a conservation plan for the endangered giant otter. Since 2001, he has been director of the Frankfurt Zoological Society, which leads conservation efforts in 18 countries on four continents.

PhD. Rob Williams holds a degree in biology from the National University of Wales in Cardiff and a doctorate in biological sciences from the University of East Anglia. From 2005 to 2015, he served as director of the Frankfurt Zoological Society in Peru. He has worked on six continents for various conservation organizations, including RSPB, BirdlIfe International and the Wildlife Conservation Society. He is the author of six books and many scientific papers. He currently works independently in conservation, tourism, photography and film production and is writing two books.

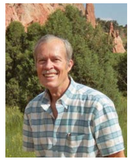
Pedro Gamboa is a lawyer with more than 22 years of experience in the public sector. Since December 2011, he has served as head of Peru´s National Service of Natural Protected Areas. He also is regional coordinator of REDPARQUES and vice president of the Latin America and the Caribbean Region before the International Coordinating Council of the UNESCO Man and the Biosphere Program. In 2016, he received the Bruno H. Schubert award for his outstanding efforts for the conservation of national protected areas in Peru.

PhD. Marc Dourojeanni, is an agronomist and forestry specialist with a doctorate in sciences. He was dean of the School of Forestry Sciences at La Molina National Agrarian University (UNALM) in Peru and director general of forestry and wildlife in the Peruvian Ministry of Agriculture. He also worked at the World Bank, was the first head of the Inter-American Development Bank´s Environment Division, and was founder of Pronaturaleza and vice president of the International Union for the Conservation of Nature (IUCN) and the World Commission on Protected Areas. He is the author of 17 books about the Amazon, protected areas and environmental policy. He is professor emeritus at the UNALM.

PhD. José Antonio Ochoa, holds a degree in biology from San Antonio Abad National University in Cusco and a doctorate from the National University of Córdoba in Argentina. He has held two postdoctorate positions, one at the American Museum of Natural History in New York and the other at the University of São Paulo Institute of Biosciences. He is the author of various scientific papers and book chapters about biodiversity, systematics, biogeography and conservation. He is currently project coordinator for the Frankfurt Zoological Society and professor in the School of Sciences at San Antonio Abad National University in Cusco.

Isau Huamantupa-Chuquimaco, was born in Cusco, Peru, in 1980. He is a biologist with a specialty in botany and ecology. He holds a Master´s degree in tropical biodiversity and conservation from Menéndez Pelayo International University in Spain. He is the author of various scientific papers and book chapters that include the description of various species new to science in the families Vochysiaceae and Ericaceae. He is a professor at San Antonio Abad National University in Cusco and is pursuing a doctorate at the National School of Tropical Botany in Rio de Janeiro.

PhD. Patricia Álvarez-Loayza, was born in Morococha, Peru, in 1975. She holds a bachelor´s degree in agronomy engineering from La Molina National Agrarian University (UNALM) and a doctorate in ecology and evolution from Rutgers University in New Jersey. She is the author of many research papers about tropical ecology and conservation. She has 20 years of experience in tropical forest research, 17 of which have been spent in Manu National Park. She currently is research associate at the Field Museum of Chicago, the Tropical Conservation Center and CIMA-Cordillera Azul, Peru.



PhD. John Terborgh, is James B. Duke Professor Emeritus of Environmental Sciences at Duke University in Durham, North Carolina, and a member of the National Academy of Sciences. In 1992, he was awarded a John D. and Catherine T. MacArthur fellowship for his work in tropical ecology. In 1996, he was granted the National Academy of Sciences´ Daniel Giraud Elliot award for his research and for his book, Diversity and the Tropical Rainforest. Between 1973 and 2011, he operated the Cocha Cashu Biological Station while studying trophic cascades and interactions between plants and animals.

Miguel Macedo was born in Lima, Peru, in 1975. He is a licentiate in anthropology with a degree from the Pontifical Catholic University of Peru, completed Master´s studies in Amazonian studies and is pursuing a doctorate in anthropology at San Marcos National University. He has worked in the Amazon since 1998, mainly on issues related to management of natural protected areas and indigenous populations in isolation and initial contact, in various regions of Peru.

Johny Farfan was born in Cusco, Peru, in 1977. He holds a degree in biology from San Antonio Abad National University in Cusco had has completed Master´s studies in climate change and sustainable development. He is the author of scientific articles about the use of natural resources in native communities in Manu. He has worked in Manu since 2007, initially conducting research in wildlife and agroforestry, and later in the conservation and management of Manu National Park. He currently works as a specialist in the use of natural resources in Matsiguenka communities.

Luis Felipe Torres was born in Lima, Peru, in 1984. He is a licentiate in anthropology with a degree from the Pontifical Catholic University of Peru and holds an associate´s degree in development studies from the Latin American School of Social Sciences (FLACSO – University of Havana) and a Master´s in Latin American studies from Newcastle University in England. He worked for five years in the Peruvian Ministry of Culture´s Office of Indigenous Peoples in Isolation and Initial Contact, implementing activities to protect isolated indigenous people and those in initial contact in Manu National Park. He currently is pursuing a doctorate in social anthropology at the National Museum of the Federal University of Rio de Janeiro.

Ingrid Chalán was born in Lima, Peru, in 1977. She holds a bachelor´s degree in Communication Sciences from the University of Lima and a Master´s in development, tourism and environment from King´s College London. She is editorial director of the conservation magazine Andes Amazonia and was co-author of the chapter, «La reserva de la biósfera del Manu: educación ambiental intercultural en los Andes tropicales)», published in Educación ambiental en las reservas de la biósfera del Perú (2016). Since 2013 she has worked as communications coordinator for the Frankfurt Zoological Society in Peru.

Juvenal Silva is a Peruvian biologist who holds a degree from San Antonio Abad National University in Cusco. He began his relationship with Manu in 1996 as a researcher at the Cocha Cashu Biological Station. He worked in assessment and monitoring of fauna diversity along the Tres Cruces Elevational Transect as part of the ProManu Project. He was coordinator of the Conservation of the Eastern Andes of Peru Project. In 2007, he began working with the Frankfurt Zoological Society, and he currently is coordinator of the «Protection of Forests and Sustainable Management of Natural Resources in the Manu Biosphere Reserve» project.

John Flórez was born en Cusco, Peru, in 1967. He holds a degree in agronomy engineering from San Antonio Abad National University in Cusco and a Master´s in environmental engineering with a concentration in environmental evaluation and management. He did graduate studies at José Carlos Mariátegui University Graduate School and holds an associate´s degree in strategic management from San Marcos National University in Lima. He is an expert on planning and integrated management of natural protected areas. He has served as director of the Megantoni National Sanctuary, Amarakaeri Communal Reserve and Tambopata National Reserve. He currently works for the National Service of Natural Protected Areas as director of Manu National Park.

PhD. Antje Muellner studied biology and conservation in Frankfurt and Hamburg and holds a doctorate in tropical zoology from the University of Würzburg. She has worked as a field researcher in Malaysia (1991), the Ivory Coast (1992-1994) and Ecuador (1995-2000). She worked as a researcher and project consultant for German development agencies such as GTZ, with the «Sucumbíos Forestry Program)», and KfW, with the «Gran Sumaco Project» (2000) in Ecuador. Since 2002, she has served as director of the Frankfurt Zoological Society´s South America and Asia Program.

Hauke Hoops was born in Marne, Germany, in 1965. He holds a biology degree from the University of Ulm in Germany. He founded the NGO Patuca e.V. (Germany) and, with his wife, Claudia Lagos, the Patuca Association (Honduras) for the conservation and sustainable development of Patuca National Park. Since 2000, he has led initiatives involving risk management, institutional capacity building and preparation for and humanitarian responses to disasters in Latin America and the Caribbean. At the global level, he has worked with international organizations such as Oxfam and CARE to coordinate with inter-agency networks from his base in Panama. Since 2015, he has served as the Frankfurt Zoological Society´s director in Peru.

PhD. Avecita Chicchón holds a doctorate in anthropology from the University of Florida in the United States. With degrees from the University of Cincinnati in the United States and the Pontifical Catholic University of Peru, in 2004 she received an honorary doctorate from the University of the Peruvian Amazon (UNAP). She has served as director of Conservation International´s Peru program, as the MacArthur Foundation´s program officer for Latin America and the Caribbean, and as executive director of the Wildlife Conservation Society´s Latin America program. She has more than 30 years of experience in natural resource use, biodiversity conservation and sustainable development in Latin America and the Caribbean. She currently directs the Gordon and Betty Moore Foundation´s Andes-Amazon Initiative, which seeks to ensure the conservation of biodiversity and the climate function of the Amazonian biome.

Photographers´ bios

André Bärtschi, born (1953) and educated in Switzerland, André Bärtschi has a background in interior design from the Zurich School of Design and graphics studios. As a photographer he specializes in the natural history of tropical forests and traveled to Manú for the first time in 1978. Since then he spends part of the year in some of the remotest places of the New World tropics. His work has been published world-wide in renowned magazines such as GEO, BBC Wildlife, International Wildlife, Natural History, Smithsonian and National Geographic and in numerous nature books. Several of his photographs won awards in the annual Wildlife Photographer of the Year Competition and in 1992, with an image taken in Manu, he was awarded the top prize in this largest and most prestigious international contest of its kind.

Charlie Hamilton-James is the National Geographic Society 'Innovation in Photography´ Fellow and a National Geographic Magazine photographer. He specialises in wildlife and conservation photojournalism and has covered issues across Africa and South America. His photography was showcased by 2014 BBC 2 television series 'I Bought a Rainforest´ which followed Charlie as he travelled across the Amazon photographing the complex issues of people and wildlife. When not taking photo´s Charlie also works in wildlife film production – His company Halcyon Media LTD has made films for BBC, National Geographic and Animal Planet and have won numerous awards.

Oscar Mujica is a biologist, specialized in ecology, who did studies on the fauna of the forests of Manu. Furthermore he is a nature photographer with a special focus on Manu. He has published articles in national and international magazines and is the author of two guide books on the animals of Manu. Currently he works as a project coordinator for Frankfurt Zoological Society.

Daniel Rosengren is an ecologist from Sweden with 5 years of experience in lion research in Serengeti. Since 2015, he has been working as a full-time photographer, specializing in nature and wildlife photography. In 2001, he spent four months at the Cocha Cashu research station in Manu National Park as an assistant for the Short-eared Dog research project. In 2016, he made two trips to Manu, both visiting the highlands and venturing as far into the Amazon as Yomibato.

Heinz Plenge Pardo is a professional photographer and editor specializing in the rich natural and cultural heritage of Peru. He participates constantly in photographic production throughout Peru and in the edition of high-quality graphic publications, especially books and magazines. In 2003, he produced an exclusive photographic report entitled, *El Cusco, Joya Cultural*, commissioned by National Geographic Magazine (Spanish edition). He is the photographic author of the books, *Tesoros del Bajo Urubamba*, *Manual de Fotografía en las Áreas Protegidas* and *La Cocina Peruana tiene su Norte*, as well as the books *Quinua and Chía*.

Heinz Plenge has published dozens of photography books, including *Amazonia Extrema*, *Perú Maravilloso*, *South American Animals* and la *Ruta Viva* volumes *I*, *II* and *III* in 2016. His work has been featured in more than 30 photographic exhibits in Europe, Asia, North America, Central America and South America, including *Homenaje a la Tierra*, *Santuario de la Lluvia*, sponsored by National Geographic, and *Norte del Perú: Gente-Mitos-Naturaleza*, presented in 2015 at the Museum für Völkerkunde in Hamburg, Germany. His photographs have been published in books and magazines with a worldwide circulation, including National Geographic, GEO, BBC Wildlife, Natural History and WWF Magazine.

«Our lives and livelihoods depend on the breathtaking biodiversity that surrounds us and of which we, too, are a part. It enriches our lives and inspires us with its ever-evolving beauty».

Achim Steiner, UNDP Administrator

«A wonderful introduction to one of the most extraordinary protected areas on the entire planet, Manu, an Amazon forest wonderland. This book is a revelation of an Eden to be treasured for all current and future generations».

Thomas E. Lovejoy, University Professor of Environmental Science and Policy, George Mason University

«Of all the spectacular and diverse parks on our planet, it is Manu National Park that most fills my dreams and memories. These pages lead me once again into the overwhelming biodiversity, sights and sounds of a thousand species of birds, sublime riverine landscapes, and glimpses of vanishing un-contacted tribes. This book is a call to action, to all of us, to help save Manu».

Bruce Babbitt, Former U.S. Secretary of the Interior

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