

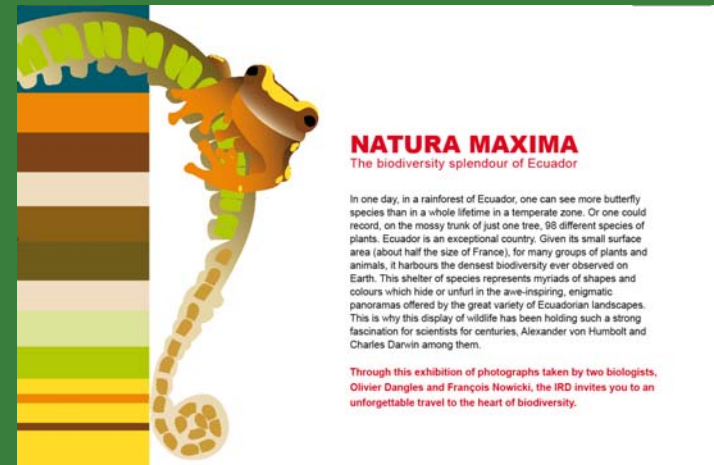
Please try to respect as much as possible the order of the panels of that exhibition

ENGLISH VERSION

# NATURA MAXIMA



Panneau 0.0



Panneau 0.1

# 1 An exceptional biodiversity



Panneau 1.1



Panneau 1.2



Panneau 1.3

## An exceptional biodiversity

Ecuador harbours some of the most species-rich ecosystems on Earth. How can we explain this *megadiversity*? This situation partly arose, several million years ago, from the uplift of the Andes Mountains, which helped to create ecosystems with highly heterogeneous characteristics depending on their altitude and latitude, from the Andean summits down to the Amazonian forest to the East, or to the coastal plain to the West. The Andes created a physical barrier difficult to cross, thereby breaking up the ancestral communities of fauna and flora, which thereafter evolved differently depending on their "new" environment. Other factors add to this, such as an extraordinary ecological heterogeneity (soils, microclimates and so on) in several regions which is the source of exceptional species diversity.

Cotopaxi Volcano and Páramos, these ecosystems constitute the tropical alpine vegetation of the Andes.  
Antisana Ecological Reserve (4600 m)

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The biodiversity splendour

Cartel 1.1

## Birds and fruits

Nearly 1800 bird species are described from Ecuador, more than half of the 3000 species found in all South America. This incredible diversity is unmatched in such a small area anywhere else in the world. Ecuador boasts some 19 species, which occur in lowland humid and montane forests of the Andes. The great diversity of these frugivorous birds has probably evolved in response to the diversity and availability of large-seeded fruit produced by canopy trees.

Many-banded araraçari (*Pteroglossus pluricinctus*) feeding on the fruit of *Trattinnickia glaziovii* (Burseraceae)  
Yasuni National Park

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The biodiversity splendour

Cartel 1.2

## Tens of thousands of species per km<sup>2</sup>

The vast majority of species found in Ecuador live in the Amazonian rainforest. At Yasuni National Park, in an area of about 34 football fields (25 ha), over 1100 species of trees can be found, the highest density of tree diversity ever recorded. As many as 35 000 insect species were estimated to be found in a 3-km radius locality in Yasuni, amounting to 40% of the number of species described for the whole of North America.

Hercules beetle (*Dynastes hercules*)  
Chocó forest

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The biodiversity splendour

Cartel 1.3

# 1 An exceptional biodiversity



Panneau 1.4

## Spiders or orchids?

Ecuador is home to more than 4000 species, which represents about 80% of all orchids found in South America. Orchids are by far the most diverse plant family in Ecuador, a large proportion (40%) of them being endemic species. Several of the 20 or so species comprising the genus *Brassia* are pollinated by parasitic wasps which normally lay their eggs inside spiders. Possibly attracted by the appearance of *Brassia*, the wasp stings the lip, while trying in vain to grasp its supposed prey.

Spider orchid (*Brassia* sp.)  
Maquipucuna Reserve

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The biodiversity splendour

Cartel 1.4



Panneau 1.5

## Frogs on the mountain slopes

There are about 440 species of frogs described in Ecuador, almost 10% of all frog species, and the highest density of frog diversity on Earth. Various Andean anurans such as tree frogs are particularly diverse at intermediate elevations (1000–2000 m).

Tree frog (*Dendropsophus sarayacuensis*)  
Sangay National Park (1000 m)

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The biodiversity splendour

Cartel 1.5

# 1 An exceptional biodiversity



Panneau 1.6

## A home for everyone

As for many insect groups, the huge diversity of forest grasshoppers in the Ecuadorian rainforests is partly explained by their high degree of specialization in their habitat preferences. Some species forage only in the highest parts of the canopy, others inside the canopy foliage. Some species are dependent on lianas and epiphytes and others are characteristic of trunks and branches. And several species are found only on palms.

Leaf katydid (*Typophyllum* sp.)  
Siempre Verde Reserve

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The biodiversity splendour

Cartel 1.6



Panneau 1.7

## Who are these snakes?

There are about 405 recorded reptile species in Ecuador, half of them snakes. Since 1900, about 13 new species have been reported every ten years, resulting from exploration of new areas or studies on Museum-collection specimens. This trend should persist in the forthcoming years.

Treesnake (*Imantodes inornatus*)  
Esmeraldas

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The biodiversity splendour

Cartel 1.7



Panneau 1.8

## Red listed

Ecuador harbours 382 species of mammals which puts it by far in the first place of mammal diversity per square metre worldwide. Of the 4 species of tapirs found in the world, 3 (Baird's tapir, mountain tapir and lowland tapir) live in Ecuador. All of them are red-listed as either vulnerable or endangered. Why worry? First, tapirs play a key role in long-distance dispersal and survival of plant seeds. Second, they are members of a mammal family which is highly distinctive from an evolutionary viewpoint.

Lowland tapir (*Tapirus terrestris*)  
Yasuni National Park

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The biodiversity splendour

Cartel 1.8

## 2 Exchanges for life



Panneau 2.1



Panneau 2.2



Panneau 2.3

### Exchanges for life

The term biodiversity should remind us that no one organism lives in isolation. The many different ways that the millions of organisms on the Earth interact with each other contribute to their survival and to the balance of ecosystems. "Negative" interactions such as competition, predation and parasitism are frequent and important forces in the wild. They have strong effects on the structure of both plant and animal communities. "Positive" interactions such as mutualism, commensalism and facilitation play a critical role in natural communities by reducing environmental stress and by creating new niches on which many species depend. In this cloud forest, for instance, the diversity of vascular epiphytes (e.g. bromeliads and orchids) is generally favoured by bryophyte cover and organic matter accumulation. It has been found on a single tree up to 98 different plant species.

Forest of paper tree (*Polylepis pauti*)  
Cayambe, Coca National Park (3500 m)

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The biodiversity splendour

Cartel 2.1

### Camouflage

Representing a significant food meal for many predators, katydids in this tropical region have evolved numerous, often complex ways to avoid being caught. The cryptic appearance of katydids is an efficient strategy to avoid visual detection by diurnal predators. This strategy, however, is useless against nocturnal predators like bats that can detect calls produced by katydids while attracting their mates. Katydid must therefore reduce call repetition, call at higher frequencies or replace sound signals by vibration through the plants.

Katydid (*Tettigoniidae*)  
Maquipucuna Reserve

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Cartel 2.2

### Appearance

Many prey species such as wasps, coral snakes or skunks, use colourful signalling to warn predators that they are toxic. Predators can learn to associate prey warning coloration with its noxious properties. To deter predator attack, the larvae of *Automeris* use two types of warning signal: colour and venomous hairs or spines. This strategy possibly enhances the avoidance learning behaviour of predators and increases caterpillar survival.

Spiny caterpillar (*Automeris* sp.)  
Mindo forest

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The biodiversity splendour

Cartel 2.3

## 2 Exchanges for life



Panneau 2.4

### On constant watch

Lava lizards often perch atop the heads of resting marine iguanas to take advantage of a perch that provides them with a good opportunity to catch flies and other insects. The perch is probably also a good place for basking or watching for potential mates and competitors. Potential benefits for iguanas are not clear, as their skin parasites are usually cleaned up by mocking birds and finches.

Marine iguana (*Amblyrhynchus cristatus*) and lava lizard (*Microlophus alberti*)  
Galápagos National Park - Fernandina Island

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Cartel 2.4



Panneau 2.5

### Manna from tears

Some insects have specialized in tear-feeding, where they mainly feed on placid animals. In addition to sodium, tears also contain proteins that could represent a high-quality resource throughout the year. To our knowledge this series of photographs is the first to document a tear-feeding behaviour by solitary bees on river turtles. While bees benefit from this interaction, turtles appear to be harmed in most cases, shaking the bees away or diving into the water to escape from them.

Solitary bee (*Centris* sp.) and yellow-spotted river turtle (*Podocnemis unifilis*)  
Yasuni National Park

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The biodiversity splendour

Cartel 2.5



Panneau 2.6

### Taking refuge

To escape from predation, many prey species such as insects and frogs have to spend much of their lives inside refuges. What appears to be trivial behaviour for the observer represents in fact a stressful situation for the prey. Time spent inside refuges has a cost that should be minimized, such as the loss of time available for feeding or mate searching. Therefore, the decision to emerge from the refuge can be particularly delicate because it requires prey to estimate food availability and predation risk outside the shelter. The strategy of many prey species in the tropical forest is to come out at night when many, although not all, predators are less active.

Tree frog (*Hyaloscirtus alytolylax*)  
Otonga Nature Reserve

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Cartel 2.6

## 2 Exchanges for life



Panneau 2.7

### Aggregation behaviour

Insects display a remarkable variety of defensive adaptations against their predators. One of them is to signal distastefulness using warning colorations. In sting bugs, the combinations of black, yellow or red produces a contrasted pattern which is recognized by predators as a signal that implies distastefulness. Insect aggregation can reinforce the effectiveness of this strategy because a group of individuals projects a larger signal to a predator than single individuals. Predators are generally less inclined to attack aggregated bugs than solitary bugs, therefore insect survival increases.

Aggregation of sting bugs (Hemiptera)  
Yasuni National Park

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Cartel 2.7



Panneau 2.8

### Sentry duty

In several parts of South America, parrots, parakeets and macaws come to clay cliffs in large noisy groups, to feed on soil particles. On these occasions, they are fully exposed to predators and must interact with the other species coming to feed on the cliff. Parrot species try to avoid competition among each other by using the clay cliff at different moments of the day. However, when several species are present at the same time, those with larger body size or in dense groups generally move other species a little further. Such a dynamic benefits the whole community: birds that are waiting at the cliff can be vigilant and warn of impending danger.

Cobalt-winged Parakeets (*Brotogeris cyanoptera*)  
Yasuni National Park

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Cartel 2.8



Panneau 2.9

### Partnership

In order to optimize reproduction species must choose a mate who will enable them to produce as many high-quality offspring as possible. In seabirds, most species have long-term partnerships that endure from one breeding season to the next. An advantage of these kinds of partnerships is that they reduce the potential costs of mate sampling, such as injury or predation, delays in finding mates, or missing a breeding opportunity. However, ending a partnership may be advantageous especially for young birds following one or more seasons with poor reproductive success.

Nazca boobies (*Sula granti*)  
Galápagos National Park - Española Island

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The biodiversity splendour

Cartel 2.9

# 3 Treasure to preserve



Panneau 3.1

## Treasure to preserve

In Ecuador, like almost everywhere on the planet, biodiversity has been facing massive disturbances caused by human activities to meet the growing demands for food, fresh water, timber, fuel and minerals. To date, some 282 species, nearly 7% of Ecuador's endemic flora qualify as critically endangered.

This loss of biodiversity can have important consequences owing to the major role played by these species, ranging from small invertebrates to large predators, in the functioning of ecosystems and for the well-being of humans.

At present intense deforestation combined with subsequent extension of agriculture to higher altitudes is threatening this surprising páramos vegetation (high-mountain plant formations, characteristic of the terrains in the northern Andes). This ecosystem is, for many aspects, the object of important environmental concerns, because it harbours a substantial amount of endemic flora and fauna but also because it is the constant source of high-quality water which feeds many Andean rivers and streams.

Frailejón (*Espeletia pycnophylla*) – El Angel Ecological Reserve

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Panneau 3.2

## Essential sunbeam

Pollination and seed dispersal are essential ecosystem services provided for humankind and tropical forests. A study of the hummingbird–plant community in the Eastern Ecuadorian Andes found hummingbirds visiting 12 plant families, 29 genera and 72 species - most of them belonging to bromeliads, orchids, and Ericaceae. The pollinating role of hummingbirds is crucial for forest ecosystems, and the local extinction of some species in the Ecuadorian highlands has been shown to alter the reproduction of the native plants.

Shining sunbeam (*Aglaeaactis cupripennis*) pollinating a puchick (*Tristerix longibracteatus*)  
Yanacocha Reserve

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The biodiversity splendour



Panneau 3.3

## Cushion plants

Cushion plants are often colonized by other plants, such as gentians, because they facilitate their establishment by providing them with nutrients, water, protection from the wind, and warmer temperature than the one outside the cushion which would strongly limit their survival. This suggests that the presence of cushions is important to maintain plant diversity in high-Andean ecosystems.

Gentian (*Gentiana sedifolia*) growing in a cushion plant (*Xenophyllum rigidum*)  
Antisana Ecological Reserve

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The biodiversity splendour

Cartel 3.1

Cartel 3.2

Cartel 3.3

# 3 Treasure to preserve



Panneau 3.4

## Early warning signal

Like guards watching over the state of health of our Earth, the amphibian species are among the most sensitive organisms to climatic changes and to the destruction of their natural habitats. This is the case of the Pacific horn frog, a species listed as "vulnerable" in the CITES red list. In Peru and Ecuador its distribution is severely fragmented and there is continuing decline in the extent and quality of its forest habitat. This frog shows a great diversity of color patterns among individuals. An interesting anti-predator feature of these frogs is the bright colors displayed as a warning signal when individuals open their mouths.

Pacific Horn frog (*Ceratophrys stolzmanni*)  
Guayas

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Panneau 3.5

## Keystones

Many predatory animals are considered as keystone species, i.e. species which have a disproportionate effect on ecosystems with regard to their abundance. A study on predator-free islands created by a hydroelectric impoundment in Venezuela showed that the densities of rodents and herbivores are 10 to 100 times greater in the absence of top predators. The effect of predator removal in tropical forests propagates down through the food web, resulting in a severe reduction in the density of seedlings and saplings of canopy trees.

Ocelot (*Leopardus pardalis*, captive animal)  
Misahuai

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Panneau 3.6

## Sea lions: the great providers

On the Galápagos Islands, shoreline plant growth and distribution are limited by the low nutrient availability in soils due to the recent volcanic origin and harsh climatic conditions. These plants benefit from the presence of the sea lions. Because sea lions feed in the ocean and rest and breed on island shores, they transport nutrients from the rich marine systems to the poor terrestrial ones.

Galápagos sea lion (*Zalophus wollebaecki*) and sea purslane (*Sesuvium portulacastrum*)  
Galápagos National Park– South Plaza Island

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The biodiversity splendour

Cartel 3.4

Cartel 3.5

Cartel 3.6



Panneau 3.7

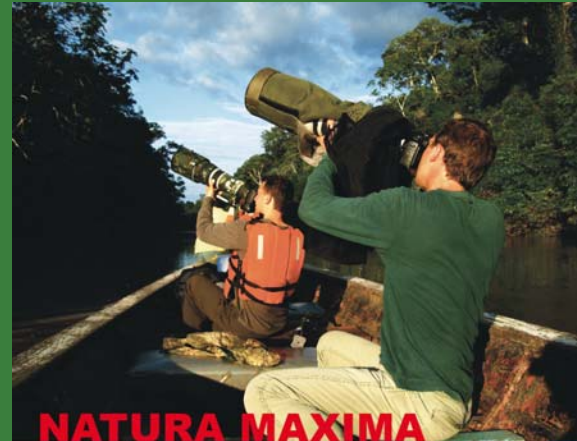
## Education

Among the range of actions that can be undertaken to favor biodiversity preservation, environmental education, especially for young people, is a major element. Learning about nature as childhood, then adolescence, proceed is the best means for favoring, in the near future, decisions that would allow protection of plants and fauna and the sustainable management of natural resources. In Ecuador as elsewhere, young people, especially those who live in urban areas, would need to observe the birds and insects flying from flower to flower to understand the importance of pollination. Or discover the forests to gain awareness of the millions of years required for oil to be formed from plants. Such education would allow new links to be forged with the natural world and wildlife, more essential because better informed. But also –and above all– marked with love and respect. As Stephen Jay Gould put it, *"We cannot win this battle to save species and environments without forging an emotional bond between ourselves and nature as well – for we will not fight to save what we do not love"*.

Olivier DANGLES and François NOWICKI

Child (*Homo sapiens*) and red-bellied piranha (*Ptygocentrus nattereri*)  
Yasuni National Park

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Panneau 3.8

Cartel 3.7