Introductory Edition

Trees of Panama and the Neotropics

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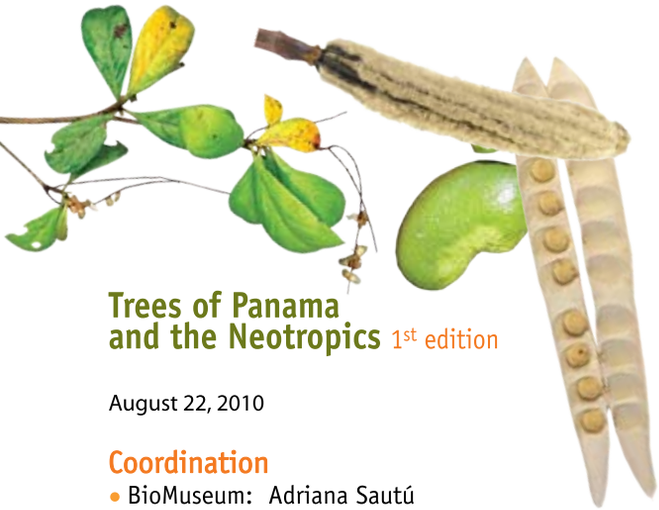
Smithsonian PRORENA APRENDO BIOMUSEO



Trees of Panama and the Neotropics 1st edition

August 22, 2010

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Our thanks for the valuable collaboration of:
Native Species Reforestation Project (PRORENA), Rivieth De Liones, Jefferson Hall, William Jácome, Gian Montufar, Steve Paton, Michael van Bruegel, Daniela Weber.

Photographs: Alexander Arosemena, Richard Condit, Carmen Galdames, Ginkgotree, Marcos Guerra, Andrés Hernández, Marky Larjavaara, Steve Paton, Rolando Pérez, Wendy Tribaldos, Blanca Martínez, Universidad de Costa Rica, Salomón Vergara, Wiki Commons, Nina Wurzburger, Christian Ziegler.

Illustrations: BioMuseum, Mariel Chong, Treena Joi, Blanca Martínez, Rolando Pérez.

Maps: Milton Solano (Smithsonian), SASI Group (University of Sheffield) y Mark Newman (University of Michigan) de www.worldmapper.org

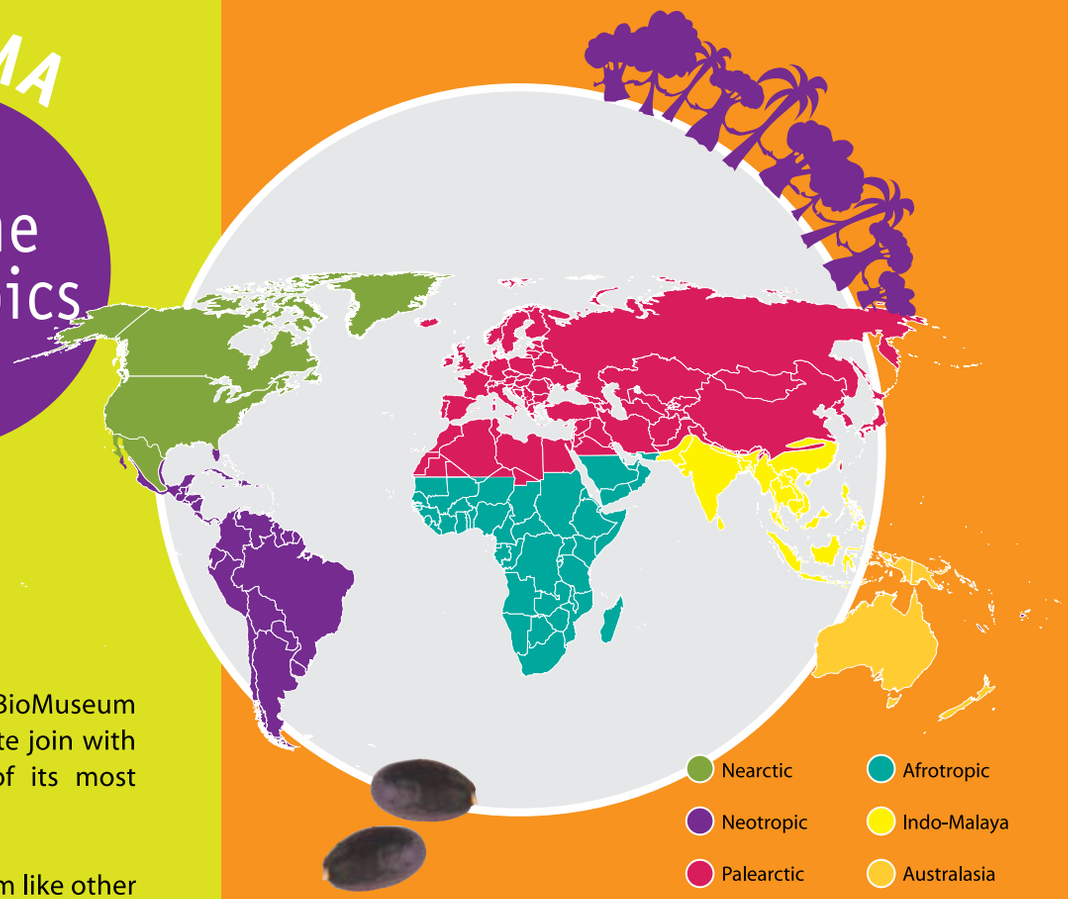
Next edition: August 29, 2010

http://stri.org/espanol/arboles_panama/
This information was provided by:

Smithsonian PRORENA

With the financial support of:
HSBC Climate Partnership

TREES OF PANAMA and the Neotropics



In the International Year of Biodiversity, the BioMuseum and the Smithsonian Tropical Research Institute join with Aprendo to celebrate biodiversity in one of its most important components: **trees.**

Why don't trees have "fan clubs" to protect them like other endangered animals do? Perhaps it is because they don't have cute little eyes like pandas, or maybe because they don't even walk; the truth is that a lot of people think trees are boring. But if that's what you think, get ready to change your mind!

In this series, we will tell you why trees are important and why we need to know more about them. We will tell you about famous trees, about trees in our gas tank and how trees can help us reduce global warming. Then, we will give you the details of **12 native tree species** so that you, too, can become a tree expert. With each species, we will give you ideas so that you can play at being a scientist in your own backyard, and stories that will help you understand topics ranging from global climate change to the secret lives of trees.

Just one more thing…we cannot be held responsible if, after reading this series, you start sprouting roots and branches or find birds nesting in your hair!

We have also created a web page
http://www.stri.org/espanol/arboles_panama/index.php
where we will share more stories and unusual information
to help you become a fan of native trees

We decided to pay homage to the native trees of our region, but since biodiversity does not understand political borders, we expanded to include our **"biogeographical region" or "ecozone": the Neotropics.** Ecozones are inhabited by groups of plants and animals that share a history of millions of years together. Central and South America have been together for 3 million years, ever since Panama completed the process of emerging and united them. That's right! **Panama** was a **bridge that changed the biodiversity of the Neotropics**; and, even though it may seem hard to imagine, trees also used us as a bridge!

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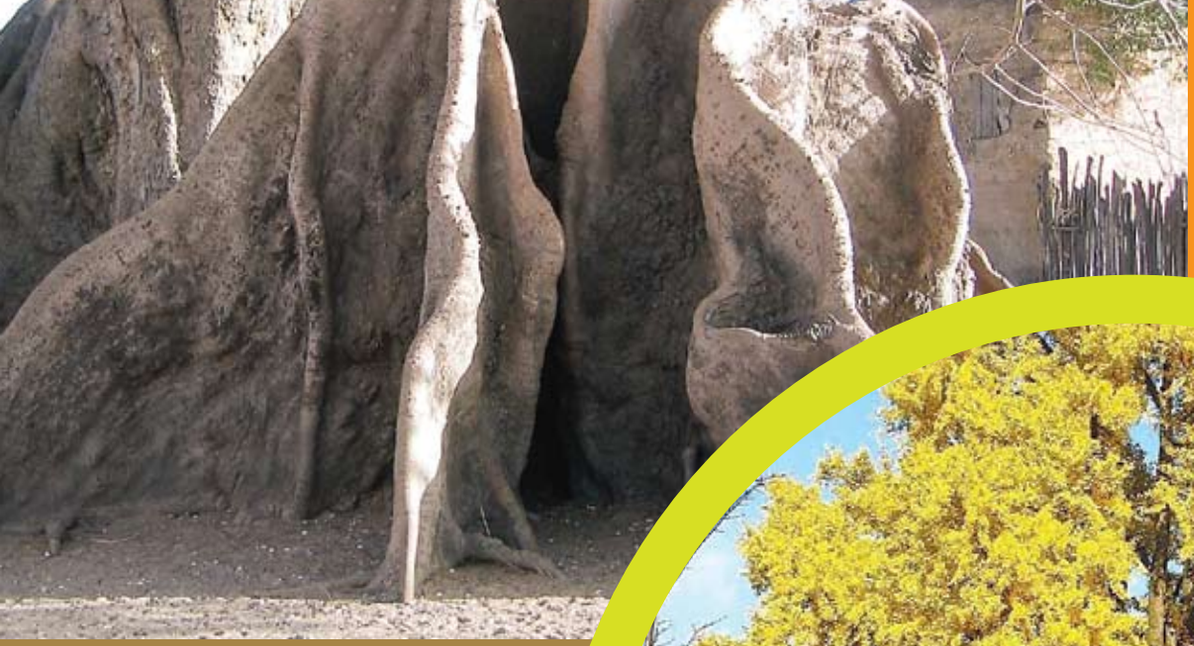
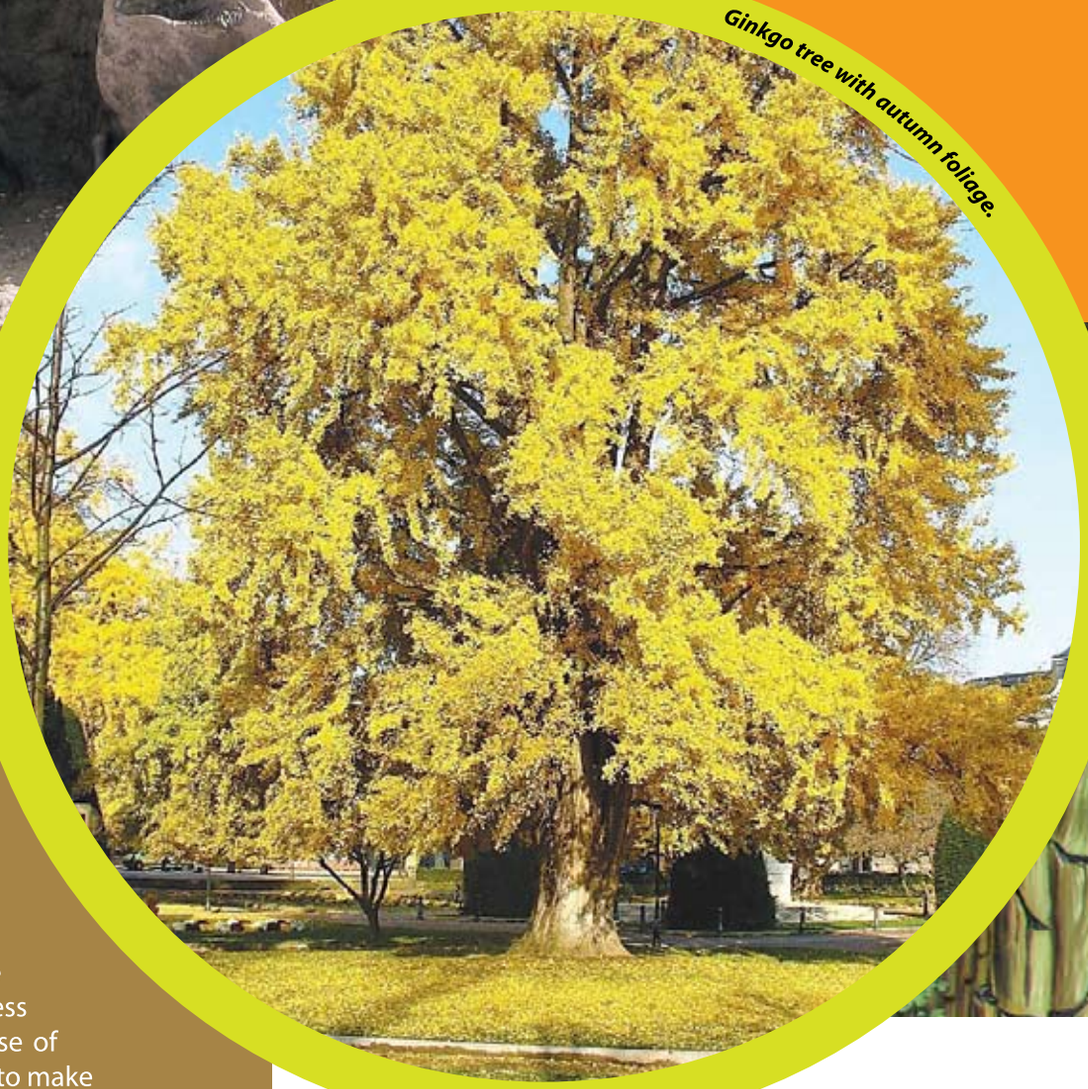


These are the buttress roots of the old ceiba tree in Villa de Mar Lodj, in Senegal.



Ginkgo tree with autumn foliage.

Trees and us

What is a tree?

It is not easy to define a tree, since nature resists being explained in a few words. For example, a tree that grows high in the mountains tends to be small and gnarled. Does this make it less a tree? Are shrubs, which have branches starting almost at the base, less than the tallest trees with trunks? Because of this difficulty with definitions, and in order to make peace with nature, scientists invented the words "in the strictest sense." So, the exact definition of a tree is: "plants with seeds that develop a trunk that grows in rings each year." Then we can be less "strict" and concede the honorary title of tree to other plants that deserve it, such as palms, which do not precisely have a woody trunk but are included in all guidebooks on trees.

Trees in our life

Our ancestors had long arms that enabled them to climb with ease; they spent the greater part of their lives in trees. Even though we have come down from the trees, we have never gotten very far from them. We have a thousand and one uses for them: wood, food, shade, fibers, medicines, firewood, clothing, refuge, tannins, condiments, water, honey, clean air, beauty, and much more.

In addition to their practical uses, trees have a significant influence on our culture: there is not a village that does not have its sacred tree. Trees can unite heaven and earth, serve as the dwelling place of good or bad spirits, provide protection, bear witness at weddings and be planted when a child is born or an adult dies. And in some myths, the first man was made of wood.

Trees at the center of life

In African traditions, there are two sacred meeting places: in forests and under "trees of the word", old trees under which villagers gather to make decisions. An example is the old ceiba which is the tree of the word in Villa de Mar Lodj, in Senegal.

My brother, the tree

The Oubangui of Central Africa plant a tree when a child is born. If the tree does not thrive, they believe the child's health is in danger. If the child falls sick, he receives treatment underneath the tree. When the tree bears fruit, it is time for the child to marry, and when the child reaches adulthood and eventually dies, his spirit will rest in his birth tree.

The Kunas of Panama bury the umbilical cord of their newborns beneath a tree, which will then be their "vegetable sister", since the Kunas regard trees as female.

A tree that survived the atomic bomb

On August 16, 1945, the atomic bomb was dropped on Hiroshima. Eight months later, among the charred remains of what was once a majestic *Ginkgo biloba* tree, a green shoot appeared, searching for a path to the light. Today, the tree is more than 16 meters tall and is regarded as a symbol of peace and hope. Descendents of this tree have been planted in parks all over the world.

Illustration of arborous ferns of the Carboniferous period

The first trees, trains and steamboats

The fossil record tells us that the first tree-like plants appeared 350 million years ago. Although plants had not yet developed the seeds or wood by which a tree is defined today, these gigantic relatives of ferns grew to a height of 40 meters… the same height as a 12-story building! Three hundred million years later, these forests-turned-to-coal provided the energy for steam engines, marking the beginning of the age of trains, steamboats and the Industrial Revolution. Not a bad way to continue living off of the forest!

Find more unusual stories about famous trees at our website:
http://www.stri.org/espanol/arboles_panama/index.php

more info

Abela, Ignacio. 2008. **La magia de los árboles. Simbolismo. Mitos y tradiciones. Plantación y cuidados**. RBA Libros, Integral. Barcelona.

Tudeg, Colin. 2006. **The tree. A natural history of what trees are, how they live and why they matter**. Crown Publishers. New York.

GRUPO REY

Native trees and biodiversity

How many kinds of trees are there?

We will probably never know how many species of trees there actually are. One reason is that most trees are found in tropical forests, where plants and animals do their best to go unnoticed. Botanists have estimated that there may be between 50,000 and 60,000 species of trees.

A delicate, priceless balance

How much are clean rivers worth? How much are cool afternoons in a park or plaza shaded by trees worth? Who decides what a sacred forest is worth to a group of indigenous people? And what is the value of the tree you sit back against to read a book, or the one under which your dad gave your mom her first kiss?

If we count only the medicines, foods and hardwood that the trees of the forest provide, their value is very great. But we must also include the benefits provided by the soil, air and moisture that surround us, and the interactions between each component of this open machine that is the ecosystem…and that is very hard to do. The benefits that forests give us – as part of a whole with their environment – are known as "environmental services", and include controlling the water cycle, capturing CO_2, producing oxygen and providing refuge for a complex biodiversity that regulates soil and water and can be a source of food or medicine. In the last section of this issue, we will talk about an experiment to investigate these environmental services in Panama.

Biodiversity

Biological diversity is much more than the number of species. Different tree species increase diversity by constructing a system of several stories or strata and their associated plants, which increases possible habitats for animals. But there is also biodiversity among the group of individuals within the same species: not all trees are exactly alike, just as not all humans are exactly alike.

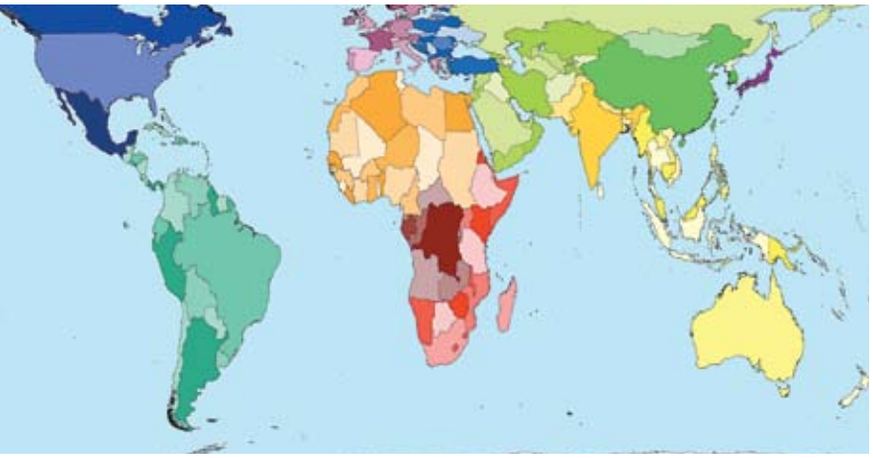
This diversity within the same species facilitates evolution and response to environmental changes.

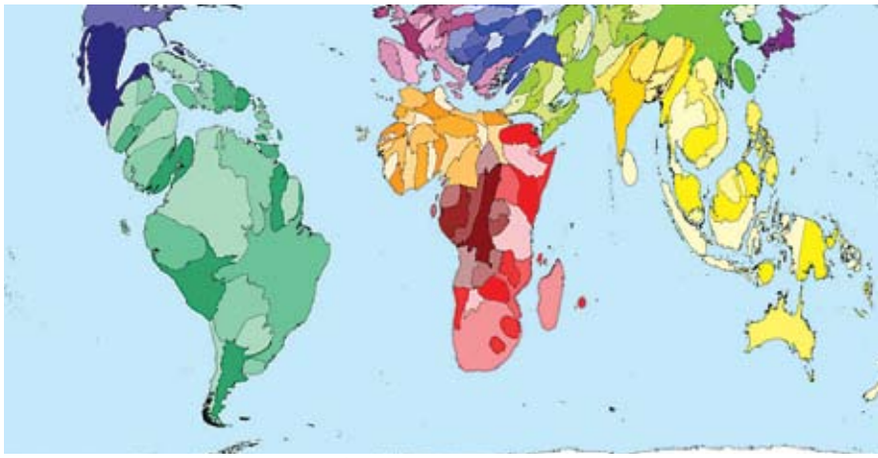
The greater the diversity and complexity of a natural system, the more unpredictable the effects of human intervention will be.

A deformed map to "see" diversity

Below on the left is a normal map of the world. On the right, you see a "deformed" map in which the surface area of each country is proportionate to the number of species of native plants.

Species diversity increases as we move from the poles to the equator. Boreal forests, such as those found in northern Canada, are dominated by about nine species, whereas thousands of species are present in the forests of our Neotropics, and the number of species per hectare can be in the hundreds!





Can you see how our Neotropical countries "fatten up" if we are represented in proportion to our biodiversity?

Source: www.worldmapper.org

Native or exotic?

We say that a plant is native when it grows naturally in a region, and that it is exotic when it has been introduced by man from another region. But sometimes, certain exotic plants can become accustomed to their new homes, so we call them "naturalized". For example, our very tropical mango trees were brought from India by the Portuguese around the year 1700; the mango liked the Neotropics so much – as did the Portuguese – that it became "naturalized" and sometimes grows without being planted…sort of like it got its American ID card!

We know the cultivation secrets of very few tree species compared to the 60,000 species we believe exist, and it is easier to cultivate the ones we are familiar with and plant large numbers of a single kind; this is known as monocultivation. You are probably familiar with teak, eucalyptus and pine, all of which are "foreigners" in Panama. They are beautiful and useful, but they cannot replace the native trees that were here first, or the tropical forest which provides us with such complex services through its incredible biodiversity.

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more info

- Abela, Ignacio. 2008. **La magia de los árboles. Simbolismo. Mitos y tradiciones. Plantación y cuidados.** RBA Libros, Integral. Barcelona.
- Tudeg, Colin. 2006. **The tree. A natural history of what trees are, how they live and why they matter.** Crown Publishers, New York.

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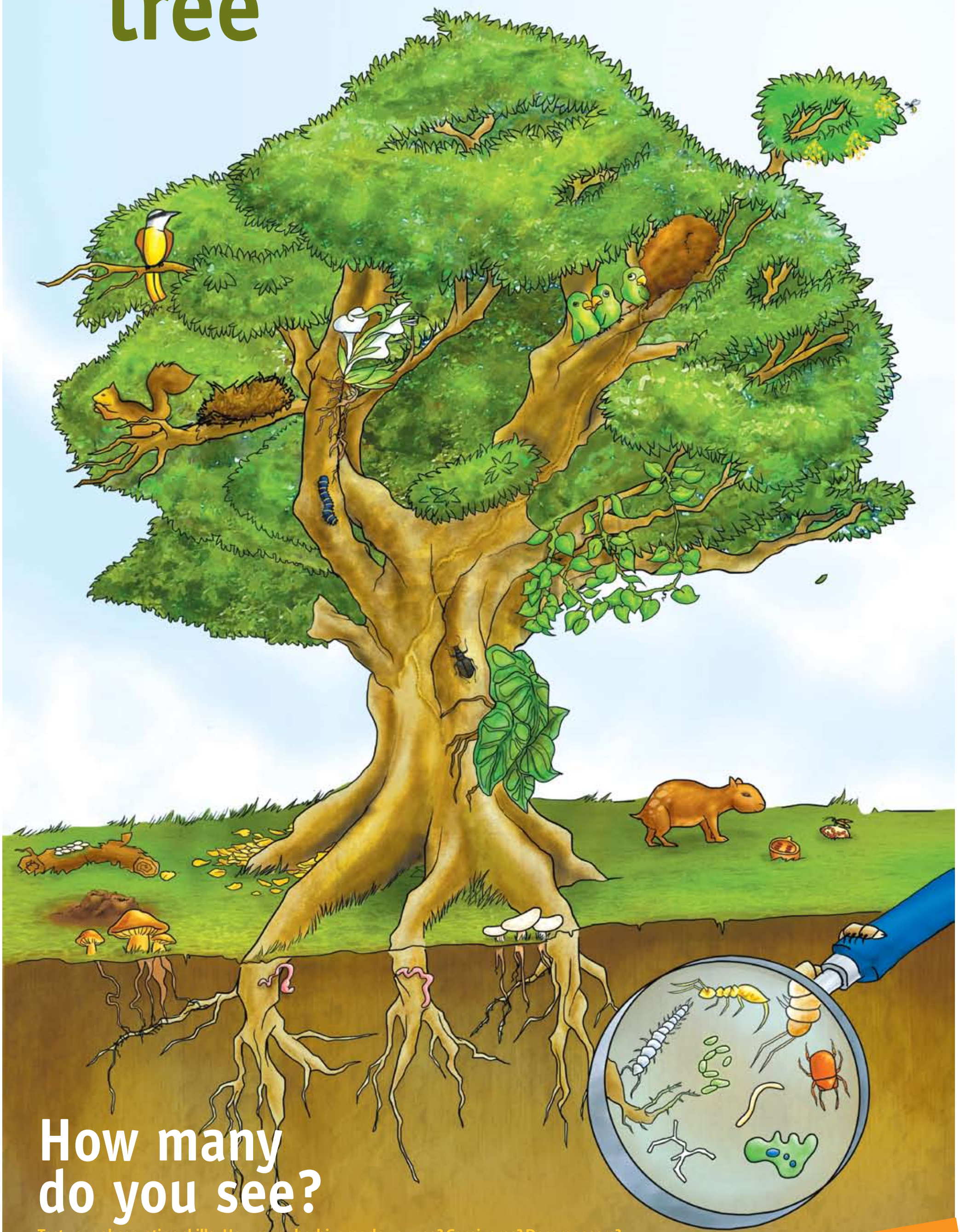
the house tree

If you look closely, a tree is like an apartment building inhabited by many families. When you plant a tree, you plant much more than a tree: **you plant a home.**



How many do you see?

Test your observation skills: How many herbivores do you see? Carnivores? Decomposers? Epiphytes? How many organisms use the tree as their home or shelter? Which ones are just passing through as they hunt for prey?

- ☐ Yellow-bellied flycatcher
- ☐ Squirrel
- ☐ Squirrel nest
- ☐ Caterpillar
- ☐ Beetle
- ☐ Termite path
- ☐ Bugs and seed
- ☐ Fruit
- ☐ Ant nest
- ☐ Fungus
- ☐ Orchid
- ☐ Flowers
- ☐ Bee
- ☐ Termite nest
- ☐ Parakeets
- ☐ Vine
- ☐ Agouti
- ☐ Mite
- ☐ Collembola
- ☐ Symphylans
- ☐ Nematode
- ☐ Amoeba
- ☐ Bacteria
- ☐ Hyphas
- ☐ Microrhizomes
- ☐ Worm
- ☐ Vine
- ☐ Root

8 herbivores, 1 carnivore, 10 decomposers (including all soil organisms), 3 epiphytes, 5 species that use the tree as their house/shelter, 1 organism that is resting on the branch while it looks for a flying insect to eat.

more info

Find more information on the answers at our website:

http://www.stri.org/espanol/arboles_panama/index.php

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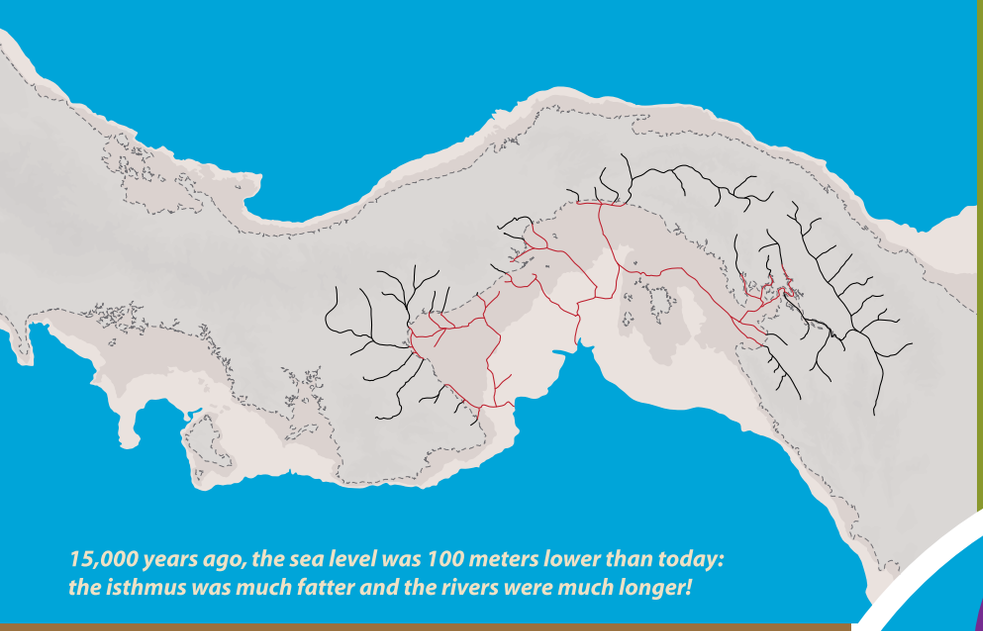

15,000 years ago, the sea level was 100 meters lower than today: the isthmus was much fatter and the rivers were much longer!

The last ice age began 40 million years ago and has advanced and receded at least 60 times! The last peak of cold and ice was the one portrayed in the movie "Ice Age" and occurred 20 thousand years ago. Since this last glaciation is the one most people are familiar with, it is known as the "Ice Age" with capital letters.

Ice ages, climate change and trees

A planet accustomed to change: the "Ice Ages"

Our planet is very old: 4,500 million years old. It has gone through many changes during this time: in its structure, its crust and its climate, experiencing warm and cold periods. The evidence found in rocks, in very ancient layers of ice and in fossils reveals that there were times when there was no ice anywhere on Earth, and other periods when enormous glaciers the size of continents extended over much of the planet.

These cold periods lasted millions of years and were characterized by the advance and retreat of glaciers. The correct term for the total period of lower temperatures is "ice age", and "glaciation" for peaks of maximum cold.

What caused these changes? We still don't know fully, but it appears to be a complex interaction between:

- The cycles of the sun, Earth's orbit and the planet's inclination.
- Changes in the position of continents, mountains and ocean currents (such as when the isthmus of Panama emerged).
- Changes in the composition of greenhouse gases in the atmosphere (such as in the global warming we are currently experiencing).

20 million years ago, Panama did not exist and the Atlantic and Pacific oceans were connected. The conditions of the sea were similar in both oceans, and organisms could cross from one side to the other.

The isthmus of Panama emerges and marine currents change

Around 3 million years ago, the isthmus of Panama became a land bridge between North and South America and a barrier between the Atlantic and Pacific oceans: it prevented the exchange of waters and fortified the Gulf stream, and the current ocean circulation patterns were formed. This change intensified glaciations and had important effects on the last ice age, causing the cycles of glacial advance and retreat to be faster and shorter and influencing the biodiversity that we are familiar with today.

Greenhouse effect, CO_2 and trees

The greenhouse effect is present on all planets that have an atmosphere with particles and gases. These particles and gases reflect part of the energy that the planet emits, enabling heat to be retained on the surface and favoring life. But too many gases reflect back too much heat!

Carbon dioxide is one of these gases; it is produced by respiration and consumed by plant photosynthesis. Since humans colonized all of the continents and developed agriculture approximately 7,000 years ago, the surface area of forests capable of consuming CO_2 has decreased by half.

At the same time, emissions have increased with the growth in population, as forests are burned for agriculture, cattle farming and building cities. And since the time of the Industrial Revolution, the concentration of CO_2 has increased at a pace unprecedented in Earth's history because we are releasing the carbon stored up over millions of years as we burn coal and petroleum.

Affecting large-scale cycles is not within our power, but we can try to decrease our negative influence in the short term. Forests and trees help decrease CO_2 concentrations in the atmosphere: It's time to consume less and plant more!

Carbon dioxide, methane, water vapor and ozone are the principle "greenhouse gases".

Climate change, global warming or greenhouse effect?

The truth is that we all get confused by these phrases.

- The greenhouse effect is a characteristic of our atmosphere that prevents part of the heat emitted by the planet's surface from escaping into space, thereby warming our world.
- Climate change is a change in climatic conditions that has occurred repeatedly throughout Earth's history and can be caused by numerous factors.
- Global warming is the increase in the planet's average temperature over the past 100 years. It is clearly related to the accelerated increase in greenhouse gases produced by human activities.

In many publications, the term climate change is used as a synonym for this recent global warming caused by greenhouse gases.

Find more unusual stories about famous trees at our website:
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more info

- NOAA paleclimatology site. http://www.ncdc.noaa.gov/paleo/glaciation.html
- Smitshonian Education. 2009. Prehistoric climate change and why it matters today. Available online, URL: http://www.smithsonianeducation.org/educators/lesson_plans/climate_change/smithsonian_siyc_fall2009.pdf

GRUPO REY

The Ecological Footprint

Lately, the "fashion" is to calculate our Ecological Footprint to determine if our lifestyle needs just one planet to continue, or more than one planet. The concept is easy to understand because we all know that in reality there is only one Earth. Because of the simplicity of this concept, the Ecological Footprint has emerged as a global measurement of how mankind makes use of nature.

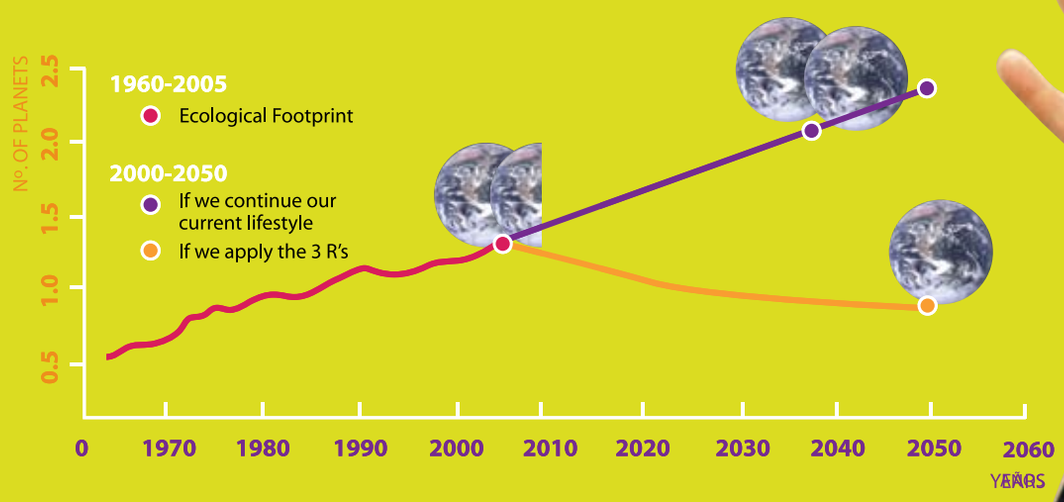
The boy who grew everything he ate

Bill Rees spent his summers on his grandfather's farm in Canada, working long hours in the fields where he raised vegetables. One afternoon, he was sitting on the porch of the house with his 12 cousins, brothers and sisters, enjoying a delicious stew. Just when he was about to start eating, he stopped to look at the ingredients of the stew and he realized that there was not a single ingredient that he had not helped grow! A certain fascination kept him from eating for a while, as he sat with his eyes fixed on his plate. He was overcome with a feeling of the intimate connection between himself and all of nature that he would never forget.

Bill was still attempting to understand this connection with the earth when he entered college, and was a pioneer in a field known as "Human Ecology". Even after he became a college professor, he was still driving himself crazy trying to apply a principle of animal ecology to aspects of human activity. This concept is known as "load capacity", and tells us how many individuals can live in a habitat without overexploiting it. How much land does one person need to produce everything he or she consumes and dispose of all the garbage he or she produces? It worked, and in 1992, with the help of a doctoral student, they published a book in which calculations were made for the first time of what would later be called the "Ecological Footprint".

? And what is the global Ecological Footprint for all humankind?

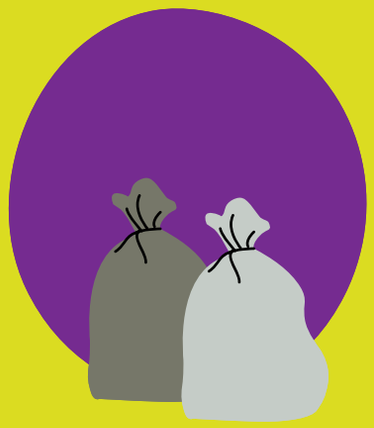
The 2009 calculations indicate that we humans use the equivalent of 1.4 planets each year, and the projections say that we will be using two planets by the year 2040.



If we distribute the productive land available on our planet among its 6 billion inhabitants, this would allow for an ecological footprint of 1.8 hectares apiece. So if all of us (all humankind) are using 1.4 planets, can you calculate the average number of hectares per inhabitant of our ecological footprint?

2.52 hectares

Calculating the Ecological Footprint



The Ecological Footprint measures the amount of Earth's productive land that we use for:

1. Absorbing the CO_2 generated by our energy use and garbage.
2. Constructing houses and buildings.
3. Obtaining non-food resources (Wood, minerals, medicines).
4. Growing crops and raising livestock.
5. Fishing our food from the sea.

In the lab

Several Ecological Footprint calculators can be found on the internet. Almost all of these have joined the Global Footprint Network and have agreed on the same calculation method. Make sure that the website you use is part of the global network to ensure that the results are comparable with other sources.

How much meat, fish and vegetables do you consume?
More land is needed to produce meat than vegetables.

Do you buy from the local or international market?
By consuming products that come from far away, we are also consuming the energy used to transport them.

How do you get around?
By using collective transportation, walking or riding a bike, you save energy and produce less contamination.

Do you save energy?
Energy and water are scarce resources that we must use responsibly.

And what about your garbage?
The golden rules of sustainability are: REDUCE, REUSE, RECYCLE. Do you practice any of these? Are there businesses or institutions in your community that recycle sorted materials?

QUIZ: Four of these questions are related to the same category for calculating the Ecological Footprint (of the 5 that are explained in the footprint to the left). Which of the five categories is it?

more info

- Global Footprint Network http://www.globalfootprintnetwork.org/
- Mike Gismonti. 2000. Aurora online with William Rees. Interview in the Athabasca University online Journal. Aurora Issue 2000. Available online. URL: http://aurora.icaap.org/index.php/aurora/article/view/18/29

GRUPO REY

Jeff Hall

Much more than just trees: environmental services

The final questions of this issue that remain to be answered are which trees are better to plant, how and how many to plant, and what amount of forest needs to be protected. These are very difficult questions to answer: scientists all over the world try to answer them, and they do so by trying to learn more about the environmental services provided by forests and trees. One of these scientists is Jefferson Hall of the Smithsonian Tropical Research Institute in Panama, who is in charge of Agua Salud, a large-scale experiment that covers 850 hectares in the Panama Canal Watershed and receives the support of the HSBC Climate Partnership*. Jeff tells us: "This experiment seeks to answer how environmental services change between forests, hardwood plantations and cattle land. Do forests reduce the risk of flooding? Where is more water available during the dry season? Which trees capture more carbon? Which trees attract greater biodiversity? Agua Salud will also compare younger forests with more mature ones, and reforestation with teak versus species that are native to the area.

What environmental services does Agua Salud measure?

CO_2 absorption by trees

The growth in diameter of the trees is measured: based on how much they "fatten up", the amount of CO_2 they consume can be estimated.

The water cycle

Each type of vegetation studied will cover a "micro-watershed", which is an area of land that provides water for a stream. Small dams will be built at the end of the streams in order to measure the amount of water during the entire year.

Biodiversity

Each year, inventories are carried out in each type of environment of the different kinds of plants and animals found there.

Native trees of Panama and the Neotropics

10 of the 12 species of native trees that will be described in the coming Sunday editions of this series form part of the Agua Salud experiment. Learning more about native trees will help us use and care for them more wisely. Remember that native trees are home to our abundant diversity, provide us with beauty, recreation and culture, and are our best line of defense against global warming!

*The HSBC Climate Partnership is an initiative of HSBC Bank, formed by the Smithsonian Tropical Research Institute, Earthwatch, The Climate Group and WWF. For almost 100 years, the Smithsonian has generated invaluable scientific information that has revolutionized tropical biology.

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- Ahorrar 4,068,891 galones de agua
- Ahorrar 778,500 Kw/hr de energía
- Ahorrar 415.2 barriles de petróleo

*Cifras de enero del 2009 a la fecha

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