

OS ANFÍBIOS DA MATA ATLÂNTICA: DIVERSIDADE E O IMPACTO DAS MUDANÇAS LOCAIS E GLOBAIS

ATLANTIC FOREST AMPHIBIANS: DIVERSITY AND THE IMPACT OF LOCAL AND GLOBAL CHANGES



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The Neotropical region has approximately half of the global diversity of amphibians. However, the description of new species is still increasing as a consequence of the increasing in the number of researchers in the Neotropics.

The destruction and transformation of natural ecosystems is the main threat to the amphibians and it is increasing in several places of the Neotropics, generating declines and extinctions of populations and species.

We are losing species that are being extinct before we can collect and describe them.

This situation is particularly dramatic in the Atlantic forest, one of the most diverse biomes that was almost entirely destroyed in the last centuries.

We need to describe species faster than today because it is more difficult to protect unnamed entities and because we need a better comprehension of the real diversity we have.

The destruction and transformation of natural ecosystems is the main threat to the Atlantic forest amphibians.

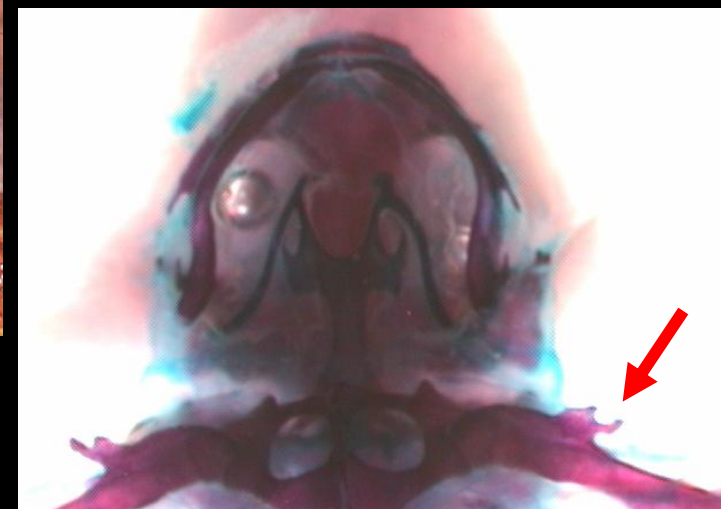
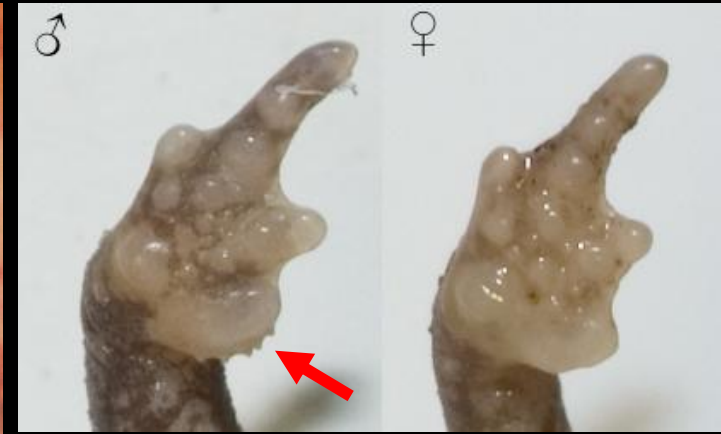


In the Atlantic forest, any survey in an unstudied place results in a check list with at least 5-10% of new species.

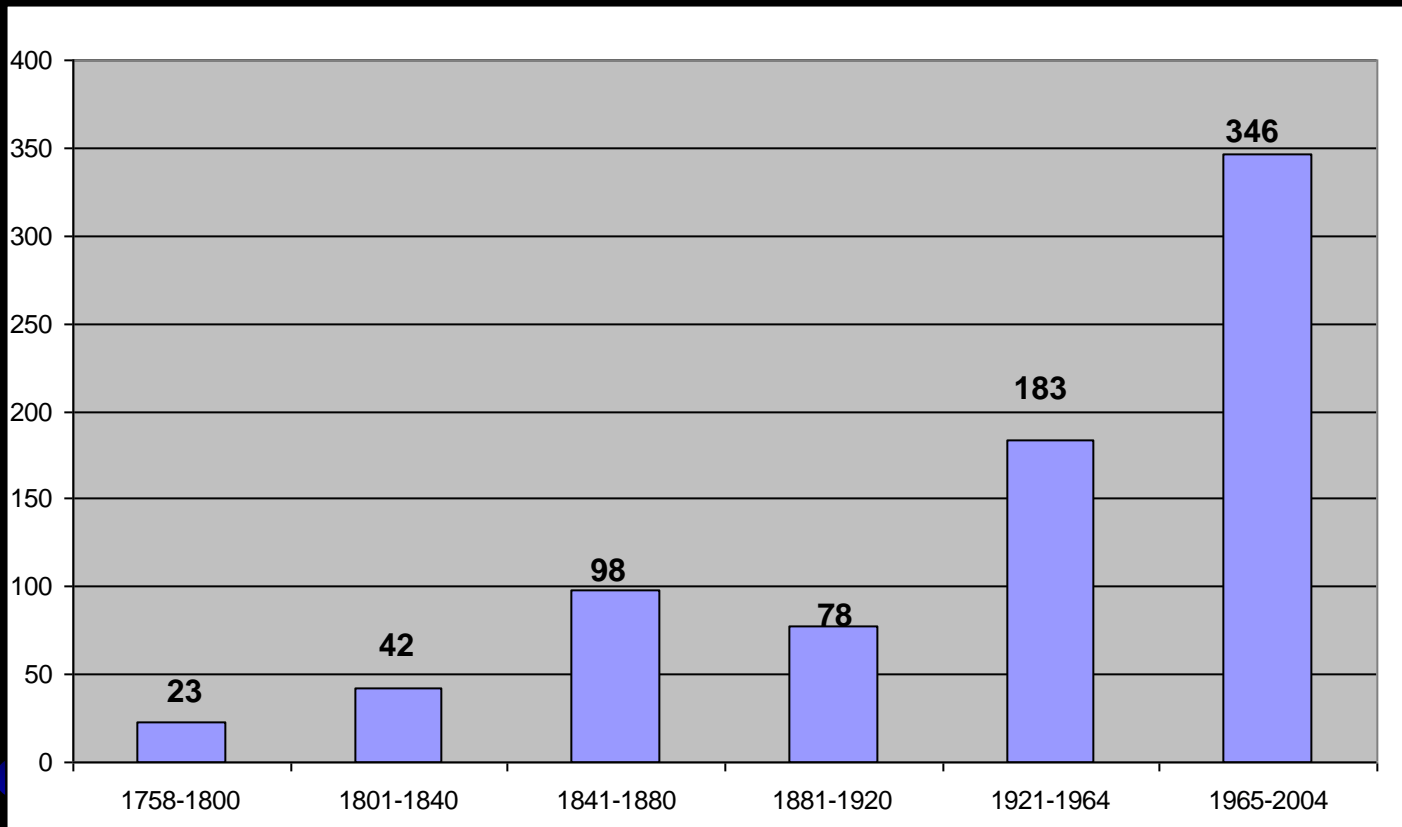


Some examples of new species of amphibians being described in my laboratory. Although my research group is not exclusively dedicated to taxonomy, at this moment we are describing approximately 25 new amphibian species (90% from the Atlantic forest). This is a common situation in the different research groups in Brazil.

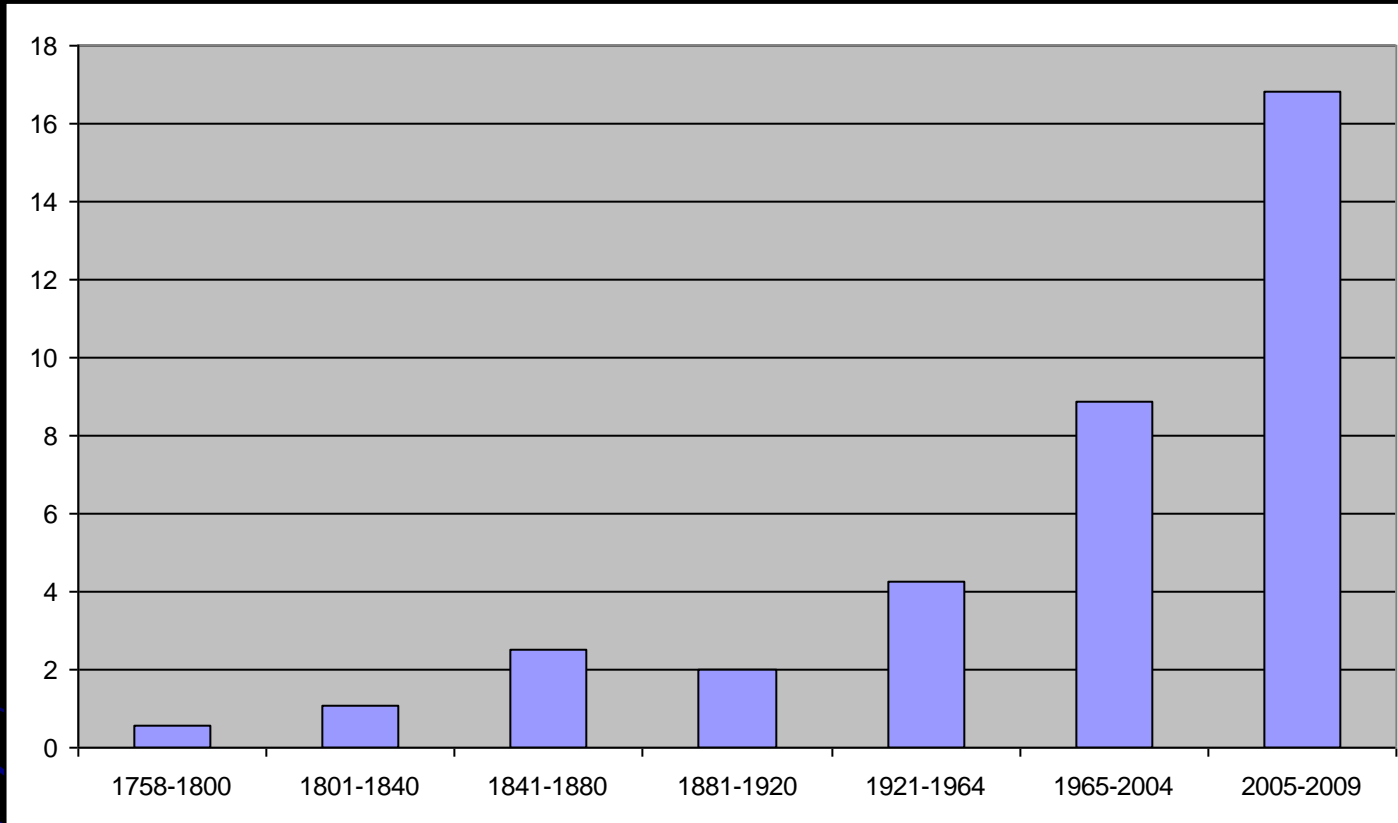
In some cases we are finding new species that have very unusual characters (miniaturization, reduction of fingers and toes, humeral bifid spine, and small spines on the basis of 1st finger), suggesting that a new generic name is applicable.



New genus and species of a basal bufonid from Atlantic forest with approx. 1 cm SVL. This is a key species for the comprehension of the evolution of Bufonidae.



Total number of descriptions of amphibian species occurring in Brazil separated into ~40-year intervals. Almost half of all species were described between 1965 and 2004, the majority from the Atlantic forest.

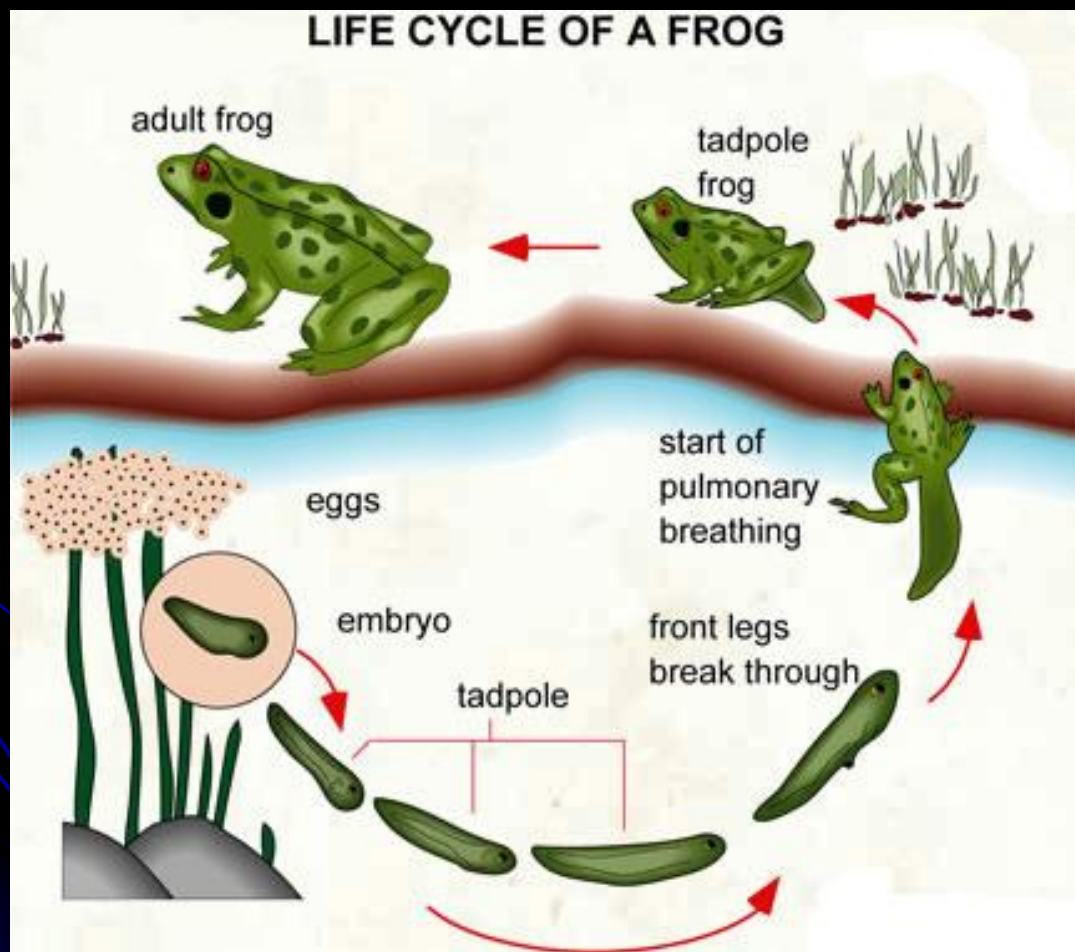


Mean number of descriptions of amphibian species/year in Brazil. This year (2010) we are in 21 species, the majority from the Atlantic forest.

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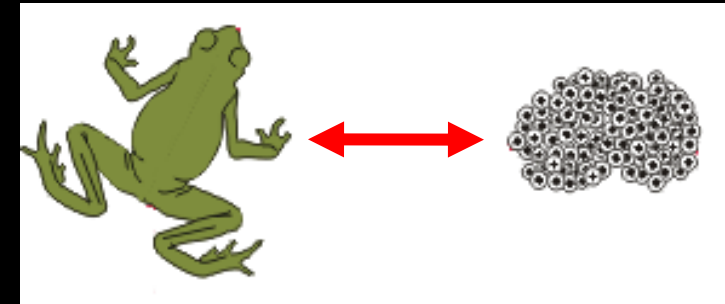
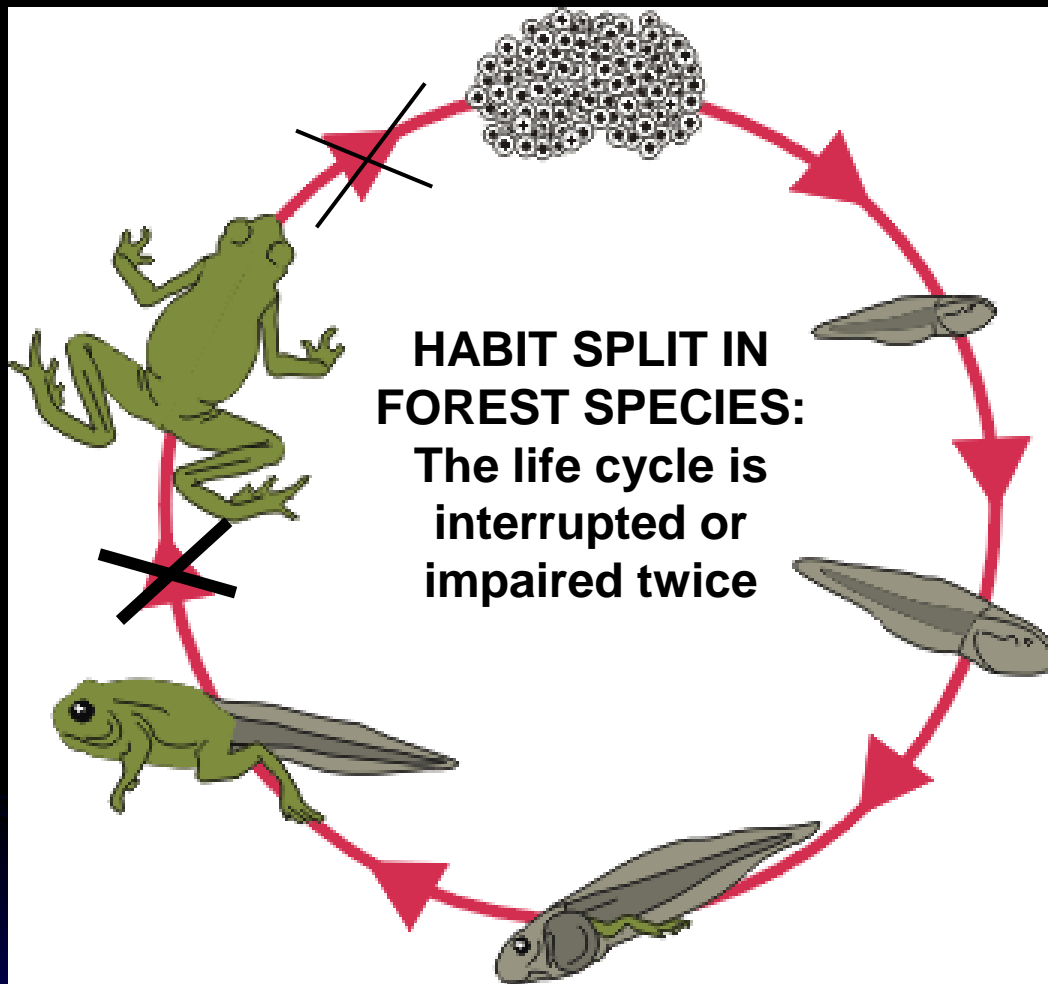
Example of local change generated by habitat degradation, negatively affecting the survival of amphibians with biphasic life-cycle in the Atlantic forest:

The Habitat Split (Becker et al., 2007, Science).





The habitat split is induced by human activities. Farmers, interested in water resources, cut the forests near the rivers, forcing the forest species of amphibians to live in forest remnants at the top of mountains. During the reproductive season the amphibians are compelled to leave the remnants to search water bodies for the reproduction in the lower places artificially opened by man. The amphibians die massively during the migration process and year after year suffer a fast decline and became extinct.



The life cycle of species with direct development is not affected by habitat split, because it is independent of water.

The life cycle of biphasic species, the most common situation for amphibians, is strongly affected by habitat split.

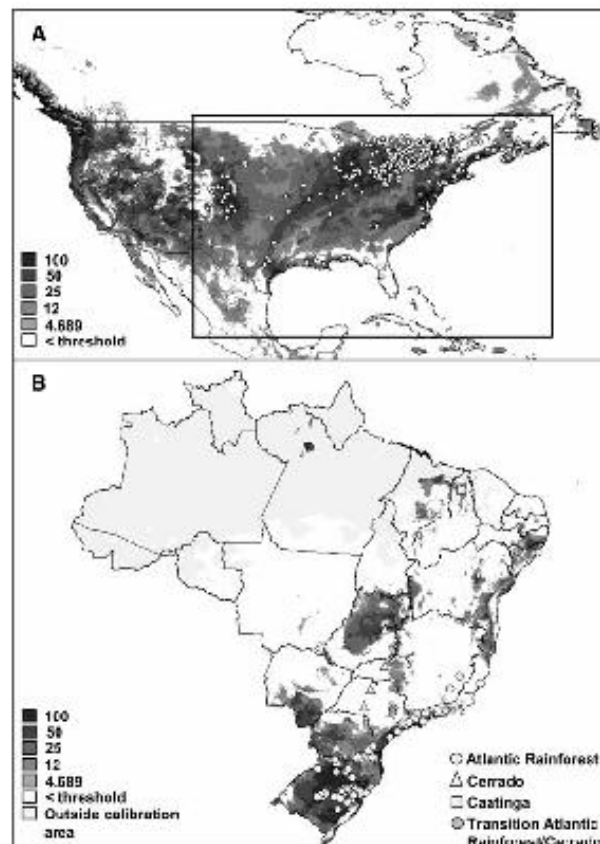


Example of local change generated by alien species introduced by humans:

Lithobates catesbeianus (the American Bullfrog), was introduced in Brazil some decades ago (1930) for meat production in frog farms.

They escaped or were released from the farms and started to reproduce in the field. It is an aggressive species that prey the native species, including other anurans, is a strong competitor, and probably is disseminating diseases to the native anurans. The Bullfrog entered the Atlantic forest and is well adapted to several of its ecosystems, being a concern to the preservation of native species.

Fig. 1 (A) Predicted potential geographic distribution for *Lithobates catesbeianus* in North America resulting from Maxent climatic modeling using occurrence records within the species native range. The inset is the area of environmental calibration for the purpose of projecting the habitat suitability model (see text for details); (B) Projection map for the potential distribution of *L. catesbeianus* in Brazil. Real occurrence localities of the species in distinct Brazilian biomes are represented by distinct polygon shapes or shading (see legend in the figure)

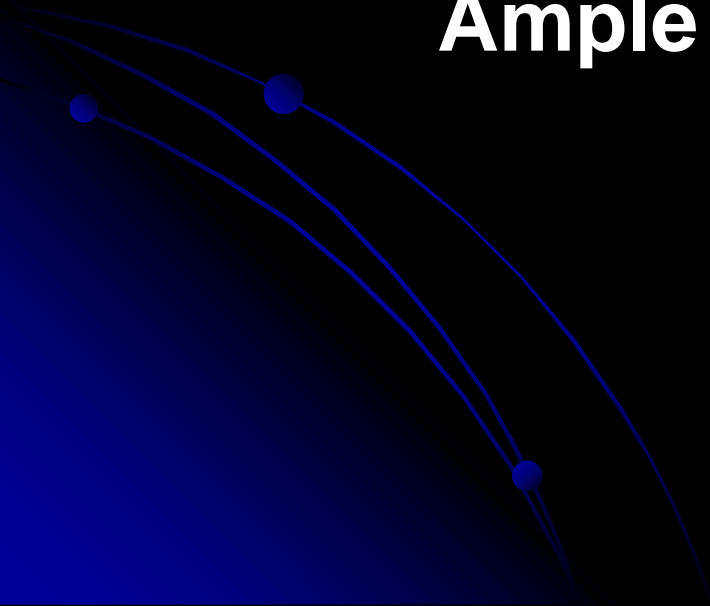


Besides the human induced local impacts, it is possible that the global climate change will have very negative effects for several amphibian species in the future. For example, the raise in sea level will be harmful to the amphibians, since the sea water is lethal to them.

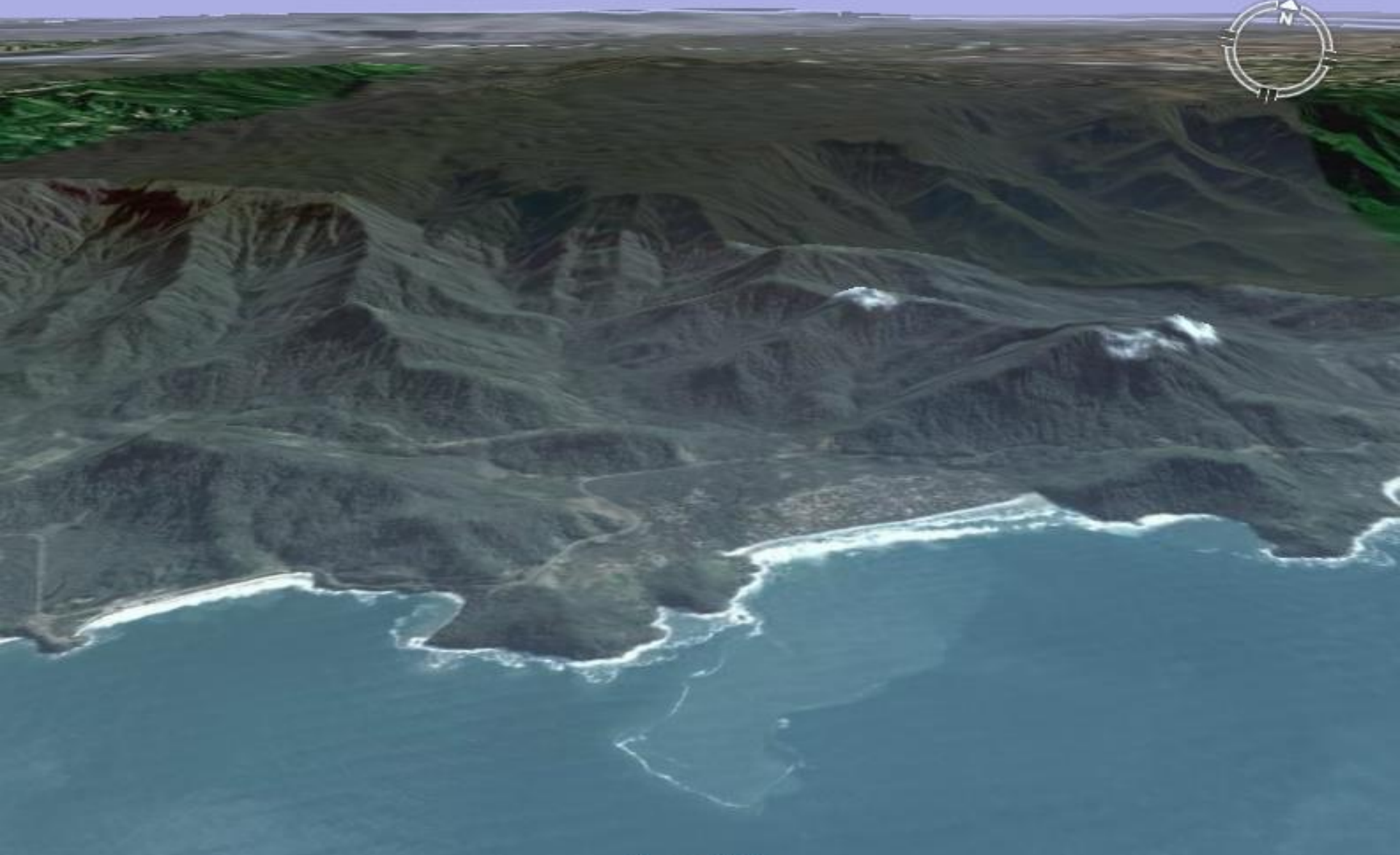
We may have at least two scenarios:

Restrict Rising in Sea Level

Ample Rising in Sea Level



Mountains restricting the rising in sea level



1164 m

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Pointer lat -23.395026° lon -45.015045° elev 27 m Streaming ||||| 100%

Eye alt 3.28 km

Mountains restricting the rising in sea level



Rising restricted by mountains.

In this case the amphibians could have sufficient time to migrate to higher places, but may be they do not will find adequate habitats to live and reproduce. Probably the lowland species will be extinct.

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Ample rising in sea level in plain sea shores



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512 m

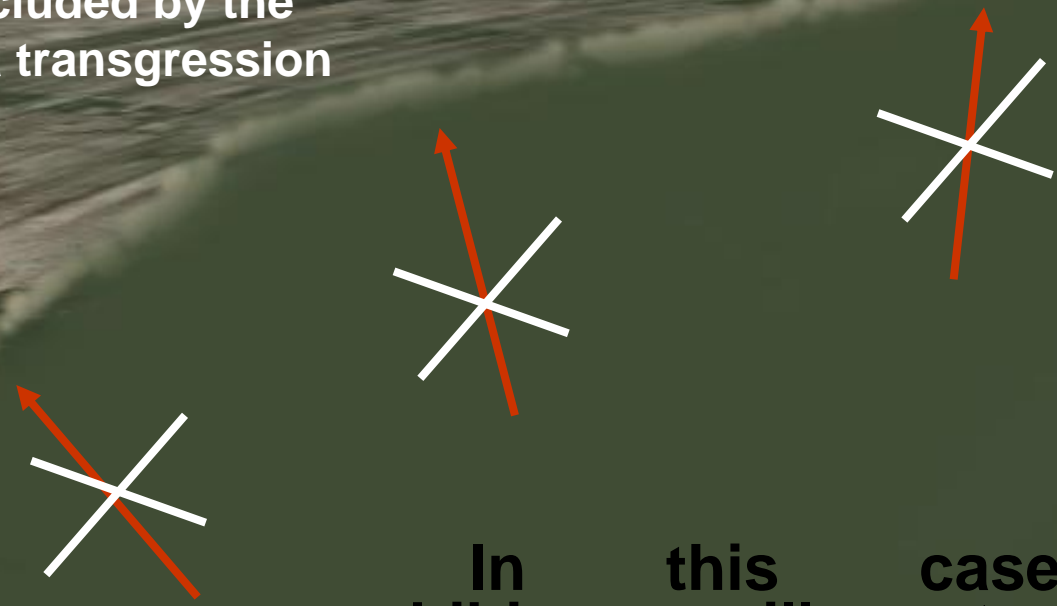
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Ample rising in sea level in plain sea shores



Rising not precluded by the relief. Ample sea transgression



In this case the amphibians will not have sufficient time to migrate to adequate places. The populations will be decimated by the high salinity. Probably the lowland species will be extinct.



Examples of endemic species of Atlantic forest anurans that probably will disappear if the Atlantic Ocean invade the lowlands: (A) *Xenohyla truncata*, (B) *Scinax alcatraz*, (C) *Aparasphenodon brunoi*, (D) *Arcovomer passarellii*.



***Scinax alcatraz* is an emblematic example of critically endangered species from the Atlantic forest. Today it is threatened by its small and restrict distribution to Alcatrazes island in São Paulo state, Brazil. The island is used as a target by the Brazilian Navy and frequently the bromeliads where *S. alcatraz* reproduced ignites after the bombardments (in one recent bombardment, 70% of all bromeliads used for reproduction of this species were destroyed). If it survive the navy, in the future may be the Atlantic Ocean will destroy all the places where this species lives.**



Genus *Brachycephalus*
Endemic to the Brazilian
Atlantic forest

Temp. today: 15 °C

Temp. in 2100*: 17 °C



~~Poor *Brachycephalus*,
they can't fly.~~

* ([CO2]≈710ppm; cenário CCM3;
Govindasamy et al. 2003)

Image NASA
Image © 2007 TerraMetrics

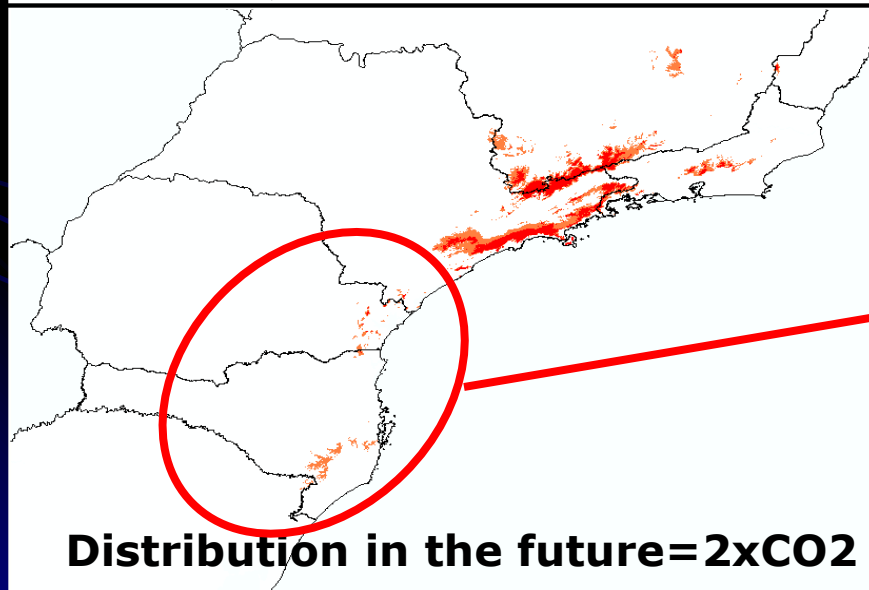
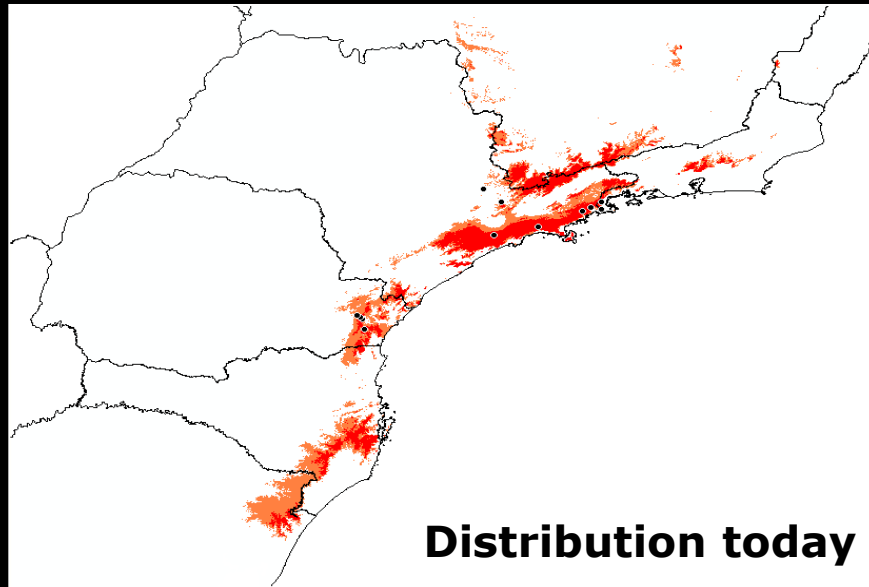
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1413 m

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Eye alt 4.06 km

Genus *Brachycephalus*



Possible habitat loss in the south of the distribution with population declines and species extinctions.



Brachycephalus ehippium (A), *B. vertebralis* (C) and *Brachycephalus pitanga* (D) probably will suffer population declines as a consequence of habitat reduction in southeastern Brazil; *B. ferruginus* (B) may become extinct by the large habitat reduction in south Brazil.

WE MUST PROTECT THE AMPHIBIANS, BUT HOW TO CONVINC THE PUBLIC OPINION AND THE POLITICIANS THAT THIS IS IMPORTANT?



Examples of endangered or extinct species of anurans from the Atlantic forest.

For us it is easy to understand the importance of the different species in nature. In the specific case of the amphibians we can say, for example, that they are very important in the trophic chains, being meal for several species. However, it is not sufficient to convince a layman. For a layman what is the importance of bats, snakes, etc. ? May be none.



We need to convince people about the importance of the amphibians from an utilitarian and mercantilist viewpoints (I do not like these viewpoints, but may be they work), in a way that people can understand what they will lose with the reduction of the amphibian biodiversity.

Amphibians are predators of insects that may spread infectious diseases. Declines and extinctions of amphibians may imply that this insects will proliferate and we will have an increase in the incidence of some diseases. However, these diseases affect poor people in undeveloped countries. Again, this is not completely convincing, from the capitalist viewpoint, that this group of animals must be preserved.



The control of pests of agriculture may be more convincing in several cases.

Still considering utilitarian and mercantilist viewpoints we can convince better a layman if we say that we may lose information about chemical compounds present in the skin of the amphibians and that these compounds may be useful for the development of medicines.



The use of amphibians as medicine is a tradition among some Indian groups in the Amazon Basin. The sapo-kambô (*Phyllomedusa bicolor*) is used in the “vaccination process”. The Indians say that the vaccination cures some diseases, like malaria. The first time I heard about vaccination I interpreted this as a popular believing, because the Indians described hallucinations and malaise as adverse reactions to the vaccination .

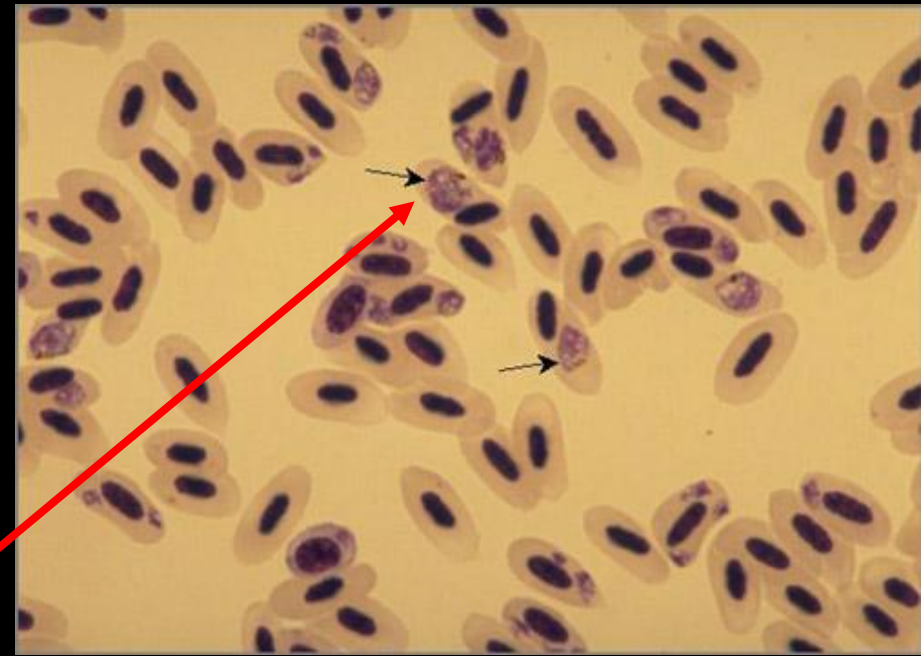
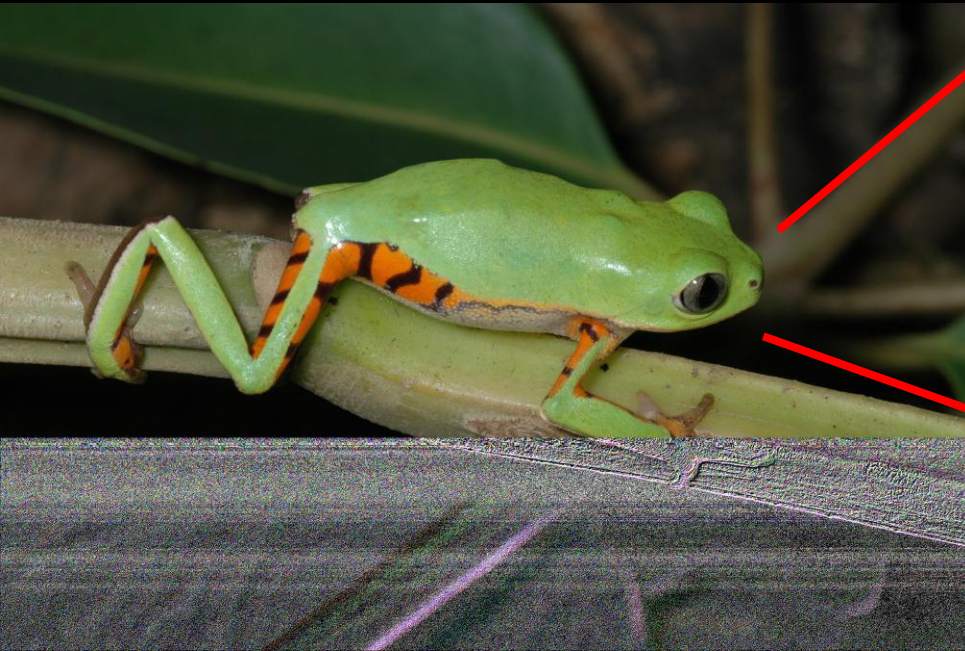


In fact, some of these compounds are strong hallucinogens (but I doubt that the layman will be convinced to preserve amphibians because they may be use like marijuana, LSD, etc.).



Treefrogs of the genus *Phyllomedusa* have compounds in the skin that cause hallucinations.

Besides the hallucinogens, there are other compounds in the skin of *Phyllomedusa* that kill protozoa like *Plasmodium* (that causes malaria) and *Trypanosoma* (that causes Chagas disease), and apparently are harmless to human cells.



Maybe I was wrong about the Indian vaccination. Probably they discovered a medicine that cures malaria.



We are still finding new species, like this *Phyllomedusa*, around huge cities, like São Paulo, in Brazil. Certainly this new species has chemical compounds in the skin that may be potentially useful for the development of drugs for disease treatment in humans. However, the conservation status of this new species is unknown and the species may be at risk.

What can we do to preserve the diversity of organisms and to mitigate the harmful effects of the human activities on the natural populations?

1) WE MUST STOP THE DEGRADATION OF THE ECOSYSTEMS!

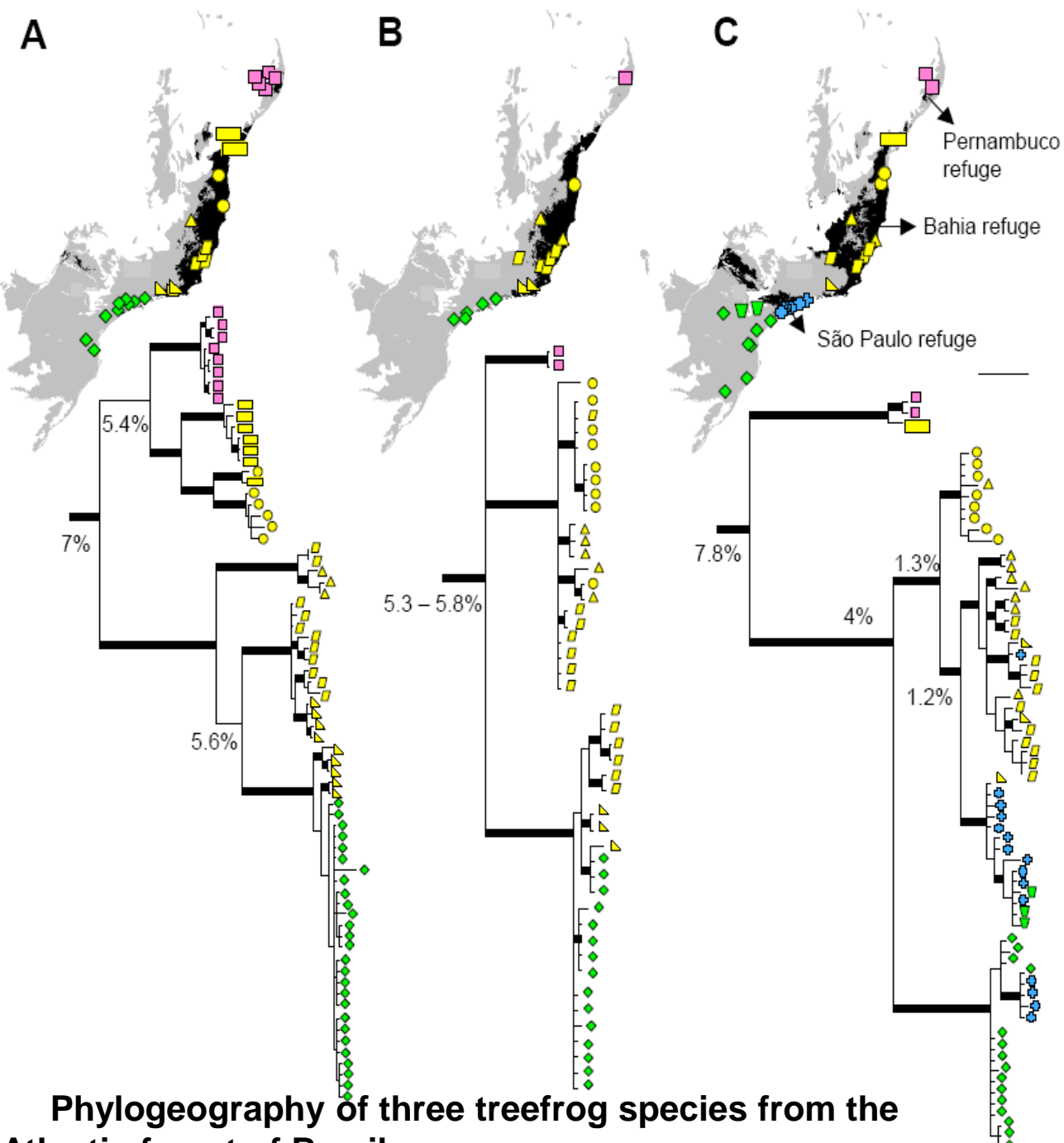
(THIS IS EASY TO SAY AND HARD TO DO IN A WORLD WITH 6.7 BILLION PEOPLE)

2) We must offer good education for the Brazilians.

3) We must regenerate the degraded environments and reconnect the habitats.

4) We must understand better where are the stable areas (refuges) over geologic time. These areas must be protect as a priority, because they work as centers of origin and dispersion of species.

A GOOD WORK OF GENETICS IS NECESSARY IN THE ITEMS 3 AND 4.



Using phylogeographic analyses based on DNA sequences and modeling, it is possible to determine with better precision the quaternary refuges, that represent the areas with climatic stability over the geological time. This areas must be a priority in conservation.

Phylogeography of three treefrog species from the Atlantic forest of Brazil.



Thank you!
Obrigado!