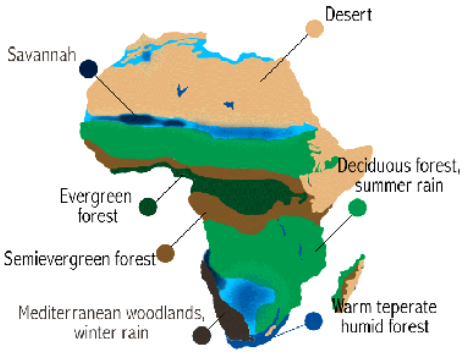
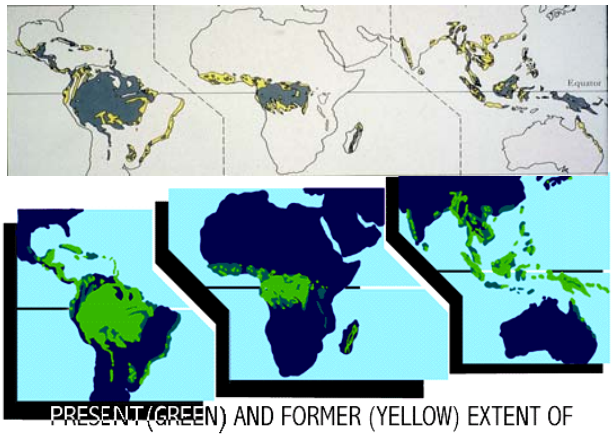
The Tropical Rain Forest

The tropical rain forest is the most productive and species-rich terrestrial ecosystem on earth

- **How can such productive forests grow on soils of extremely low fertility?**
- **Why is biological diversity so high in the tropics?**
- **What are the consequences of the expected, almost-total loss of humid tropical forests?**

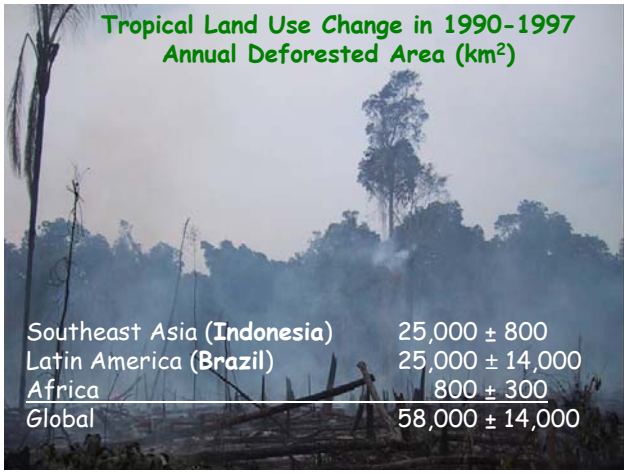
Several different types of forests exist in the tropics

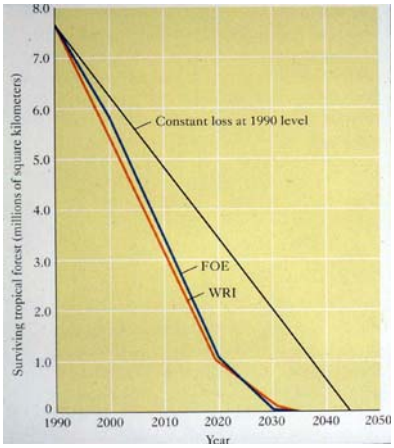




PRESENT (GREEN) AND FORMER (YELLOW) EXTENT OF HUMID TROPICAL FOREST

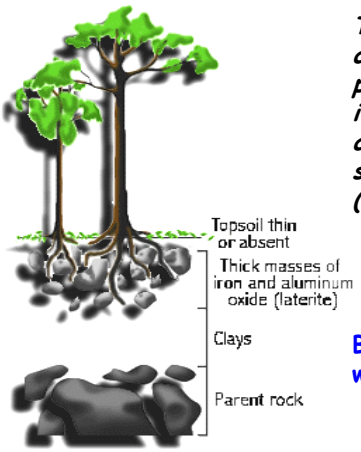
Timber production is a major cause of deforestation





Deforestation of Tropical Rainforests is proceeding rapidly!

(see them while you can…)



Tropical forests are highly productive, and so it is natural to assume that the soils are fertile (many nutrients).

But, that would be wrong…

Soil Fertility & Nutrient Cycling

1. Rapid weathering and time have led to depleted soil nutrients
2. Waters draining tropical landscapes are nutrient poor
3. Nutrients are found mainly in the plant biomass
4. Experiments show the effectiveness of roots at capturing nutrients
5. Comparisons of 7 tropical forests and their biomass and nutrient stocks

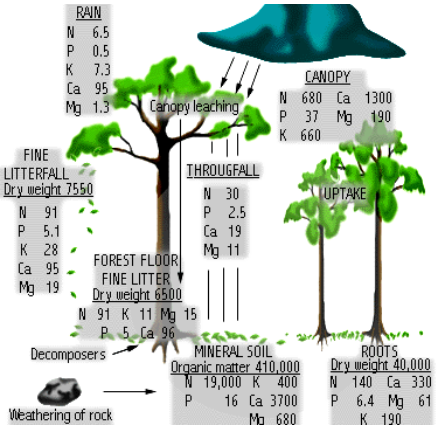
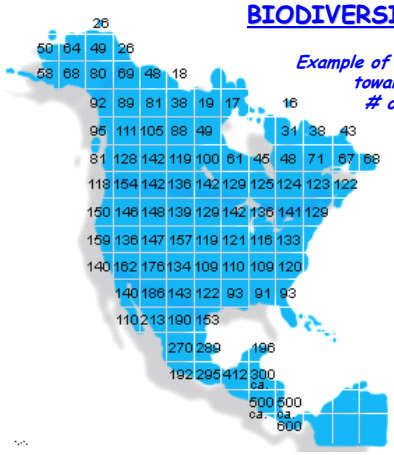


Table of Data on Tropical Rainforests (modified from J. Terborgh, 1992, Scientific American Library)

Parameter	Amazon caatinga, Venezuela	Oxisol forest, Venezuela	Lower Montane rainforest, Puerto Rico	Evergreen forest, Ivory Coast	Dipterocarp forest, Malaysia	Lowland rainforest, Costa Rica	Moist forest, Panama
Aboveground biomass (tons/ha)	268	264	228	513	475	382	326
Root Biomass (tons/ha)	132	56	72.3	49	20.5	14.4	11.2
Total Soil Nitrogen (kg/ha)	785	1697	-	6500	6752	20,000	-
Total Soil Phosphorus (kg/ha)	36	243	-	600	44	7000	23
Turnover time of leaves (years)	2.2	1.7	2.0	-	1.3	-	0.9

BIODIVERSITY

Example of increasing biodiversity toward the tropics - # of bird species



BIODIVERSITY

Tropical forests contain ~50% of the 5-30 million species on earth.

Why are tropical forests so diverse?

(1) Ecological specialization

Multi-layered forests

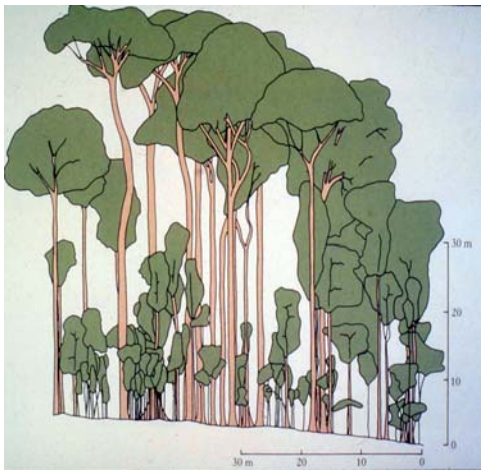
(2) Evolutionary history

Geographic isolation

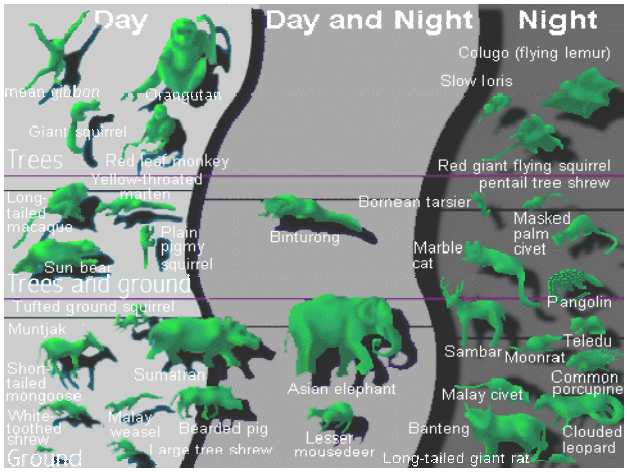
Episodes of climate change

(3) Other factors

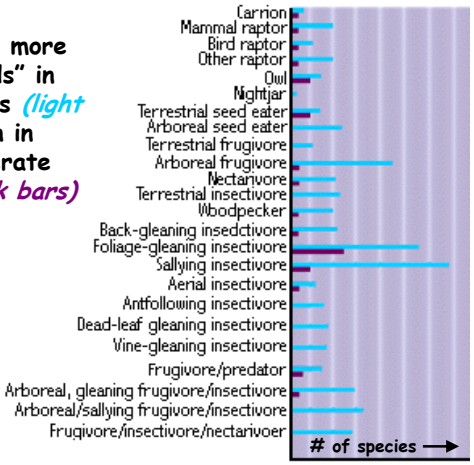
High year-round productivity

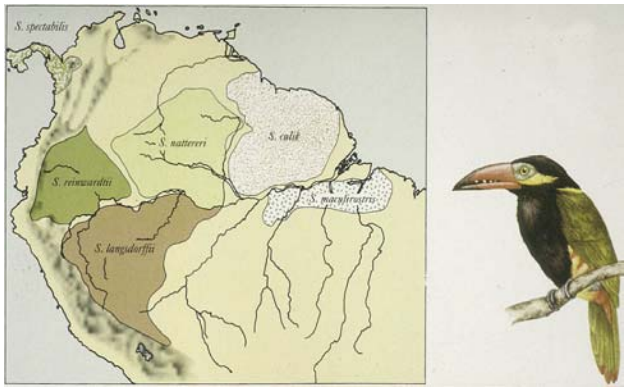


Up to 5 Layers of vegetation exist in the tropical forest, compared to only 2-3 layers in a temperate-zone forest.



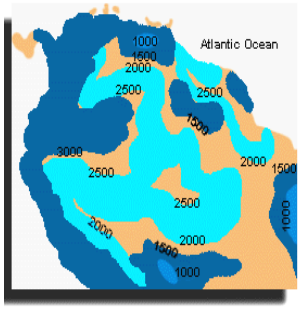
There are more bird "guilds" in the tropics *(light bars)* than in the temperate zone *(dark bars)*





Species have specific "ranges", and geographic isolation can lead to the evolution of new species.

Repeated climate change in the tropics may have led to frequent geographic isolation, and thus more species.



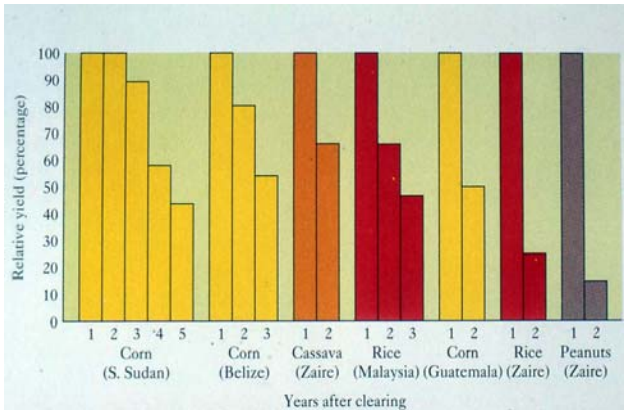
Annual precipitation, mm

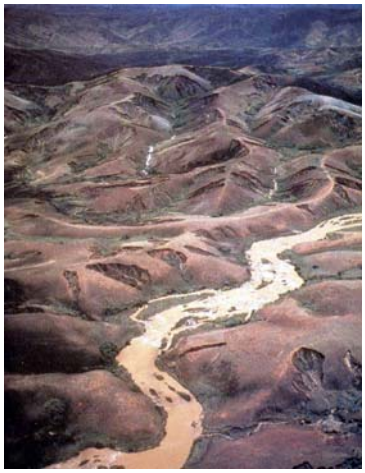
Area receiving <1500 mm

Species loss is studied in deliberately created forest fragments, here shown in Brazil

Deforestation is due both to slash and burn for agriculture and to cutting for timber and firewood

Crop yield drops quickly after slash and burn agricultural





Deforestation causes massive erosion and disrupts the water cycle, which may alter the regional climate

Summary

- High productivity, but low nutrients in soils
- Most nutrients in biomass, Efficient nutrient cycling
- 50% of world's species - why?
- Specialization in a complex, stable environment
- Evolutionary history - climate change and forest fragmentation
- Human impacts - loss of area (20% originally to 7% now, to <1% *when?* -- soon…)
- Interplay of people, ecosystem function (agriculture, logging, mining), and politics influence the rainforest