

## Tropical Storms and Hurricanes

### Tropical Storms and Hurricanes:

- Bring heavy rains and wind speeds of between 39 and 73 mph; they reach hurricane status if wind speeds exceed 74 mph.
- Increase the mortality rate of trees to 40% in highly impacted areas, versus the 2% to 5% of rainforest trees that die of natural causes in normal years.
- Destroy habitats, especially microhabitats, causing species to die or move away.
- Sometimes bring permanent loss of habitat and species, depending on the severity of the storm and the extent of damage.
- Hurricanes increase the number of severely damaged trees, but the resulting breaks in the canopy allow light to reach the forest floor and can increase the growth of remaining plants.

### Case Study: El Yunque National Forest, Puerto Rico

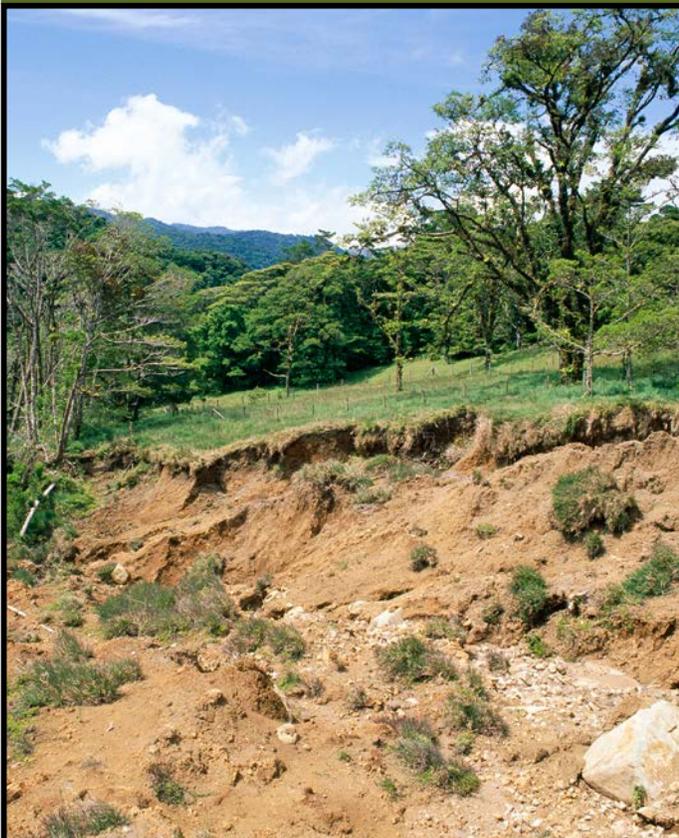
- Is a 28,000-acre tropical rainforest in the Sierra de Luquillo Mountains in eastern Puerto Rico.
- Was designated a Biosphere Reserve in 1976.
- Is home to endangered and endemic species: over 225 species of plants (23 are endemic); over 70 species of birds; diverse reptiles, amphibians, and invertebrates. Historically there were 22 mammal species here, but now the only mammals are bats (of 11 varieties).
- In 1989, Hurricane Hugo crossed eastern Puerto Rico and caused severe damage to the El Yunque rainforest; meteorologists estimate that storms of Hurricane Hugo's magnitude pass over this part of the El Yunque rainforest an average of once every 50 to 60 years.



### Recovery

- The length of recovery depends on the severity of the storm. Scientists believe that full recovery from Hurricane Hugo damage could take at least 250 years.

# El Yunque National Forest



## Drought

### Case Study: Lowland Tropical Rainforests of Borneo

- Borneo is third-largest island in the world; was once covered with dense rainforests.
- The island is part of three countries: Malaysia, Indonesia, and Brunei.
- The Malaysian part of Borneo includes the states of Sabah and Sarawak.
- The Indonesian part of Borneo includes the states of West Kalimantan, Central Kalimantan, South Kalimantan, and East Kalimantan.
- Brunei is an independent nation that includes the rest of the island.
- Borneo is home to 15,000 plant species (240 different species of trees can grow in one hectare there); 222 mammal species (including orangutans); over 350 species of birds; and many reptiles, amphibians, and freshwater fish.
- Many species there have overlapping ranges.

### Drought:

- Occurs over long periods (months or years) when a region receives less water than normal.
- Results from a reduction in either rainfall or water vapor (rainfall is related to water vapor in the atmosphere).
- Weakens natural systems, making them more susceptible to fire.
- Weakens the forest canopy and affects leaf litter decomposition, which is essential to nutrient cycling and plant growth.
- Changes microclimates and affects microhabitats.
- Brings a decrease in the number and diversity of plant and animal species.



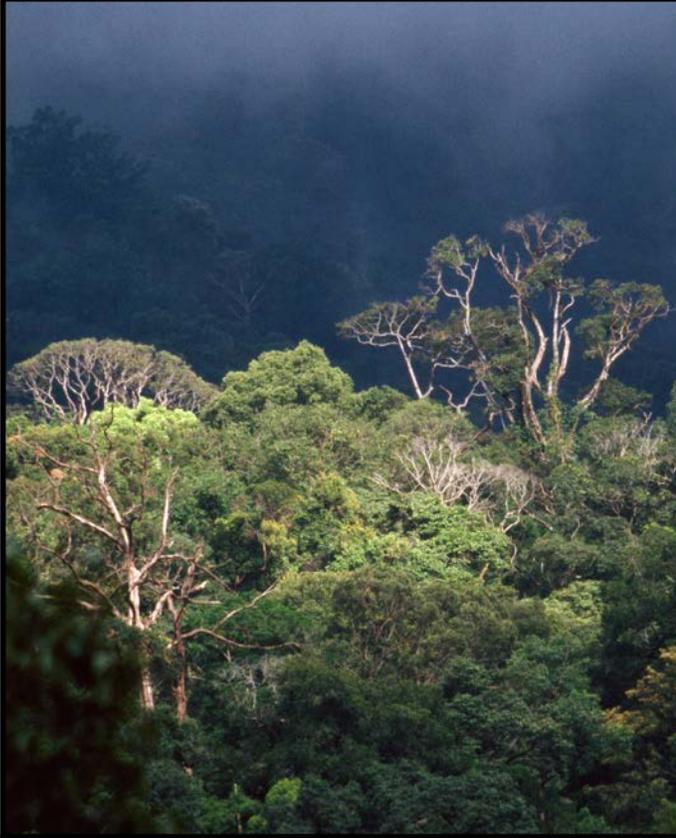
### Drought, Fire, and El Niño

- El Niño, a major warming of equatorial waters in the Pacific Ocean, occurs every three to five years. In some regions it causes wetter conditions and in others, drought conditions.
- During El Niño years, rainforests are more susceptible to large fires, which can have negative, long-term effects on forest composition, structure, regeneration, and recovery.
- Fires can occur naturally and serve an important function in maintaining the health of certain ecosystems.
- Fires in rainforests are relatively rare where human activity is very limited.
- In forests affected by fire, ground vegetation can burn and clear the forest floor, which can promote growth of new plants.
- Between 1997 and 1998, millions of hectares of rainforest were destroyed around the world during an intense El Niño-related drought; the drought affected rainforests in Brazil, cloud forests in Chiapas, Mexico, and lowland rainforests in Borneo.

### Recovery

- The length of time required for recovery from drought depends on the intensity of the drought, its duration, and the quantity of precipitation the area receives as the drought ends.

# Lowland Tropical Rainforest of Borneo



## Logging

### Different Types of Logging

#### Logging by Clear-Cutting

- Results in the removal of all species of trees from a given area.
- Is often the chosen approach because in rainforests, no one species dominates the ecosystem, and valuable timber trees are widely spaced.
- Is a practice that requires road construction and often results in the settlement of an area by humans, in turn encouraging other human practices and activities.
- Results in the elimination of wildlife species due to loss of habitat.

#### Selective Logging

- Involves the felling of specific trees of significant value.
- During this process, only selected trees are cut, but the method also brings down other trees, vines, and epiphytes.
- Opens the canopy, which can take hundreds of years to recover.
- Affects decomposition of leaf litter and nutrient cycling.
- Requires road construction, a destructive activity, for transportation of timber.
- Disturbs soil and causes erosion.
- Results in the runoff of forest soils into rivers and streams and causes siltation.
- Leaves behind remnants of trees and underbrush (called “slash”), which are dry and susceptible to burning.
- Has indirect effects, such as stress to and loss of habitats, territory, shelter, and food for wildlife.



#### Byproducts from Deforestation of Rainforest Lands

- Soil erosion and chemicals in soil, water, and air.
- Loss of habitat.
- Loss of species.

#### Recovery

- A logged ecosystem never returns to its original condition; a recovered forest is not diverse.
- Little, if any, industrial logging is sustainable over time, whether clear-cutting or selective logging practices are used.
- Recovered forest could be used to grow sustainable forestry products and for low-intensity logging and agriculture.
- Restoration of some native species is possible; this process is most successful where remnants of original forest remain and there are few human pressures.

# Logging



## Farming

### Case Study: Lowland Tropical Rainforests of Borneo

- Oil palms produce more oil per hectare than any other oilseed.
- Over 7 million hectares of Borneo rainforest are projected to be converted to oil palm plantations by 2011.

### Farming

- Brings the clearing of both undisturbed and logged rainforest for crops and grazing.
- Often follows logging, which requires that roads to an area be built for transportation of timber (the roads open the new areas to agriculture).
- Consists of either commercial agriculture, subsistence farming, or shift cultivation.

### Different Types of Farming

#### Commercial Agriculture

- Often occurs after large areas are clear-cut and then burnt to clear brush and release nutrients into the soil.
- Often uses chemicals for fertilization and pest control. The chemicals directly affect soil, water, and air quality.
- Indirectly causes stress and loss of habitats and food for wildlife.

#### Subsistence Farming

- Involves the cultivation of a small piece of land by a farmer to regularly produce enough crops for his or her family's survival.
- Involves the growth of a diversity of crops, a practice that does not deplete soil as readily as the growth of a single crop.
- Sometimes involves the use of the "slash-and-burn" technique to clear small areas.



### Shift Cultivation

- Involves setting up small-scale farming operations in disturbed areas following roads made for logging and mining. After the lands become infertile, the farmers move on to new areas.
- People do not move into undisturbed rainforest; rather, they follow other developments like roads and mines.
- Results in nutrient-poor soils.
- Farmers may use chemical fertilizers to improve crop yield.

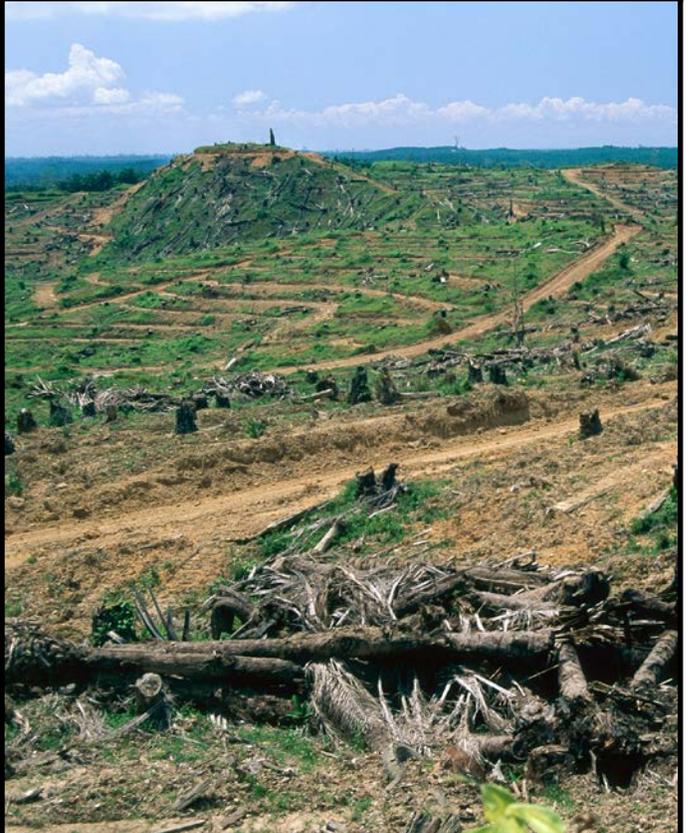
### Byproducts from Agricultural Uses of Rainforest Lands

- Soil erosion.
- Introduction of chemicals into soil, water, and air.
- Loss of habitat.
- Loss of species.

### Recovery

- Habitat destruction permanently reduces local geographic extent of rainforest species.
- The ecosystem never recovers to its original condition.
- Sustainable commercial agriculture depends on management techniques, allowing soils to remain fallow for periods of time, and reducing the use of chemicals.

# Farming



## Mining

### Different Types of Mining

#### Open Pit Mining

- In the 1970s, mining companies began moving into rainforests and developing large-scale mining operations for gold, diamonds, copper, and other minerals.
- Large open pit gold mines destroy large surface areas and remove minerals from the ground.
- Miners use toxic chemicals, such as cyanide, to separate gold from ore.
- Tailings ponds created for iron ore waste contain cyanide that leaches into groundwater.
- Extraction processes require the clearing of forest for mines, access roads, and other mining operations.
- Requires heavy water consumption.
- Causes animal species to die or move away during mining, and plant life is destroyed.
- Pollutes air, land, and water.

#### Small-Scale Mining

- Almost all small-scale gold mining uses large, heavy equipment.
- Miners are not formally trained in mining techniques and have little oversight from the government.
- Small-scale gold mining uses mercury to separate gold from ore; mercury contaminates air, soil, and water and accumulates in fish.



### Byproducts from Mining in the Rainforest

- Soil erosion.
- Chemicals that enter soil, water, and air.
- Loss of habitat.
- Loss of species.

### Recovery

- Abandoned, small-scale gold mining sites can take several decades to recover due to disturbed soil and hydrology. Although these sites can recover somewhat, they never return to their original condition.

# Mining

