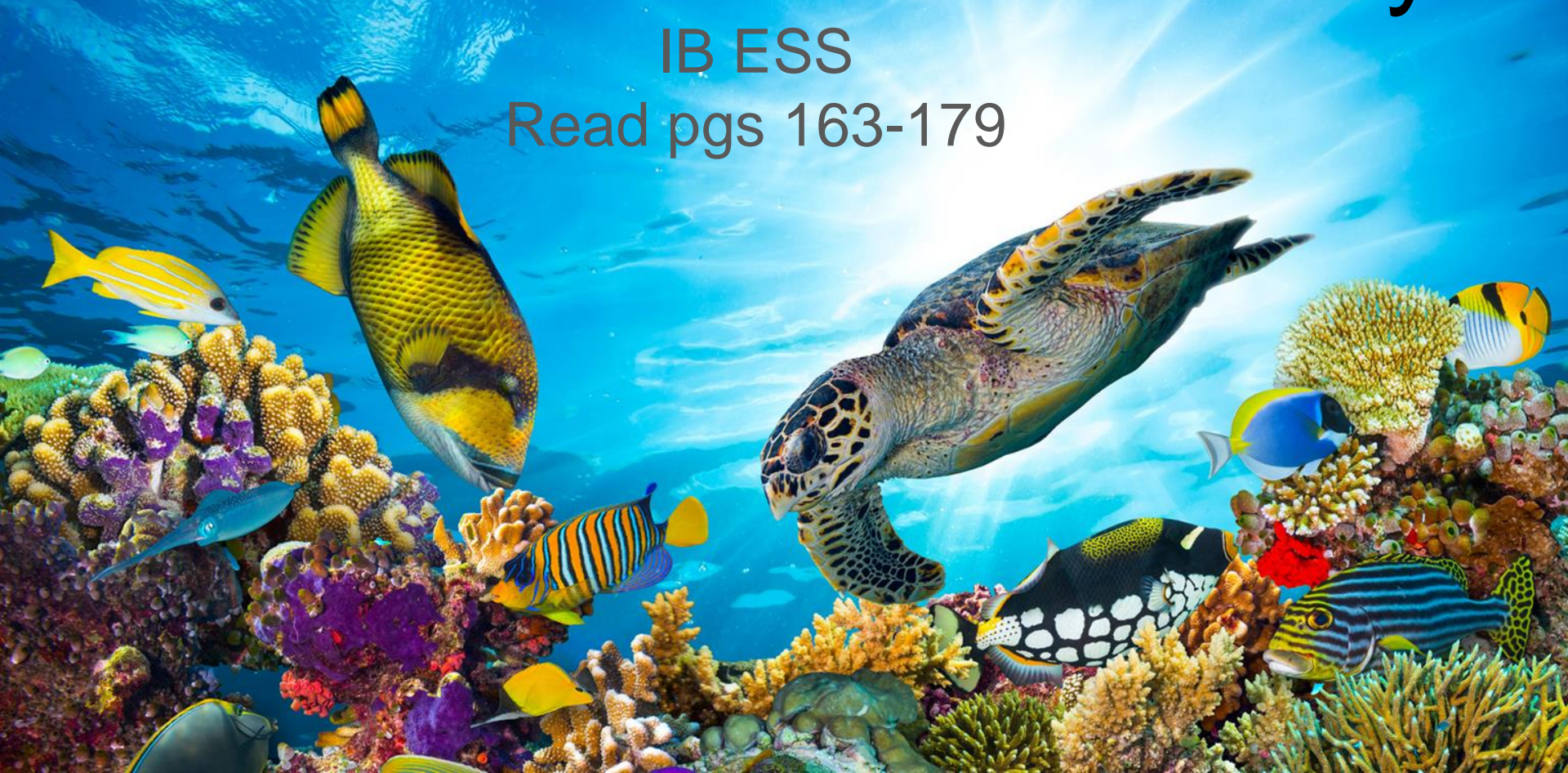


# 3.3 Threats to biodiversity

IB ESS

Read pgs 163-179



# Learning Objectives:

- Understand that estimates of numbers of species on Earth vary considerably
- Describe how the current rate of species loss is greater than in the past, mainly due to human influence
- Explain how the conservation status of a species is categorized by the IUCN
- Discuss the conflict between exploitation, development & conservation of species in rainforest biomes in less economically developed countries (LEDCs)

# KEY QUESTIONS:

1. How is global biodiversity declining in response to human activity?
2. How is knowing the conservation status of a species useful in the conservation of biodiversity?

# Species estimates & rates of extinction

- No accurate figure for # of species alive on Earth
- Organisms found are described & logged in institutions like the Natural History Museum in London
- Over 1.5 million species logged, but estimated to be more than 10 million!
  - Most #s based on mathematical models
  - Depend on amount of data available
  - Many habitats & groups of species under-recorded because difficult to reach them
  - Insufficient funding for expeditions & research
  - Disagreement about classification of certain groups

# Extinction

- Point when a species ceases to exist or the last known individual of the species dies
  - Mass extinction - times when Earth loses more than  $\frac{3}{4}$  of its species
    - Happened 5 times in last 540 million years
    - Caused by major natural abiotic events
  - Background extinction rate - natural extinction rate of all species
    - About 1 species per million per year (up to 100 species per year)
    - Of 5000 mammal species alive today, should lose 1 mammal per 200 years
      - Actual: 90 mammals extinct in last 400 years & 170 listed as critically endangered
      - Suggests current extinction rate far higher than should be
      - Ample evidence humans are causing this
      - Estimated current extinction rate between 100 to 10,000 times greater than background extinction rate

# Species loss & human activities

- Key factors responsible for current mass extinction are:
  - Loss of habitat to agriculture, cities, roads & industry
  - Overexploitation of resources such as timber & fish, and also reduction of them due to hunting & agriculture
  - Pollution of waterways, ocean & soil so they become uninhabitable
  - Introduction of alien species as humans move from 1 continent to another

# Factors that influence risk of extinction

## 1. #s of a species

- Small populations have less chance of survival if conditions change
  - Have small gene pool & unable to adapt (cheetah)
  - May be isolated in small areas or islands (tortoises on Galapagos Islands)
- Common species with wide distribution less likely to be endangered

## 2. Degree of specialization

- Some organisms dependent entirely on 1 resource for survival
  - Orchids relying on a single insect to pollinate them
  - Giant pandas dependent exclusively on bamboo for food
  - If insect or plant becomes scarce, dependent organism at risk

# Factors that influence risk of extinction

## 3. Reproductive potential

- Species that reproduce slowly are at risk
  - Elephants live a long time with lower reproductive rate...more vulnerable
  - If species hunted or overfished, those that reproduce slowly are unable to restore pop to sustainable #s

## 4. Behavior

- Species not afraid of humans with poor defenses (evolved in areas without humans)
  - Flightless birds (dodo & elephant bird)
  - Vulnerable & easily killed
- Individuals in some species have such close bonds with one another that they remain with dying members of their group...put themselves in danger
  - Elephants & whales
  - Normally exist in herds or flocks, but vulnerable when isolated in small groups



# Factors that influence risk of extinction

## 5. Trophic level

- Top predators more sensitive & at risk
- #s of species at the end/top of food chain lower
- Reductions in prey species lower down food chain have serious risk
- Large predators (tigers) at risk from hunting

## 6. Distribution

- Species with limited range more at risk
  - Spoon-billed sandpiper limited to small area in Russia...fewer than 200 birds left

# Factors that influence risk of extinction

## 7. Valued resources

- Species with body parts valued by humans are vulnerable to hunting & overexploitation
  - Ivory from elephants
  - Bush meat from large primates
  - Oil from sperm whales
  - Desirable feathers from birds like the emu

# Vulnerability of tropical biomes

- Tropical rainforest
  - Biomes located only between Tropics of Capricorn & Cancer (23.5°N- 23.5°S)
  - Among most important biomes on planet
  - Receive constant sunlight with little seasonal variation...fairly constant temps
  - High rainfall
  - Majority of rainforest in Amazon Basin ( $\frac{1}{3}$  of all rainforests)
  - $\frac{1}{5}$  found in Indonesia
  - Remainder found in central Africa (Democratic Republic of the Congo), large areas of Gabon, Cameroon, Equatorial Guinea, Central African Republic & Republic of Congo

# Vulnerability of tropical biomes

- Rainforest as an ecosystem
  - Multi-layered ecosystems with wide variety of habitats
    - Emergent layers
    - Canopy layer
    - Understorey
    - Forest floor
  - Many niches
  - Estimated 50% all species on Earth today live in rainforests
  - As many as 300 species per hectare
  - High species diversity & high habitat diversity
  - Many species endemic (found nowhere else on Earth)
  - High rate of photosynthesis (release almost 40% of Earth's oxygen)
  - Contain huge reserves of carbon (timber)
  - Vital role in regulating world weather patterns (maintain regular rainfall)
  - buffer from floods, droughts & erosion

# Vulnerability of tropical biomes

- Loss of rainforest
  - Middle of 20th century = 15% of Earth covered in forest...NOW less than 6%
    - Fragmented into small areas, separate from each other
    - Worse predictions indicate all loss within 50 years due to human activities & interference
  - Mainly caused by agriculture & logging
    - Carried out on a commercial scale to supply world's need for timber, cattle, palm oil & soya
  - Subsistence farmers & small groups present another serious threat
    - Cleared for crops or animals
    - Poor soil quality exhausts nutrients after 2-3 years
    - Farmers move on to another area & repeat process
  - Most nutrients held in plant biomass (not soil or leaf litter)
    - Abandoned areas of previously cultivated land do not recover quickly
    - Take up to 100 years to return to original diversity

# Vulnerability of tropical biomes

- Difficulties in controlling forest loss
  - Requires international legislation
  - Willingness to participate in conservation initiatives varies from country to country
  - Very dependent on economic, social & political issues
  - Most tropical biomes located in LEDCs
    - Conflict between exploitation of resources for economic development, sustainable development & conservation
    - EX. Madagascar...trying to provide for its people & conserve its wild habitats

# Threatened species

- **The Red List**

- Published by the IUCN since 1963
- Draws together info from many international organizations about threatened species
- World's most accurate record of the conservation status of vulnerable species
- Conservation issues can be quickly communicated to the public & policy-makers
- Places species in 1 of 7 categories
  - Based on conservation status
  - Factors used to assign have quantitative thresholds for pop size, pop trend, geographic range & range size, #s of mature organisms, quality & size of habitat & likelihood of extinction
  - Designed to be objective, quantitative, repeatable & able to handle uncertainty

# 7 categories of the Red List:

- Least concern (LC) - species not qualifying for other categories, including widespread & abundant
- Near threatened (NT) - close to qualifying for vulnerable status
- Vulnerable (V) - facing a high risk of extinction in the wild
- Endangered (EN) - facing a very high risk of extinction in the wild
- Critically endangered (CR) - facing an extremely high risk of extinction in the wild
- Extinct in the wild (EW)
- Extinct (E)

Info on reasons for threats & extinctions also included in the Red List



# Madagascar - a biodiversity hotspot

- Unique & irreplaceable biodiversity (80% of its species found nowhere else on Earth)
  - Endemic lemurs, 6 of 8 species of baobab tree, *Uroplatus* geckos
- Suffered environmental degradation over large land areas
  - Many species lost or endangered
  - Forests cut down, fragmented & converted to scrub land
  - Spiny forests in south replaced by cactus scrub
    - Indigenous vegetation taken & burnt for charcoal production
  - Soil being eroded from central highlands & washed away
- Estimated as much as  $\frac{1}{3}$  of country is burnt & 1% of remaining forests felled each year
- Area of natural forest less now than any time since Madagascar was first inhabited by humans 2000 years ago

# Madagascar - a biodiversity hotspot

- Among the world's poorest countries
  - People depend on land & its resources for survival
- Pop increased from 5 million in 1960 to 20 million in 2010
- 85% of locals live on poverty line
- Pop increase & poverty significant factors contributing to loss of island's biodiversity
- Factors causing damage to the environment
  - Deforestation & destruction of habitat
  - Agricultural farms
  - Erosion & soil degradation
  - Hunting & collection of wild species
  - Introduction of alien species
  - Mining for natural resources

# Madagascar - a biodiversity hotspot

- Deforestation

- Convert rainforest into rice fields (practice known as 'tavy')
  - Small areas of forest cut, burnt & planted with rice for subsistence farming
  - After few years, field left fallow...process repeated
  - 2-3 cycles exhausts soil nutrients
  - Land left to be colonized by scrub vegetation & alien grasses
  - Fires that are started for land clearance often spread to other areas, increasing amount of damage
- Logging
  - Particular problem in eastern Madagascar, where valuable hardwood ebony and rosewood trees grow
  - Some areas protected, but illegal logging a significant problem
- Following deforestation leads to erosion
  - Astronauts commented when viewed from space, Madagascar's rivers look as though it is bleeding (red soil runs into them and out the Indian ocean)
  - Up to 400 tons per hectare per year of top soil lost

# Madagascar - a biodiversity hotspot

- Exploitation of living resources
  - Indigenous animals of Madagascar hunted & trapped for collectors & pets
  - Since 1964 it is illegal to kill or keep lemurs...but still hunted in some areas
  - Many reptiles & amphibians in demand as pets in other countries
    - Geckos, snakes, tortoises & chameleons
    - Tenrecs (small insectivores) & other carnivores killed for food
  - Seas surrounding Madagascar rich in fish
    - Local laws not powerful enough to keep away foreign fishing boats taking large catches from the area
      - Sharks, lobster & sea cucumber harvested in unsustainable #s
    - More recent - permits issued for oil exploration in Madagascar waters...may add further damage to species in ocean

# Madagascar - a biodiversity hotspot

- Threat from alien species
  - Alien species - those not native to an area, introduced by people
  - Tilapia
    - aggressive fish introduced for food
    - Survives well & displaces native cichlid species in rivers & lakes
  - Snakehead murrel
    - Carnivorous fish introduced into eastern Madagascar
    - Displaced high vulnerable Alaotra grebe
    - Grebe was already endangered by habitat loss & increase in fishing
    - Now officially extinct

# Madagascar - a biodiversity hotspot

- Consequences & conservation
  - 24 critically endangered & endangered species
  - 26 listed as vulnerable
  - Many new potential medicines may disappear
  - Government began program to extend environmental protection
    - 2007 increased # of national parks to 60
    - Introduced new park management system to conserve wildlife using sustainable development programs that can provide direct benefit to local people
  - International conservation organizations help
    - The World Bank & WWF purchased \$5million of country's foreign debt in exchange for government support for local conservation projects
    - Ecotourism, agriculture, expansion of international trade, & investment in education & health are key elements of a policy to develop Madagascar's economy
    - But country faced with political challenge ...balancing growth & development with conservation...