Extinction of Island Biotas: The Brown Tree Snake

BI 201 Natural History of Guam

Class Presentation 38

Extinction

- Extinction is the complete disappearance of a species from Earth
- Extinction is a natural process
  - For example, about 230 Mybp, there were 20,000 species of vertebrates on Earth
  - Today, only 24 of those 20,000 species have living descendants ... however, ca. 50,000 new species have descended from those 24 species

- What causes extinction?
  - General causes of extinction
    - Inability to adapt to rapid changes in the environment
    - Loss of habitat with climatic change
    - Inability to adapt to new diseases or predators invading the area
    - Competition from invading species
    - Commercial exploitation

- Which species are likely candidates for extinction?

1) Island species
   - Islands cover about 7% of Earth's surface, but they contain more than 50% of all endangered species
2) Species with limited habitats
   - This applies especially if a species requires one specific food type or one nesting habitat

3) Species that require large territories to survive
   - Large predators and large herbivores typically have home ranges that extend over 10s of square miles
4) Species that have low reproductive rates
5) Predatory species that prey upon humans or livestock of humans
6) Species that are susceptible to pollution

7) Species that are economically valuable or are hunted for sport
   - Economic value includes hides, tusks, feathers, pets, and medical research
8) Species that are incompatible with human civilization

- Many endangered species fall into more than one of these categories

- What is an endangered species?
  - Endangered species are those species of organisms that are in immediate danger of extinction
  - The U.S. Endangered Species Act also recognizes species that are declining but not yet in immediate danger of extinction—threatened species
    - Threatened species are species that are still abundant in some parts of their ranges, but their numbers have declined significantly in other areas

- The Guam Endangered Species Act (5 GCA, Section 63205.(c)) lists 30 species that are protected by Guam law
  - 11 bird species
  - 3 mammal species
  - 8 reptile species
  - 4 snail species
  - 3 plant species

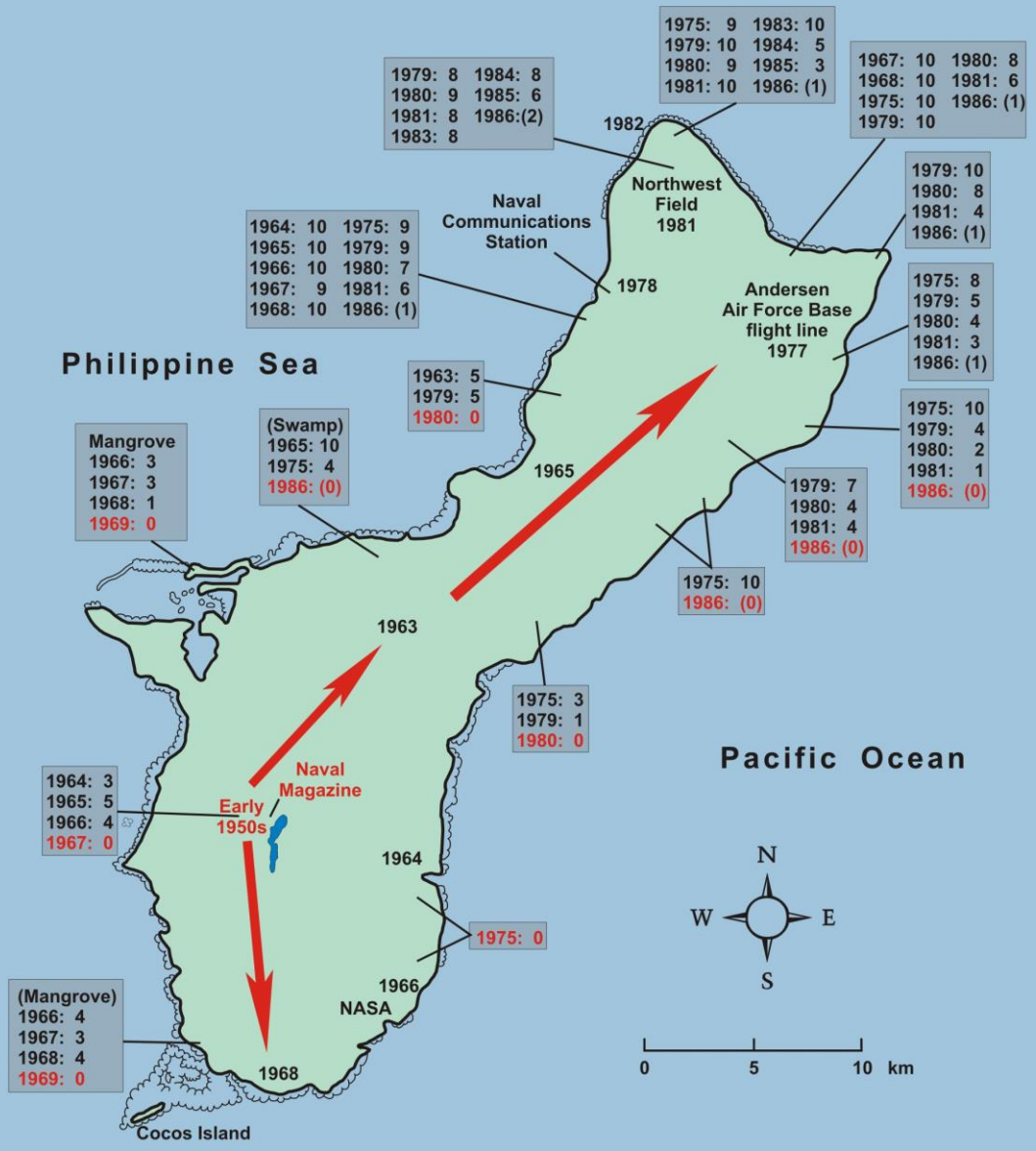
Faunal Extinction

- Guam is unique in that the island is the only place in the world where an entire fauna, the birds, has been driven to extinction by an invasive predator, the brown tree snake

- Case Study—The Brown Tree Snake in Guam
  - The brown tree snake *Boiga irregularis* was accidentally introduced in Guam after World War II
  - The native biogeographic range of the snake is from Indonesia to the Solomon Islands and south to the northern and eastern rim of Australia

- Natural history of the brown tree snake
  - *Boiga* is arboreal and nocturnal in habit
  - This is a slender snake with grooved, venom-conducting teeth at rear of maxilla
  - *Boiga* can attain large sizes, facilitating predation on a broad range of vertebrate prey
  - The sexes differ only in maximum length
    - ♀ = 2.3 m [ca. 7½ ft]
    - ♂ = 3.0 m [ca. 10 ft]

- The brown tree snake became established at Santa Rita [Naval Magazine] in the early 1950s
  - From there, the snakes spread south and north from Santa Rita
  - Snakes reached Merizo by 1968
  - Snakes reached Yigo by 1975



Map of Guam showing the dispersal of *Boiga irregularis* and the loss of forest bird species. *Boiga* colonized the southernpart of the island after World War II, and progressively spread from there, as indicated by the arrows. Each box lists the number (out of a possible 10) of forest bird species found at that location in the year indicated. For 1986, the surveys were incomplete, and those numbers are in parentheses. [Modified from Savidge, 1987]

- The brown tree snake was successful as a result of its highly adaptive behavior
  - Invasive species often exploit new resources, because they are freed from natural enemies, competitors and parasites
    - This change in niche is called **ecological release**
  - *Boiga* is not restricted to any specific habitat, forest strata, or seasons in Guam, although extreme dryness, bright sunlight, high daytime temperatures, or freezing influence the snake's activity in captivity
  - The home range of *Boiga* is extremely large in Guam
    - Adult snakes have a home range of more than 12 ha in Guam
  - *Boiga* will prey upon both active (i.e., live) and inactive (e.g., eggs) prey in Guam
    - Their diet includes almost all vertebrates (e.g., birds, geckos, skinks, etc.) and carrion of suitable size
    - Meals of up to 70% of snake's body mass have been eaten in the wild

- Reproduction of the brown tree snake is only sketchily known
  - Reproduction is highly seasonal in the snake's native range, but appears to be year-round on Guam
  - The clutch size ranges from 4 to 12 eggs
  - Eggs are probably deposited underground, or occasionally in cavities in trees
    - Incubation time is ca. 90 days
  - Hatchlings range from 275 to 400 mm in snout-vent length (SVL) at birth
  - Snakes mature at 900 to 1050 mm SVL, which is significantly larger than the 625 to 850 mm SVL of snakes in the native range; why?

- The spread of the snake coincided with the decline in bird populations in Guam
  - Initially, the snake was not considered a problem, because it was erroneously identified as the Philippine rat snake
  - The loss of birds was attributed to many possible causes, including disease, pesticides, tropical storms, introduced competitors
  - By 1986, the brown tree snake had extirpated 10 species of native birds on Guam
    - Two of these species and one subspecies were endemic to Guam

- Currently, there are only three species of Guam's native birds (Mariana crow, moorhen, island swiftlet) surviving in the wild, plus two species (Guam rail, Micronesian kingfisher) in captive breeding programs

- Costs of this invasive species exceed the loss of bird species on the island
  - Birds were the natural pollenators of most of the endemic tree species, so some tree species are also in decline
  - Electrical power outages have cost the economy millions of dollars
  - Attacks on human infants have been frequent, with children under five years of age accounting for 52% of all snake bites

- The potential for environmental and economic harm from this invasive snake extend beyond the island
  - Guam's importance as a trans-Pacific shipping hub, coupled with the tendency of snakes to seek refuge in cargo, make snake dispersal from Guam a serious threat to other island ecosystems
  - Consequently, the federal government spends millions of dollars annually to isolate the brown tree snake invasion to Guam and to find methods of controlling snake populations on the island