Indigenous, Endemic, and Invasive Species

BI 201 Natural History of Guam

Class Presentation 37

Species Invasions

- What is an “invasive species?”
  - The legal, U.S. definitions regarding invasive species were provided in Executive Order 13112 signed by President Bill Clinton on February 3, 1999
    - "Invasive species" means an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health
    - "Alien species" means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem

- Therefore, an invasive species is a species
  a) that does not naturally occur in a specific area
  b) whose introduction does or is likely to cause economic or environmental harm or harm to human health
- For these reasons and more, invasive species are of particular concern for island ecosystems, whether the introduction is intentional or accidental

- A variety of terms has been applied to these introductions
  - **non-native** species
  - **non-indigenous** species
  - **introduced** species
  - **exotic** species
  - **alien** species
  - **invading** species

- Species invasions are often disastrous, but not always
  - They may result in
    a) losses of native species
    b) changes in community structure and function
    c) alterations of the physical structure of the invaded ecosystem

- Native species inhabiting an area may be either
  1) **indigenous**, or naturally occurring within a specified geographical range
  2) **endemic**, or restricted to a specific geographical area

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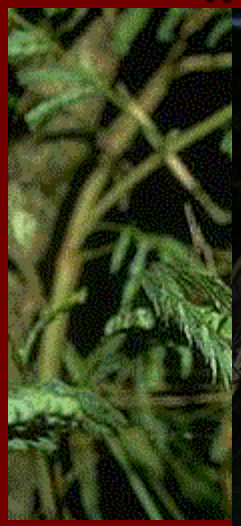

Invasive Species

- Not all introduced species are successful in becoming established in new ecosystems
- Which species are most likely to invade communities?

- Characteristics of successful invaders

  [N.B.: Not all invaders have all these characteristics]

  1. high reproductive rate, short generation time
  2. pioneer species
  3. long-lived species
  4. high dispersal rates
  5. hermaphroditic organisms [both sexes contained in same organism; self-fertilization—single parent reproduction]

6. vegetative, or asexual, reproduction
7. phenotypically plastic
8. high genetic variability
9. broad native range
10. habitat generalist
11. broad diet
12. human commensal

- Which communities are most likely to be invaded successfully?
  - Characteristics of invadable communities
    A. climatically matched with the original habitat of the invading species
    B. early successional stage
    C. low diversity of native species in invaded community
    D. absence of predators on invading species
    E. absence of native species ecologically similar to invader [i.e., potential competitors]

F. absence of predators or grazers in evolutionary history of community [i.e., “naive” prey]
G. absence of fire in evolutionary history of community
H. low-connectance food web
I. anthropologically disturbed

Case Study—The Giant African Snail and Its Predators in Guam

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- When the snails turned out to be a serious agricultural pest, efforts were made to ban importation and restrict cultivation of *Achatina fulica*

- Introduction of *Achatina fulica* to Guam apparently was accidental:
  - One account (Kondo) indicates that the snails arrived in Guam in 1943 as stowaways in a shipment of sweet potatoes from Rota sent to feed Japanese troops occupying the island
  - Another account (Abbott) states that the snails arrived in a shipment of pandanus leaves from Saipan in 1945

- Efforts to control *Achatina fulica* focused on introduct initially predatory sn
  - Experiment e 'carnivorous snail' *Gona* uld be a good candidate f rol

- Field testing was conducted on Aguiguan by the Insect Control Committee for Micronesia of the Pacific Science Board
  - 400 *Gonaxis kibweziensis* were released on Aguijan in 1950
  - By 1951, the population had grown to 21,750 snails, and they were preying upon an estimated 1,122,500 *Achatina fulica*

- By 1954, living snails were found only on the upper plateau, where an estimated 80,800 *Gonaxis* were observed feeding on 37,600 *Achatina* plus native species
- The field test was deemed a success, and *Gonaxis* was introduced into Guam, Palau, Pohnpei, Chuuk, and Hawaii

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- African snail populations have declined since *Platydemus* appeared, but evidence from other Pacific islands indicates that African snail populations decline naturally after a period of explosive growth, even when no predators are introduced
- Native snail populations have declined significantly along with the African snail, and as many as 67% of the species may now be extinct

Case Study—The Topshell *Trochus*

- It was introduced in Guam to initiate a cottage industry to supply shells for the mother-of-pearl industry, in which trochus is used for button manufacture
- Trochus, or alileng, is a browsing herbivore that has caused no documented disruptions in coral reef communities

- There have been anecdotal accounts of diminished populations of other browsing herbivorous snails (e.g., *Turbo argyrostomus*) that inhabit the same habitat, but there are no data in support of these observations
- Some biologists have postulated that herbivorous fishes may have declined following the introduction of trochus, but again there are no corroborating data

Other Notable Introductions in Guam

- Like Hawaii and Florida, Guam has witnessed declines in the native flora and fauna because of changes brought by introduced species, dating from the earliest Chamorro colonists who settled the island ca. 4,000 ybp

- Many introductions are well-intentioned but ill-advised

1) Domestic species escape and establish feral populations that cause great environmental disruption (e.g., wild pigs)

2) Biological control

- Biological control refers to the use of "natural enemies" to control pest species
- This is a sound concept on paper, but in reality most efforts at biological control are ecological disasters, because the control species often causes disruption equal to or greater than that of the pest species
  - e.g., in Guam, more than 67% of the indigenous and endemic land snails have been driven to extinction by predators introduced to control the giant African snail

3) The "*Bambi complex*"

- Pet owners cannot bear the thought of having their exotic pets destroyed when they move to a new location, so they release them in the wild
- If the released pets establish breeding populations on the island, native species are likely to decline

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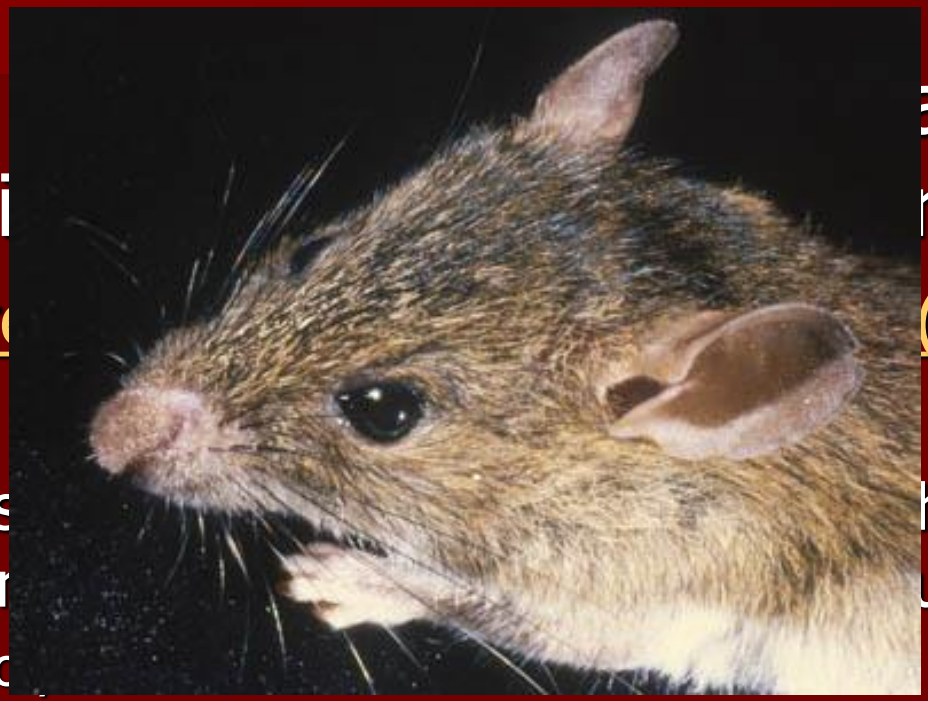

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– Japanese in -1944)

- 1942?
  - trochus
    - [Fur l in early 1950s]
- 1950s
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- 1947
  – brown tree snake *Boiga irregularis*

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- [Apparently died out after Typhoon Karen]

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- Large numbers of insects and other plant pests have been introduced with imported produce and ornamental plants
- More than 70% of the plant species on Guam are introduced, and three endemic species are on the verge of extinction