

**EXOTIC SPECIES:
CAUSES FOR CONCERN**

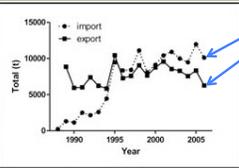


The collage consists of three photographs. The largest one on the left shows a person in a red shirt holding a very large, thick snake. The top right image shows a close-up of a frog with a yellow and blue pattern. The bottom right image shows a person in a white shirt holding a frog.

Lecture Outline

- Introduction to Exotics
 - Current Status
 - Impacts
 - Legislation
- Exotic Fish and Invertebrates
- Exotic Reptiles
- Exotic Amphibians

Importation



The graph plots 'Total (t)' on the y-axis (0 to 15,000) against 'Year' on the x-axis (1990 to 2005). It shows two data series: 'import' (solid line with dots) and 'export' (dashed line with dots). Both series show a general upward trend over the period. A blue callout box with arrows pointing to the 2005 data points contains the text '12.5-21 million frogs'.

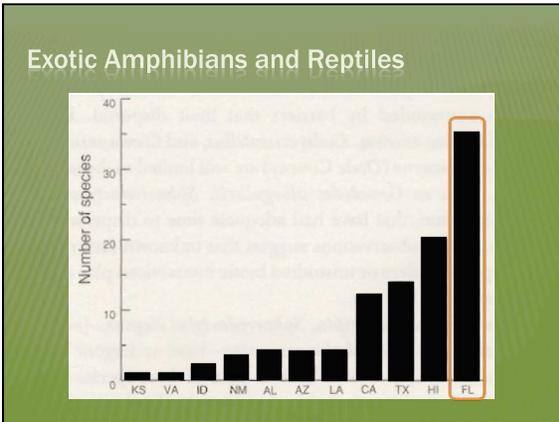
Just Frog Legs!!!



A photograph of a white bowl filled with frog legs, with a yellow price tag on top that reads 'per lb 3.13'.

- ~2,000,000 reptiles annually
- ~4,660,000 amphibians
- >670 species outside of native range **U.S. = 545 spp.**

2000-2005 - 28,000,000 amphibians through LA, NY, and SF



General Impacts?

48 yrs = 22 spp.

This slide illustrates the general impacts of exotic species. It features a photograph of a snake consuming a frog, with the text '48 yrs = 22 spp.' below it, indicating the time taken for 22 species to be introduced. Another photograph shows a frog on the Golden Gate Bridge, symbolizing the spread of these species.

Long-term impacts

- Loss of avian and mammalian insectivores
 - Increase in insect populations
 - Increase damage to native plants
- Loss of frugivores
 - Loss of pollinators and fruit-dispersal
 - Changes in floral composition

The diagram illustrates the long-term impacts of the loss of avian and mammalian insectivores. It shows a snake eating a frog, which eats insects, which in turn eat a flower. Red 'X' marks are placed over the frog, the insects, and the flower, indicating their loss. This leads to an increase in insect populations and damage to native plants, as well as the loss of pollinators and fruit-dispersal, and changes in floral composition.

Adaptations

- Native species adaptations
 - 2 snake species - ↓ gape width, ↑ body size
 - Toxin resistance
 - Eating aversion
 - Spatial avoidance
- Exotic species adapt as well
 - Toad morphology
 - ↓ body size, ↓ parotoid gland size, ↑ leg length
 - Hunting behavior - Nocturnal to Diurnal

Costs

- Brown tree snake - \$12 million/yr
 - Damages, species control, and spread prevention
- Coqui - estimated \$8 million/yr in Hawaii alone in property loss
- Germany - \$188,000 USD annually to control American bullfrogs



Laws against importation?

Norway

50 monitor lizards, 39 cobras, two iguanas, 16 big vipers, and eight small vipers (Bangkok)



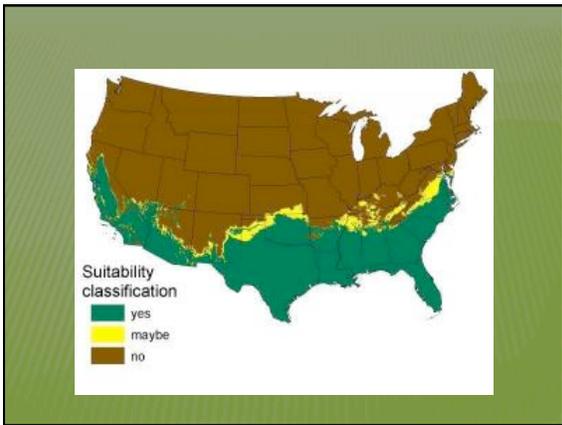
Exotic Reptiles

Burmese Python (~15-20')

Green Anaconda (~20-30')

Nile Monitor (~4-6')

Water monitor (~7-9')



Impacts

- Competition
- Predation
- Alteration of habitat

Usually a greater threat to native mammal and reptile populations





Exotic Amphibians

Subject Name	Scientific Name	Family	Order
cane toad	<i>Rhina marina</i> (Linnaeus, 1758)	Bufoinae	Anura
coqui	<i>Eleutherodactylus coqui</i> Thomas 1966	Leptodactylidae	Anura
Greenhouse frog	<i>Eleutherodactylus planirostris</i> (Cope, 1862)	Leptodactylidae	Anura
Cuban treefrog	<i>Osteopilus septentrionalis</i> (Duméril and Bibron, 1841)	Hylidae	Anura
bullfrog	<i>Rana catesbeiana</i> Shaw, 1802	Ranidae	Anura
African clawed frog	<i>Xenopus laevis</i> (Daudin, 1802)	Pipidae	Anura

Cuban Treefrog (*Osteopilus septentrionalis*)

- First appeared – 1931
- Largest Hylid in US (5-7")
- Highly arboreal
- 1 female may lay in excess of 15,000 eggs in one season
- Easily spread- Horticult.





Impacts

- Predator of other native anurans
- Competition with native anurans
 - Both aquatic and terrestrial phases
- Noxious skin secretions – reduces predation by native predators
- Economic impacts – Frequent transformer boxes



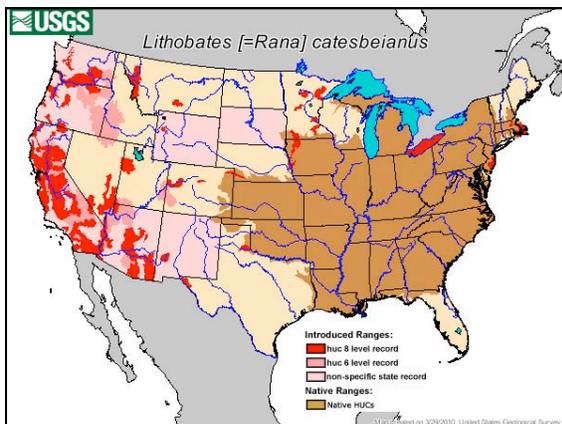
American Bullfrog (*Rana catesbeiana*)

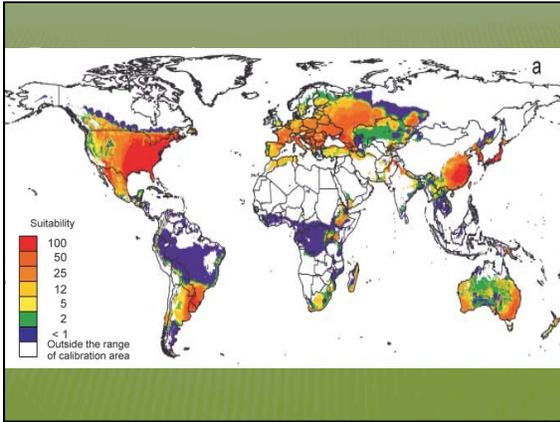
- Largest native frog in U.S. (> 6" SVL)
- Eat anything
- Self-sustaining
 - Highly cannibalistic
 - Doesn't rely on other food source
- Can affect algae population → change in aquatic community structure
- 1 female - 20,000 eggs/clutch

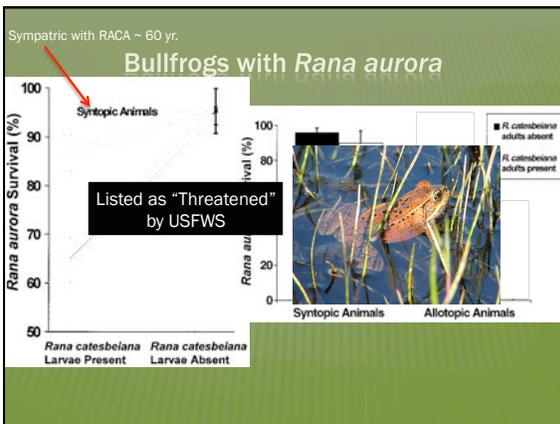


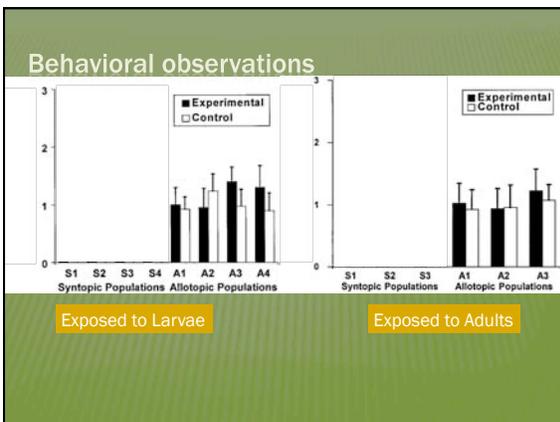
Modes of Introduction

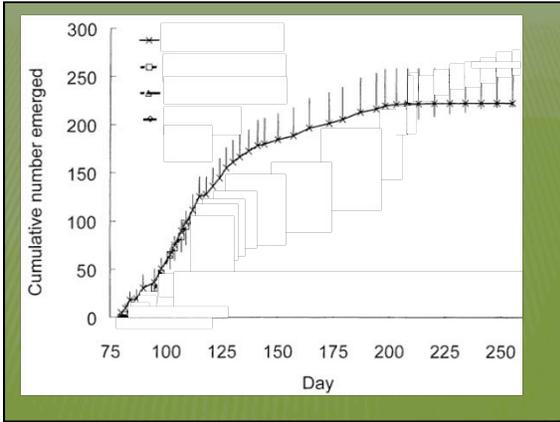












Cane Toad (*Bufo marinus*)

General Description:

- 5-9 inches (Body length)
- Large parotid glands
- Native to Central and South America
- 1 female – 8,000-35,000 eggs 2X/yr



Cane Toad Resilience

- Tolerate salinity – 15%
- Tolerate Temps – 41-104 °F
- Can lose 50% of body water
- Will eat most anything
 - Insects, vegetation, small birds, amphibians, reptiles, mammals, dog and cat food, table scraps, etc.

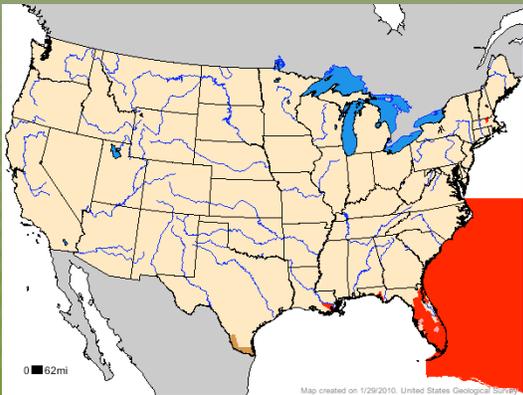


Distributional reports

- 11 U.S. states and territories
- 18 islands in the Caribbean
- 12 Countries in the Pacific



50 Countries



0 62mi

Map created on 1/29/2010, United States Geological Survey

Means of Introduction

- Control of agriculture pests (Cane beetles)
 - However, beetles live in the upper stalk
- Intentional releases
- Escapees from Zoos or pets
- Micronesia – Monitor Lizard Control



Impacts

- Highly toxic skin
 - Kills dogs, cats, native birds, mammals, and reptiles
- Competes with native amphibians for resources
- Adversely affects invertebrate populations
- Eats domestic honeybees



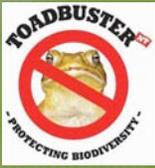
Impacts to Australian Wildlife

- Inconclusive
- 26 native species – toad-induced mortality
- Extremely high mortality rate of varanid lizards
- Potential risk of >49 snake species
- Declines in varanids, snakes, and turtles - significant cultural and economic effects on Aboriginal communities (van Dam et al. 2002)



Australians Combat Cane Toad

- Numerous techniques have been employed



All funded by Australian Government

Trapping

- Trapped for decades
- Insufficient on broad scale
- Developing scented traps
 - Baits laced with poison → Not species specific
 - Also began using sex pheromones - unsuccessful



Sterility Programs

- Daughterless Males program
 - Special gene that prevents female offspring
- Male with inherited sterility
- Advantages:
 - Species-specific, non-toxic, no global risk
- Disadvantages:
 - Mass rearing, sterilization, and release of large number of individuals – these must be as fit as wild types
 - Cost - \$750,000 over 3 yrs

Models indicate that would have to release 2 orders of magnitude > males than already present in wild

Lungworms and Lavender Beetles

- Lungworms came with introduction of cane toad
 - However, been present > 35 yrs. – No effect yet on population
- Lavender Beetles
 - Poisonous to amphibians
 - Native amphibians already know



Relocating vulnerable species to islands

- Mostly considered for the Quoll Carnivorous marsupials
Highly Endangered
- Considered using to islands of NE coast
- Cost - \$1,310,000 over 3 yrs.



Chemical solutions

- Cane-toad specific poison
- Total cost of cane toad control methods from 1989-2001 for AU government - \$9,550,000
- Advantages:
 - Non-disseminating
 - Could be controlled
- Disadvantages:
 - Unknown effects on non-target species
 - Cost - \$350,000/yr

What could you buy for \$10,000,000

- 10 McLaren F1's - \$970,000
- 15 2010 Formula 45 Yachts - \$656,115
- 2 Solid gold toilets - \$5 mill
- 20 Jimi Hendrix's 1965 Fender Stratocasters (If they existed) - \$500,000
- 38 La Modernista Diamond Pens - \$265,000
- 67 White lion cub - \$150,000



The Golden Ticket!



- AU Government → Scientists to South America
- Why isn't toad pest in native habitat?
 - Found no reasons
 - But isolated a *ranavirus*
 - Cost: \$2,000,000

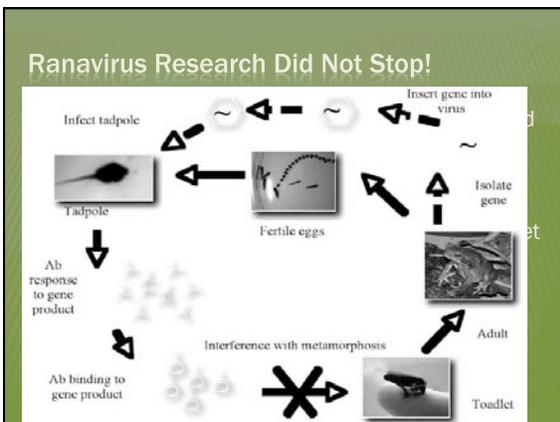


Ranavirus research

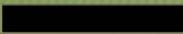
- Animal Health Lab in Geelong
 - Wanted to create virus that killed cane toads
 - In 1996, Project was abandoned
 - Found that a native frog (White-lipped tree frog) could be easily killed by virus as well



Australian Animal Health Laboratory



Issues?



Results

- 1st time anyone has manipulated a ds-DNA ranavirus
- *Ranavirus* would not take recombinant
- Resulted in recombinant virus that could protect amphibians from ranaviruses – Possibly lead to a cure
- Department of Environment, Water, Heritage, and the Arts – determined GMO's not acceptable for control measures
- Funding ended in April of 2008

Food source



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