Biology of the Galapagos

Wikelski reading, Web links

26 March 2009, Thurs
ECOL 182R UofA
K. E. Bonine

Student Chapter of the Tucson Herpetological Society

COME JOIN!!!!!
General Information...

- **Herpetology**: the branch of zoology having to do with the study of reptiles and amphibians.
- **What We Do**: Education outreach, Fun Trips, Exposure to reptiles and amphibians.
- **Meeting Time and Location**: Every third Thursday of every month; outside, on the **North side of Biological Sciences East**. Except on **March 26, 2009** (b/c spring break).
Origins of the Galapagos
(first islands about 10mya,
oldest current islands )
What happened to the older ones???

Oceanic or
Continental
Islands?

Stationary creates islands,
then tectonic plate “rafts” east
Colonization of the Galapagos
(who got there and how?)
Colonization of the Galapagos
(who got there and how?)

HOW MANY?
- Birds
- Frogs
- Lizards & Snakes
- Mammals
  - Marine or Terrestrial?
- Plants

Galapagos difficult to colonize.
Some taxa make the journey better than others.

Many _____ species than ______.
... is the diversification of a single or small groups of species into a large number of descendant species that occupy various ecological niches.

This is an evolutionary process driven by natural selection.
There are 15 currently recognised species plus five subspecies of *Scalesia*; species are shrubs but four commonly grow into trees. All are endemic to Galapagos. They are an excellent example of adaptive radiation, the development of new species to fit different vegetation zones and islands. There is great diversity between species:

- Species vary in size, from less than one meter to over 10 meters in height.
- Leaves vary in size and shape between species and are usually hairy. Leaves cluster at ends of twigs.
- The flowers are carried in white, daisy-like heads of 15 (*S. cordata*) to 300 (*S. yellow*) small flowers.
- Some species grow mainly in the arid zone while others, especially the larger trees, are adapted to the humid zone.
Daphne Major, Peter and Rosemary Grant, Princeton
El Niño is an oscillation of the ocean-atmosphere system in the tropical Pacific

http://kids.earth.nasa.gov/archive/nino/intro.html
Normal Conditions:

El Niño Conditions:

Flooding in Peru and SW US,

Drought in Australia and Indonesia

Wind to East from West
brief communications

Marine iguanas shrink to survive El Niño

Changes in bone metabolism enable these adult lizards to reversibly alter their length.

Wikelski and Thom, 2000

Why?
Cold up-welling of Cromwell current brings ___ to western Galapagos.

Without it, much of the marine food web is lost...

Galapagos Marine Iguana

Fernandina/Isabela (W)
males to 10+ kg
females to almost 3 kg

Genovesa (NE)
males only to 1 kg
females to < 1kg

Why?
Iguanas bigger on some islands:

1. Water
2. Current strength
3. Food Availability

Males bigger than females:

selection

What are sneaker males?

Video clip about Galapagos and Marine Iguanas
Martin Wikelski with Alan Alda, etc.
Borrowed video from Angela

0-10 min  intro and general biogeography
10-18 min  ~finches and beak evolution on Daphne Major
18-30 min  marine iguanas
30-39 min  nazca boobies and siblicide
39-52:40  conservation etc.
Galapagos Conservation

Discovered 1530s

Floreana Post office bay
People Bring Problems

Invasive Herbivores

Goats

No Goats

The eight-year battle to remove wild goats, donkeys and pigs from Santiago, Pinta and northern Isabela islands has cost at least $5.2 million and is still just shy of completion. The United Nations covered three-quarters of the cost.

The assault against feral goats -- along with an ongoing campaign against wild dogs, cats, pigs, donkeys and an array of invasive plants and insects -- demonstrates the challenge conservationists face in preserving this hotbed of genetic diversity. Alan Tye, interim director of sciences at the Charles Darwin Research Station on the island of Santa Cruz, said his institute focuses on just two things: "threats and threatened things."

Although 95 percent of the species that were here when humans first arrived still exist in the Galapagos, the International Union for Conservation of Nature and Natural Resources lists dozens on its "red list" of threatened species. These include the Galapagos hawk and the Galapagos fur seal, along with 57 species of Bulimulus snails.

Other species, including plants and insects, are harder to eradicate. At this point, the 720 introduced plants growing in the Galapagos outnumber the islands' 500 original plant species. Blackberry bushes, planted by farmers, have spread widely, along with quinine trees. Newer residents are bringing in ornamental shrubs such as lantana, nicknamed "the curse of India" because it drives out other plants, and other garden plants to the Galapagos.
Invasive Insects

Charles Darwin Research Station Fact Sheet

Eradication of fire ants

The little fire ant, *Vespa velutina* nov. var. *novarum*, is one of the most aggressive and invasive species ever introduced to Galapagos. Together with the fire ant, *Solenopsis invicta*, fire ants greatly affect native vegetation and ecosystems, presenting a serious threat to fragile Galapagos ecosystems. Their control is a priority project for the Charles Darwin Foundation (CDF).

Arrival in Galapagos

IV. *novarum* is native to Central and South America, but was introduced to Galapagos during 1919-1920. It first colonized Santa Cruz, but is now widely distributed on eight islands: Floreana, Isabela, Pinta, San Cristobal, Santa Cruz, Santa Fe and Santiago, and fire ants.

Historically, IV. *novarum* was probably transported between large islands on plants or as soil, and to small islands on equipment caused by people.

S. *invicta* is native to regions of the Americas. It was first reported in San Cristobal in 1989. It has been recorded on six islands: Floreana, Isabela, Santa Cruz, Santa Fe, and Santiago, and fire ants.

S. *invicta* is harder to control than IV. *novarum* as new colonies are founded by winged females that can fly over long distances. IV. *novarum*, on the other hand, invades the original colony on feet to occupy extensive areas. This process is called budding.

Impact on Galapagos

IV. *novarum* reduces ground and tree-dwelling arthropods species diversity in areas where it is dominant, causing a marked reduction of native nematodes, spiders, and ants species. S. *invicta* is also a tremendous invader of arthropods but its effects are palliative because of the way it colonizes new areas.

IV. *novarum* attacks butterfly, tortoise, and adult tortoises. S. *invicta* affects the nesting behavior of land iguanas and tortoises, and threatens the behavior of seabirds and reptiles as well as birds.

IV. *novarum* can form an extensive colony over an entire small island putting at risk endemic species that are restricted to only one island (single island endemism).

CDF Research Activities

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Charles Darwin Research Station Fact Sheet

Blackberry invasion

The five species of Blackberry (food name: nabo) are aggressive, invasive species that have a negative impact on several Galapagos Islands. They compete with native and endemic species for light, moisture, and nutrients, and affect local agriculture. Eradication of blackberry is a major focus for the Charles Darwin Foundation (CDF) and the Galapagos National Park Service (GNPS).

Arrival in Galapagos

Five species of Blackberry have been introduced to Galapagos over the last 40 years:

- *Rubus viscosa*
- *Rubus globosus*
- *Rubus solandri*
- *Rubus alveolatus*
- *Rubus neglectus*

Blackberry (R. viscosa) was introduced for agricultural purposes to San Cristobal in 1999 and has spread to Santa Cruz, Santa Fe and Isabela Islands.

Many food species feed on the fruit and are responsible for localized spread. Most cases of dispersal between islands are thought to be due to deliberate introductions by people.

The other blackberry species have been introduced more recently and are restricted to relatively small areas.

Impact on Galapagos

R. viscosa is one of the worst weeds threatening the Galapagos National Park. It has invaded open vegetation, shrubland, and forest alike. It forms dense thickets up to 2 meters high, replacing native vegetation, and threatening many rare endemic plants.

On Isabela, R. viscosa invades farmland and is difficult and expensive to control.

Although only found on isolated areas at present, there is a concern that the other four species of Blackberry could become a significant problem if they are not controlled.
Biodiversity Threats
- (incl. climate change)
- Habitat Fragmentation
- Invasive Species
- Overharvesting
- Disease

Galapagos Marine Ecology (ECOL 496O/596O)
Summer Session II: July 7-Aug 1, 2009

• Spend one month this summer in the Galapagos Islands, Ecuador!
• Visit seven of the most spectacular islands in the archipelago
• Do a service project with children at a local school and the Galapagos National Park
• Do a field ecology project and learn about Galapagos ecology and evolution
• Earn 3-6 units of graduate or undergraduate credit

For more information: www.eebweb.arizona.edu/courses/galapagos/
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Thanks for a Great 1/3 Semester