

Biology of the Galapagos

Wikelski reading, Web links



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

Alan Alda
Video?

1



Student Chapter of the
Tucson Herpetological
Society

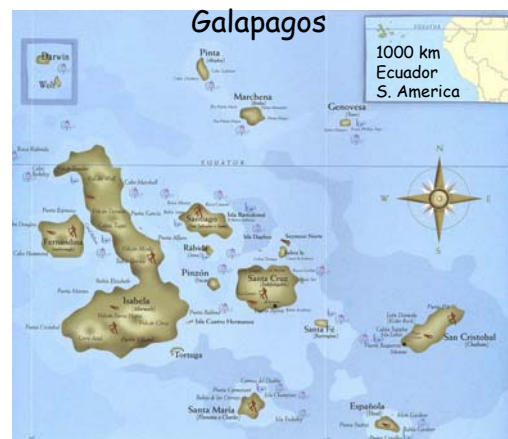
COME
JOIN!!!!



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).

3

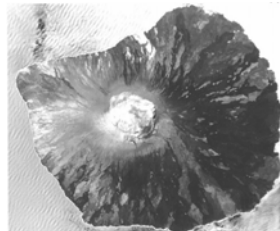


4

Origins of the Galapagos

(first islands about 10mya,
oldest current islands _____)
What happened to the older ones???

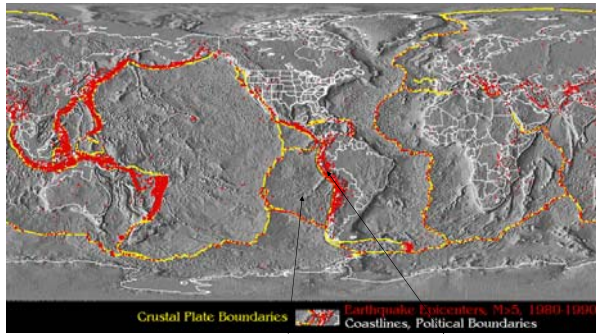
Oceanic or
Continental
Islands?



Stationary _____ creates islands,
then tectonic plate "rafts" east

6

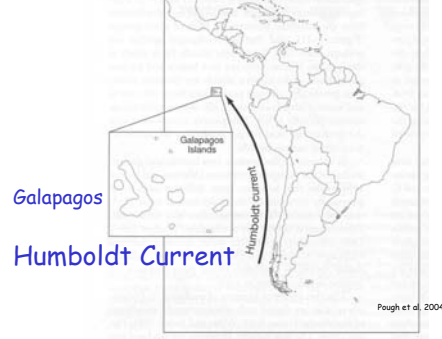
Plate Tectonics



Nazca Plate
Andes

7

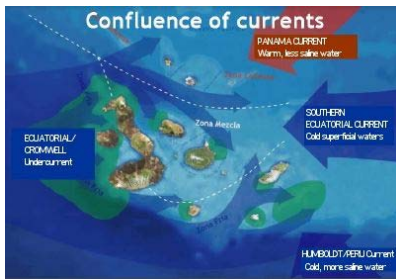
Colonization of the Galapagos
(who got there and how?)



Pough et al. 2004

8

Colonization of the Galapagos
(who got there and how?)



9

HOW MANY?

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

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

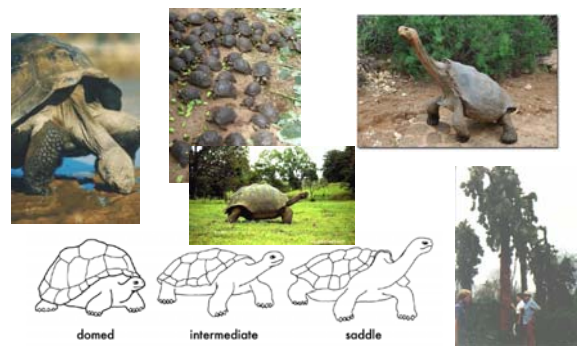
Many _____ species than _____.

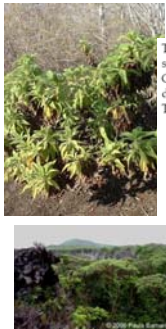
10

... 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.

11





Scaevola spp.

There are 15 currently recognised species plus five subspecies of *Scaevola*; 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 (*Scaevola confertiflora*) to 300 (*S. villosa*) small flowers.
- Some species grow mainly in the arid zone while others, especially the larger trees, are adapted to the humid zone.

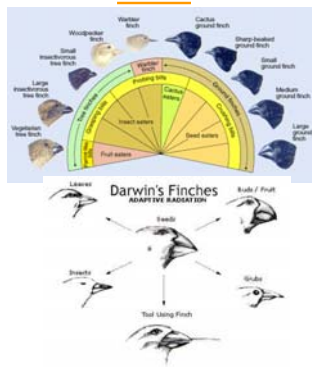
13



Mockingbirds

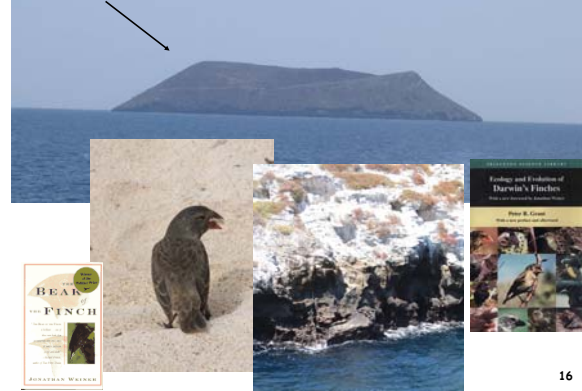


14

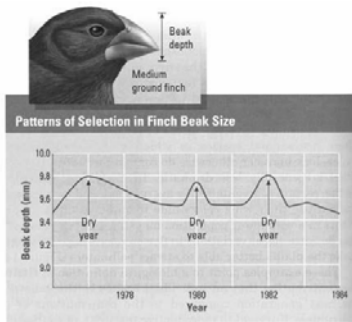


15

Daphne Major, Peter and Rosemary Grant, Princeton



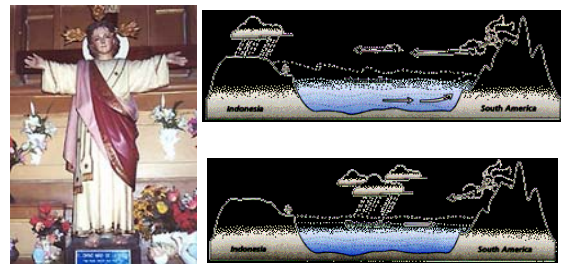
16



▲ Figure 14-31 The Grants documented changes in beak size among medium ground finches over many years.

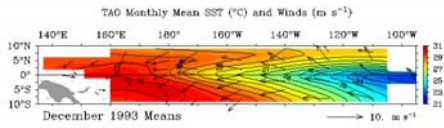
17

El Niño is an oscillation of the ocean-atmosphere system in the tropical Pacific

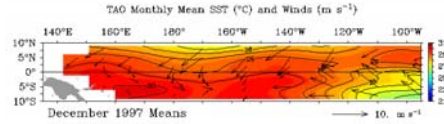


<http://kids.earth.nasa.gov/archive/nino/intro.html> 18

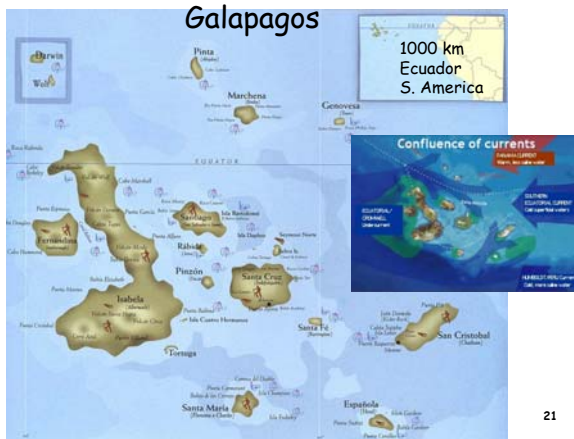
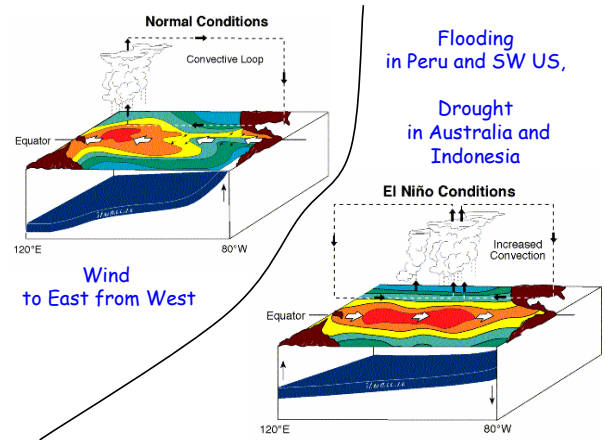
Normal Conditions:



El Niño Conditions:

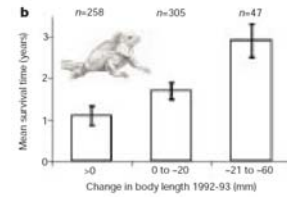


19



21

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?

23

Cold up-welling of Cromwell current brings _____ to western Galapagos.

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



27

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



Amblyrhynchus cristatus

Why?

28

Iguanas bigger on some islands:

- 1. Water
- 2. Current strength
- 3. Food Availability

Males bigger than females:

selection



What are sneaker males?

29

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.

30



Discovered 1530s

32



People Bring Problems

Invasive Herbivores



Goats



No Goats



<http://www.darwinfoundation.org/en/our-work/featured-projects/project-isabela>

37



Judas Goats on Isabela, Galapagos



<http://www.darwinfoundation.org/en/our-work/featured-projects/project-isabela>

38

Invasive Species Threaten Galapagos's Diversity, By Juliet Elperin
Washington Post Staff Writer, Monday, February 27, 2006; A06

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.

39

Invasive Insects

Charles Darwin Research Station Fact Sheet

Eradication of fire ants

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

Arrival in Galapagos

S. geminata is native to Central and South America, but was introduced to Galapagos during 1950-1952. It first colonized Santa Cruz, but is now widely distributed on eight islands: Floreana, Isabela, Machala, Pando, San Cristobal, Santa Cruz, Santa Fe, and Santiago and San Vicente.

Historically, *S. geminata* was probably transported between large islands on plants or in soil, and to small islands on equipment carried by people.

S. geminata is native to regions of the Americas. It was first reported on San Cristobal in 1951. It has been recorded on six islands: Floreana, Isabela, San Cristobal, Santa Cruz, Santa Fe, and Santiago and San Vicente.

S. geminata is harder to control than *S. invicta* as other colonies are founded by winged females that can fly over long distances. *S. geminata*, on the other hand, requires vehicles from the original colony on foot to occupy extensive areas. This process is called building.

Impact on Galapagos

S. geminata reduces ground and tree-dwelling arthropod species diversity in areas where it is dominant, causing a marked reduction of native arthropods, spiders and ant species. *S. geminata* is also a voracious feeder of arthropods but its effects are patchy because of the way it colonizes new areas.

S. geminata attacks tortoise hatchlings and adult tortoises. *S. geminata* affects the nesting behavior of land iguanas and tortoises, and therefore hatching success of endemic reptiles as well as birds.

S. geminata can form an extensive colony over an entire small island putting at risk endemic species that are restricted to only one island (single island endemics).

CDRS Research Activities

CEP FOCUS: RESTORATION



Key Facts

Species: *Solenopsis geminata*

Common name: Little fire ant

Origin: Central and South America

Class: Invasive

Impact: Affects native invertebrate populations and reptile and bird breeding

Range: Extensive, spread to eight islands and five birds

Action: Control and eradication

Species: *Solenopsis geminata*

Common name: Tropical fire ant

Origin: New World

Class: Invasive

Impact: Similar to *S. geminata*

Range: Extensive, spread to six islands and five birds

Action: Control and eradication

40

Invasive Plants

Charles Darwin Research Station Fact Sheet

Blackberry invasion

The five species of blackberry (from near east) are aggressive, invasive species that have had a negative impact on several Galapagos Islands. They compete with native and endemic species for light, water, 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 niveus*
- *Rubus glaucus*
- *Rubus adpressus*
- *Rubus chrysanthus*
- *Rubus mespilococcus*

Hill blackberry (*R. niveus*) was introduced for agricultural purposes to San Cristobal in the 1970s and has spread to Santiago, Santa Cruz, and Isabela Islands.

Many bird 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 at present.

Impact on Galapagos

R. niveus is one of the worst weeds threatening the Galapagos National Park. It has invaded open vegetation, scrubland and forest alike. It forms dense thickets up to 4 meters high, replacing native vegetation, and threatening their rare endemic plants.

On farmland, *R. niveus* renders farmland useless and is difficult and expensive to control.

Although only found over localized areas at present, there is concern that the other four species of blackberry could become a significant problem too if they are not controlled.

CEP FOCUS: RESTORATION



Key Facts

Family: Rosaceae

Species: *Rubus niveus*, *R. glaucus*, *R. adpressus*, *R. chrysanthus*, *R. mespilococcus*

Common name: Blackberry, Mora

Class: Invasive

Impact: Replaces native and endemic vegetation, invading farmland

Origin: Asia (R. niveus), Central to South America (R. glaucus, R. adpressus), Africa & Europe (R. chrysanthus)

Description: Dense thicket up to 4m high, Range: San Cristobal, Santiago, Santa Cruz, Isabela

Action: Eradication

41



Biodiversity Threats

- (incl. climate change)
- Habitat Fragmentation
- Invasive Species
- Overharvesting
- Disease

Espanola

62



Galapagos Marine Ecology (ECOL 4960/5960)
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
Katrina Mangin, mangin@email.arizona.edu, 520-626-5076

64

Thanks for a *Great* 1/3 Semester