

## Islands in the 21st Century

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## Darwin in the Galapagos

Each island had its own species of mockingbird.

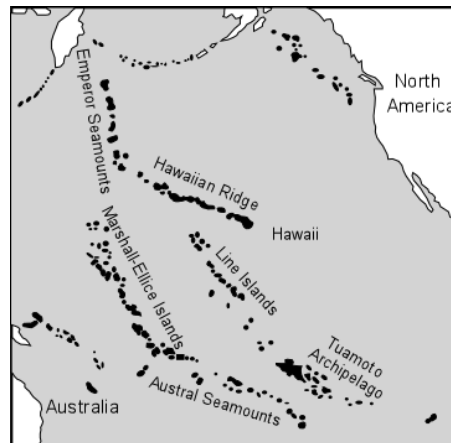
- ▶ Why different species on such similar islands?
- ▶ Why are these different species so similar?
- ▶ Why are they similar to mockingbirds of S. America?
- ▶ Why is this pattern repeated in tortoises, insects, lizards, plants, and other birds?
- ▶ Why are the Galapagos inhabited solely by good travelers?

Evolution explains all this, but it also makes predictions that Darwin couldn't test.

## Phylogeny on islands should reflect the history of island formation

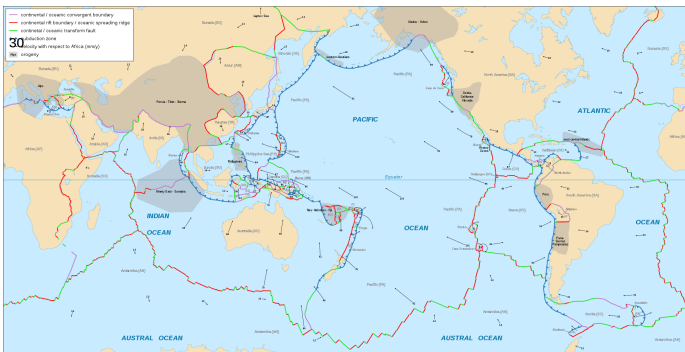
- ▶ Oldest islands were inhabited first.
- ▶ Deepest nodes in phylogeny should separate species on older islands.

## Island chains of the Pacific

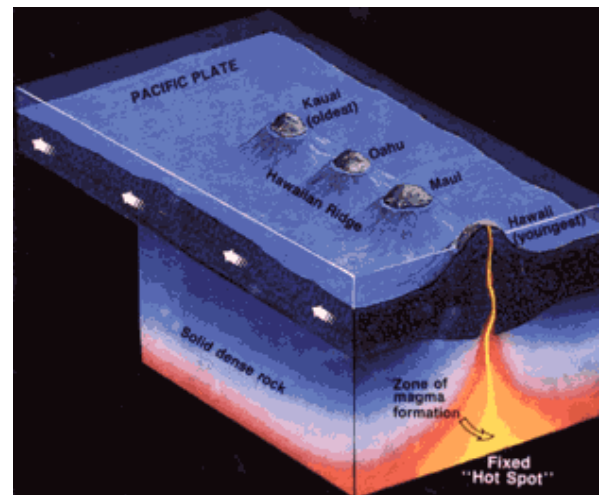


- ▶ Islands are arranged in straight lines running generally SE to NW.
- ▶ In each chain, islands increase in age from SE to NW.
- ▶ NW of existing islands, each chain continues below the sea.

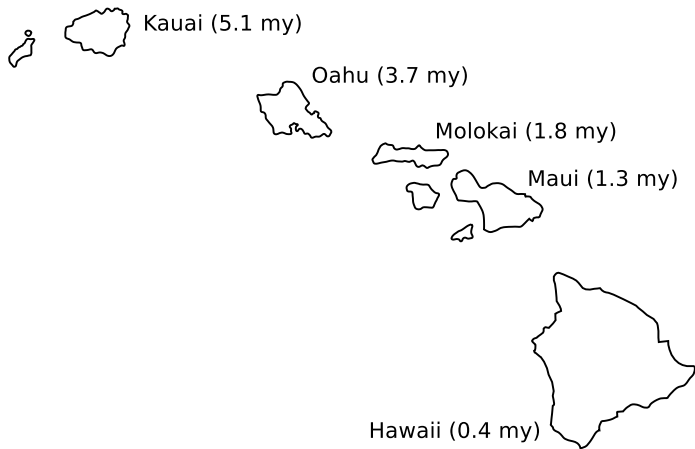
## Tectonic Plates and Continental Drift



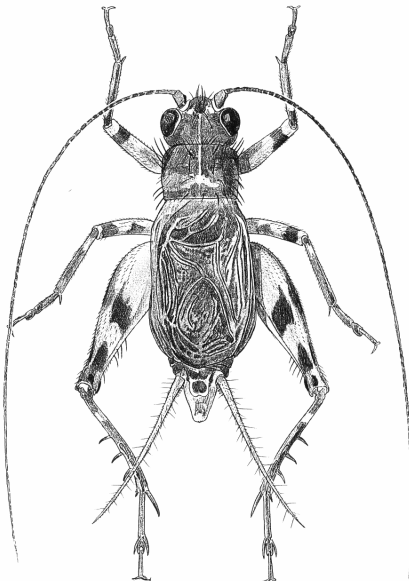
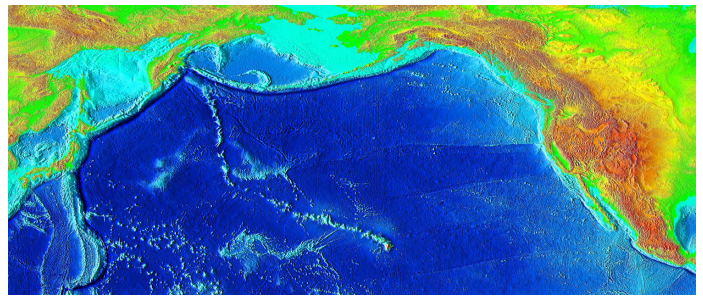
## How island chains form



### Major Hawaiian Islands



### The Hawaiian Island Chain



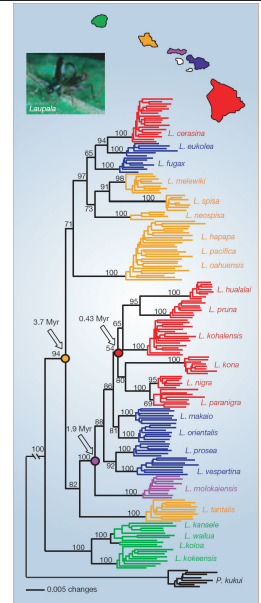
#### Hawaiian flightless cricket of genus *Laupala*

- ▶ Cannot fly; rarely move from island to island
- ▶ Many species on each island

Illustration ©1994, Daniel Otte

#### *Laupala* phylogeny

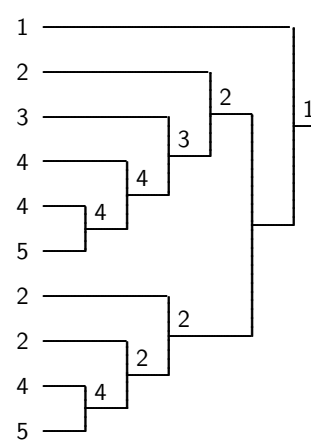
- ▶ Colors keyed to map.
- ▶ Oldest node separates green (oldest island) from rest.
- ▶ Each branch limited to an island.
- ▶ Too confusing to see much more.
- ▶ Let's make a simpler tree without so many twigs.



### Area cladogram

- ▶ Each branch represents all the closely-related species on an island.
- ▶ Label branches with the "number" of the island.
- ▶ Islands are numbered from oldest to youngest.

### Area cladogram for *Laupala* crickets

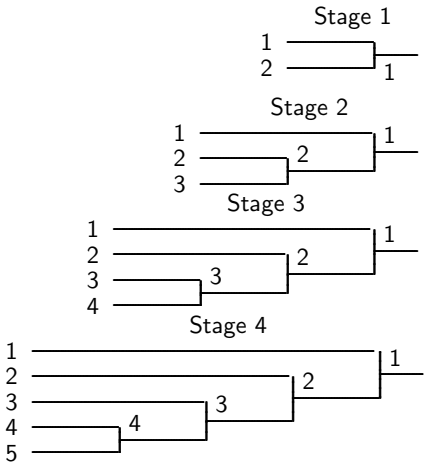


Island No.	Name	Age (Myr)
1	Kauai	5.1
2	Oahu	3.7
3	Molokai	1.8
4	Maui	1.3
5	Hawaii	0.4

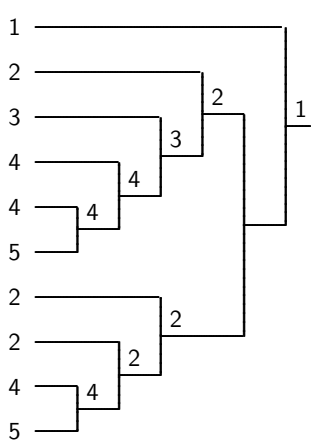
Note "stair-stepped" pattern. Why should this occur?

### Why we expect a stair-stepped area cladogram

- At each stage
- ▶ New island colonized from next-newest.
  - ▶ Branch to next-newest island splits in two.



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### Summary

- ▶ Area cladogram consistent with geological history of islands.
- ▶ This is the expected pattern, if these species evolved.
- ▶ Same pattern occurs in other taxa, on this and other island chains.
- ▶ Darwin's theory is supported by data he never imagined.