

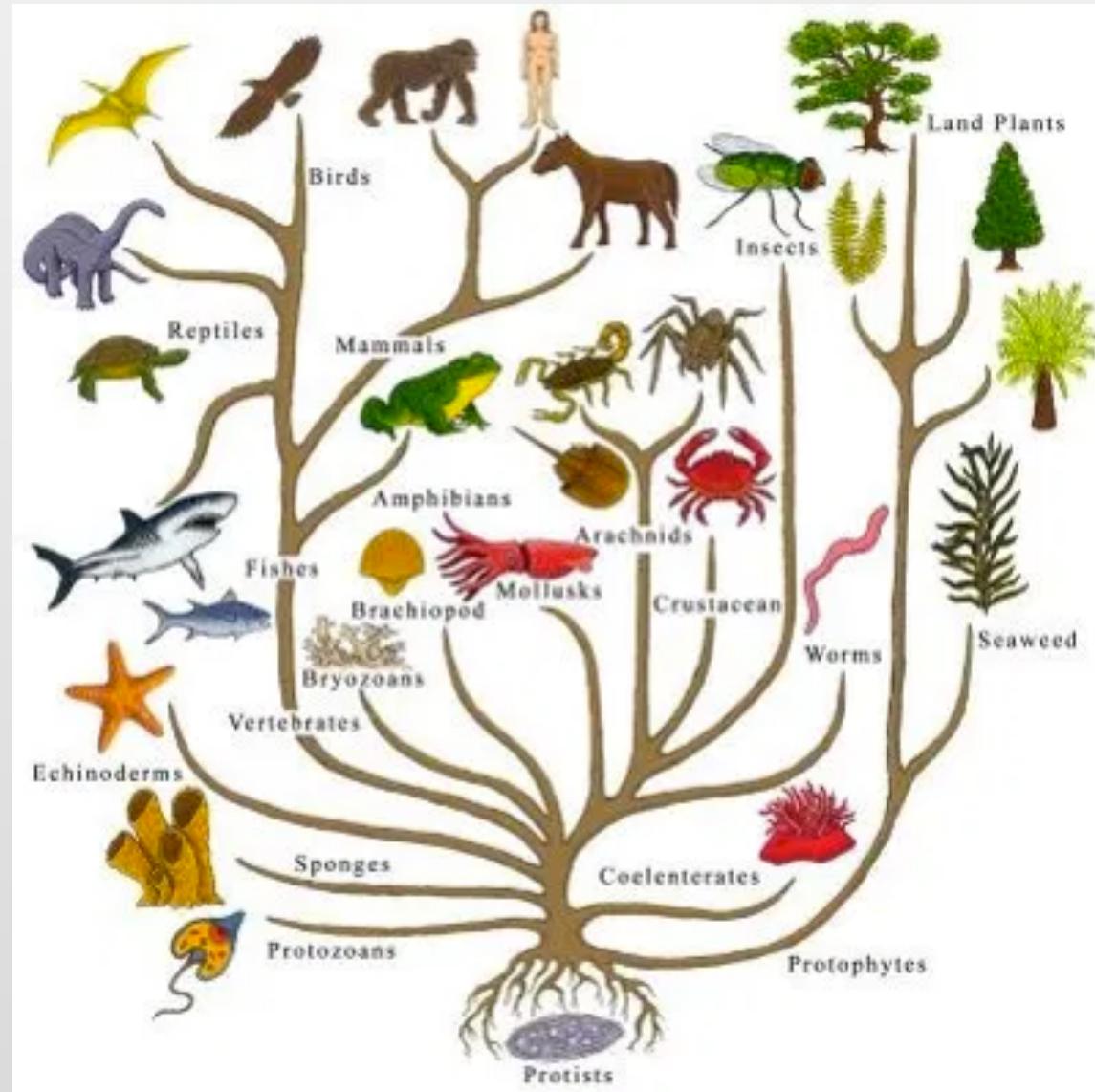
Proving Darwin's Theory of Evolution by Natural Selection

Shannon Ballard, Ph.D.
Springboard Data Science Career Track

Variation in Living Organisms



Variation in Living Organisms

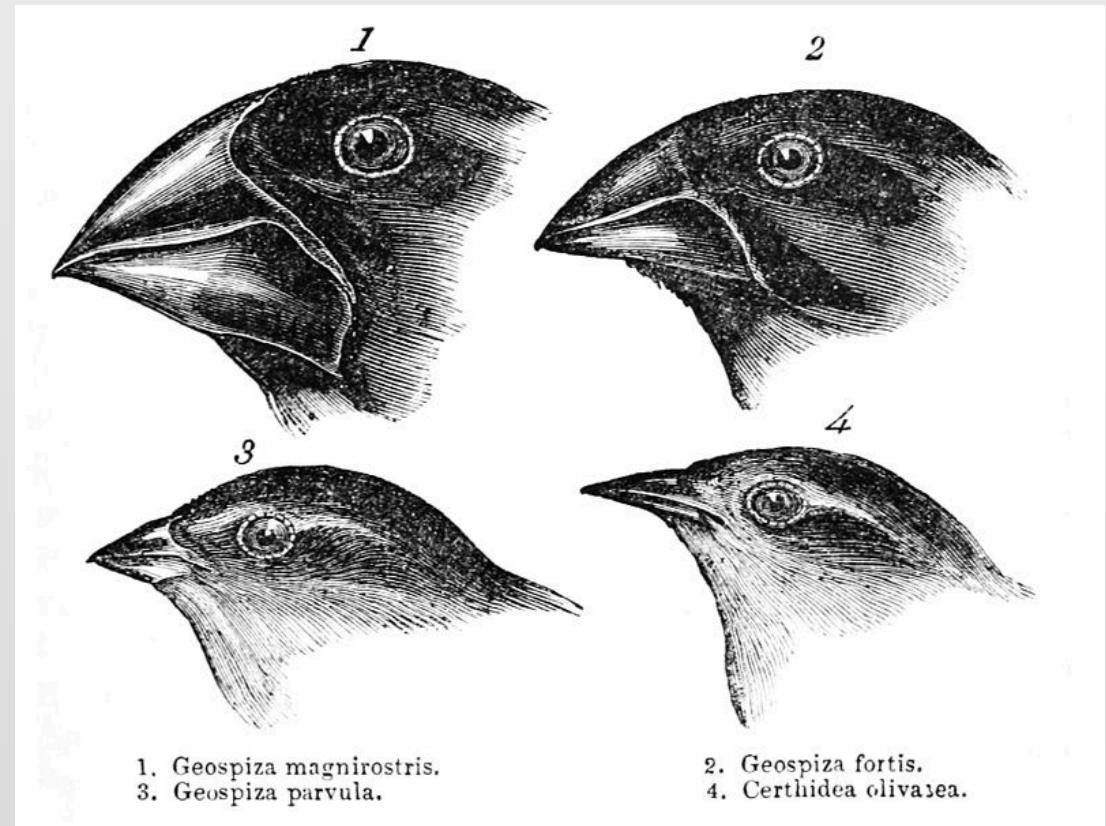


Natural Selection

“The process whereby organisms better adapted to their environment tend to survive and produce more offspring.”



Charles Darwin



1. *Geospiza magnirostris*.
3. *Geospiza parvula*.

2. *Geospiza fortis*.
4. *Certhidea olivacea*.

Is natural selection a driver of evolutionary change?

40 Years of Data Collection

Peter and
Rosemary Grant



Measured:

- Beak length
- Beak depth
- Environmental conditions
- Other variables

Geospiza Fortis



Food :

- Seeds
- Flowers

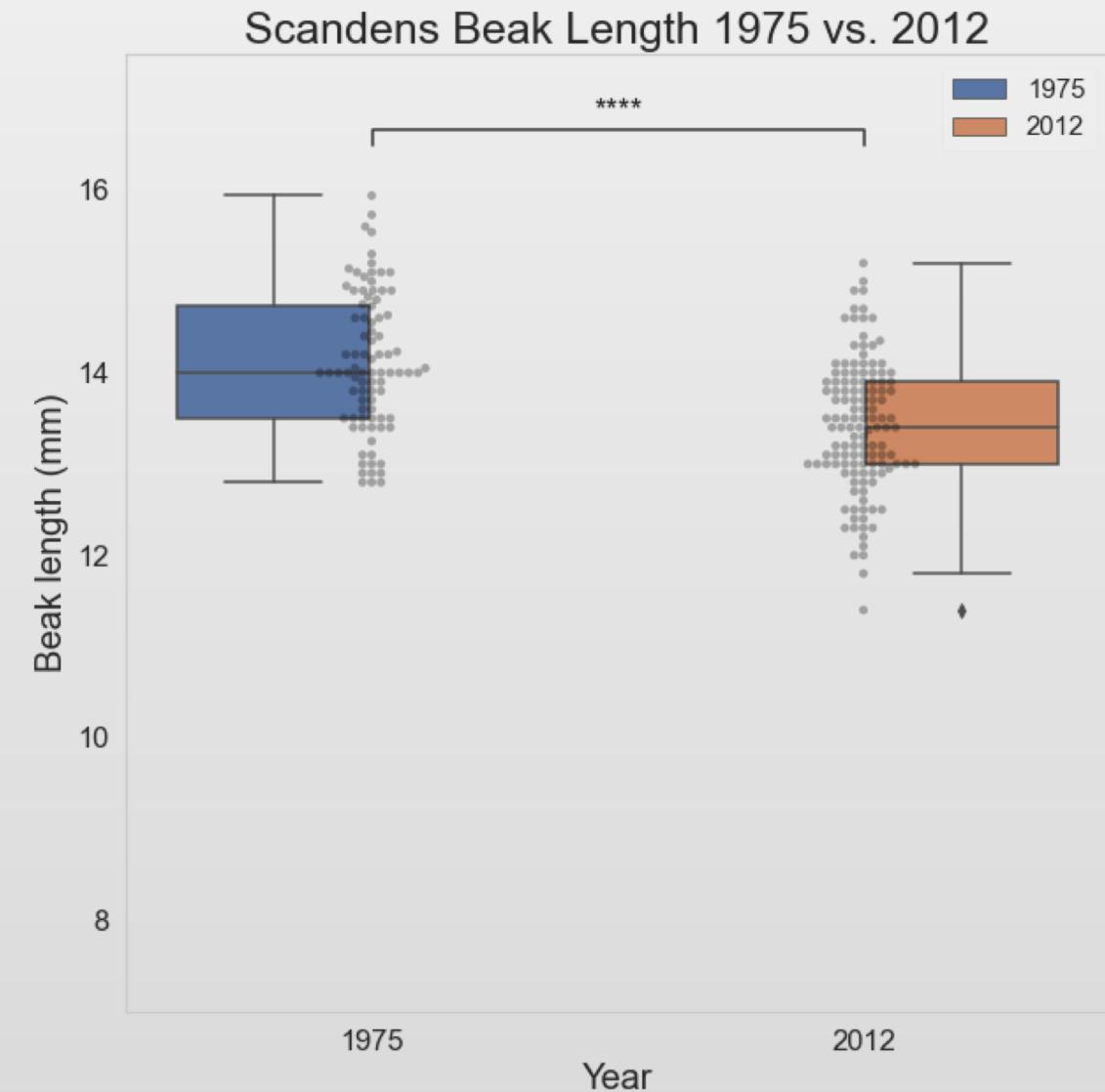
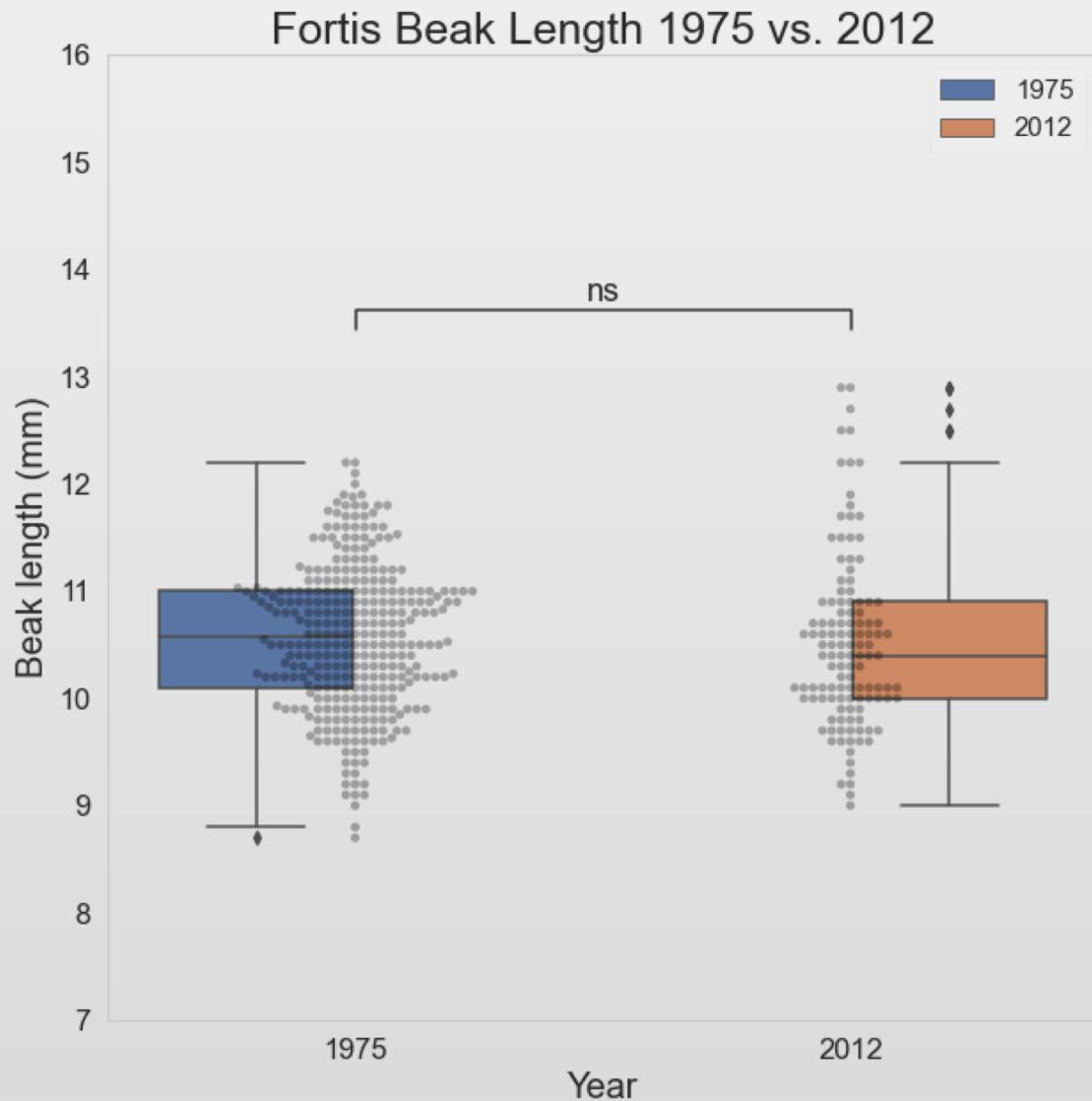
Geospiza Scandens



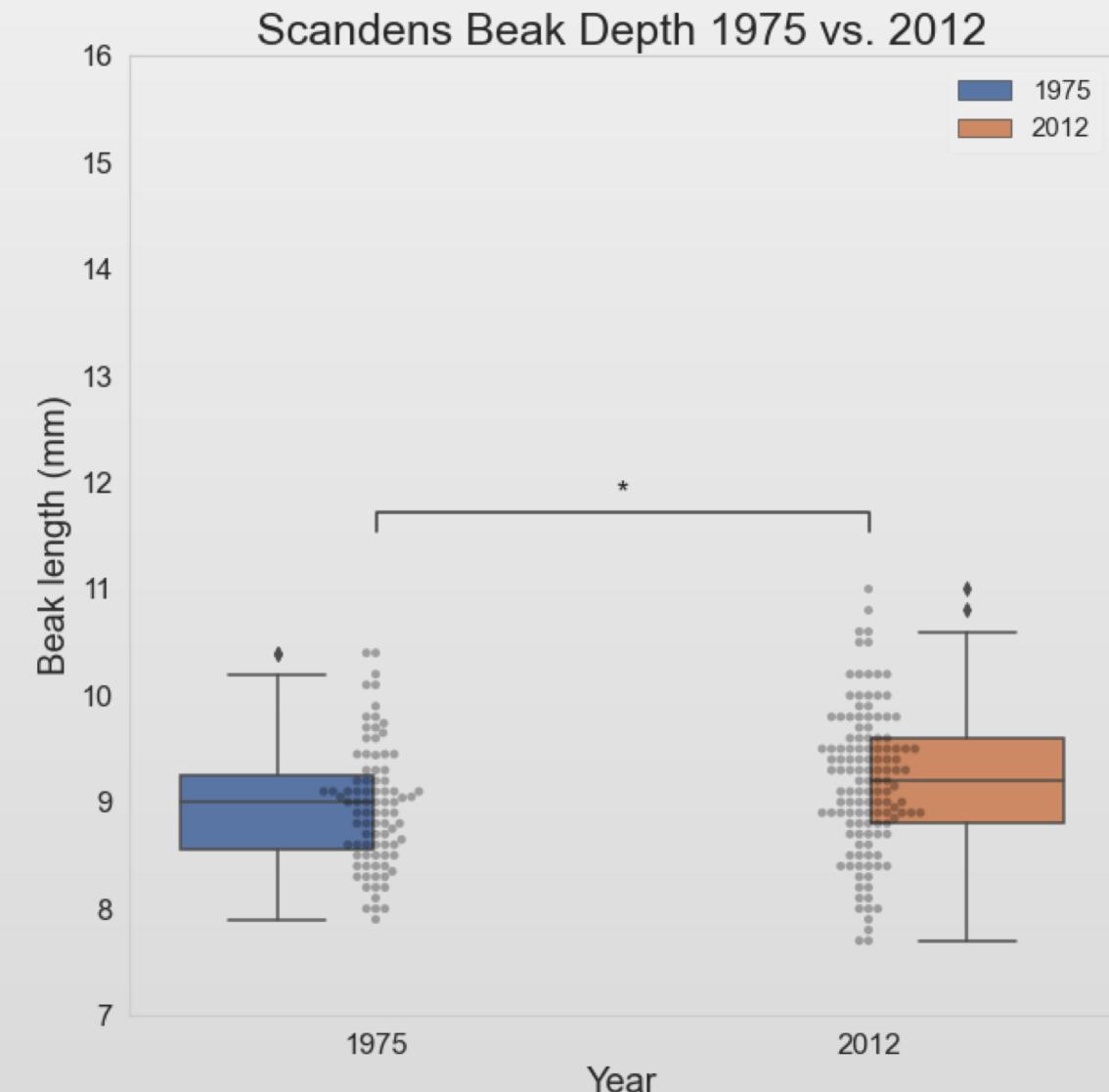
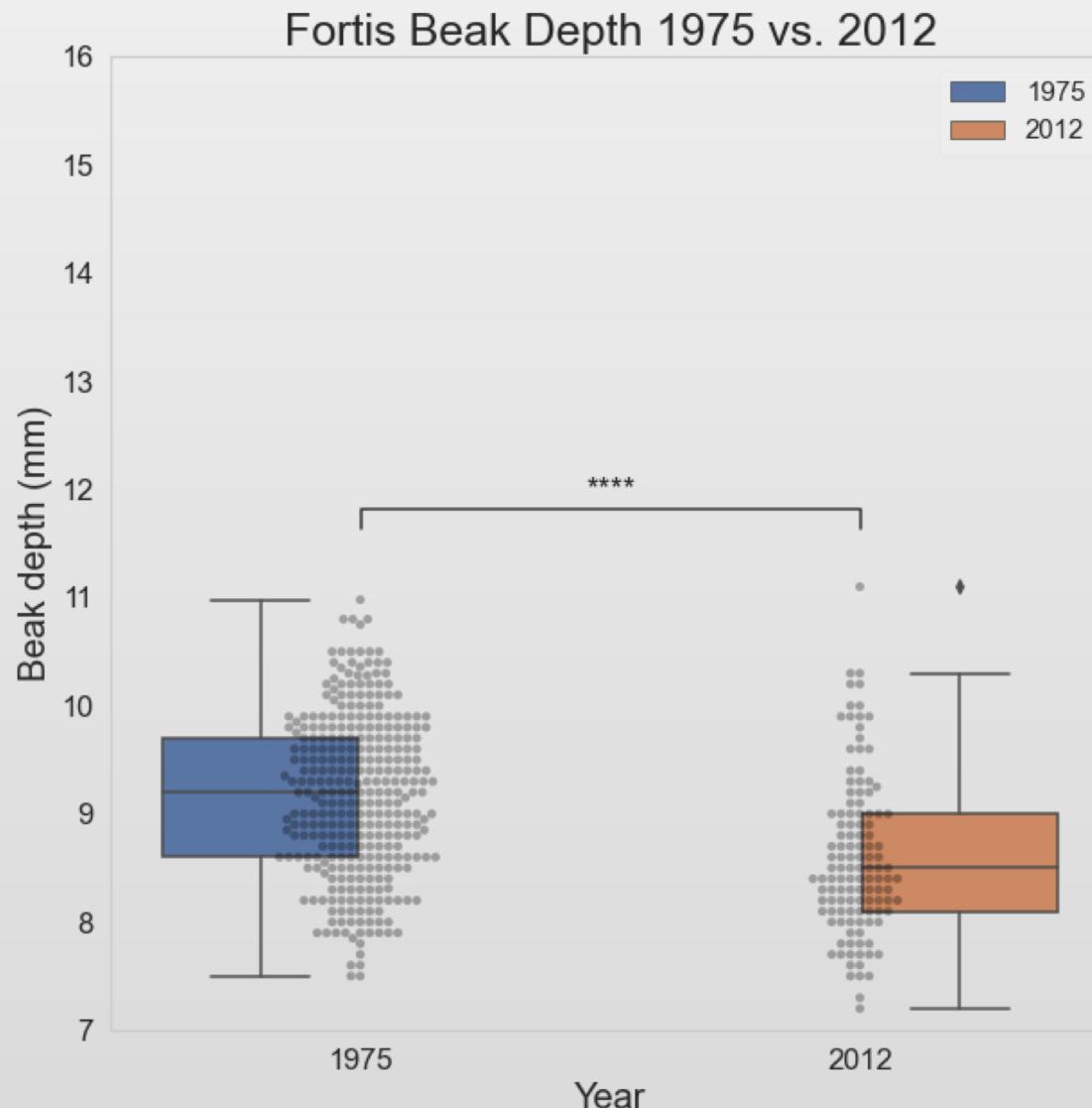
Food :

- Seeds
- Flowers
- Insects

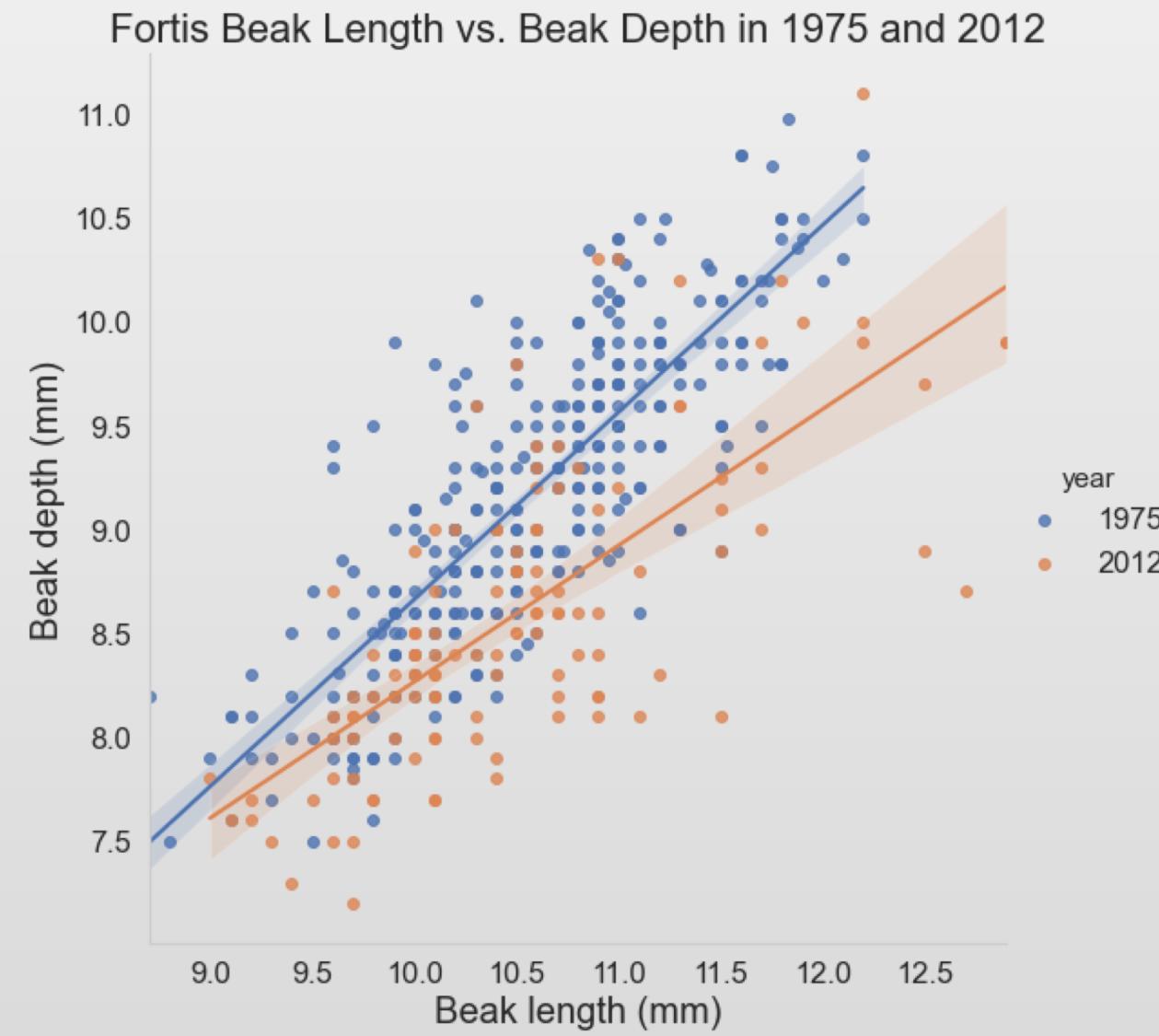
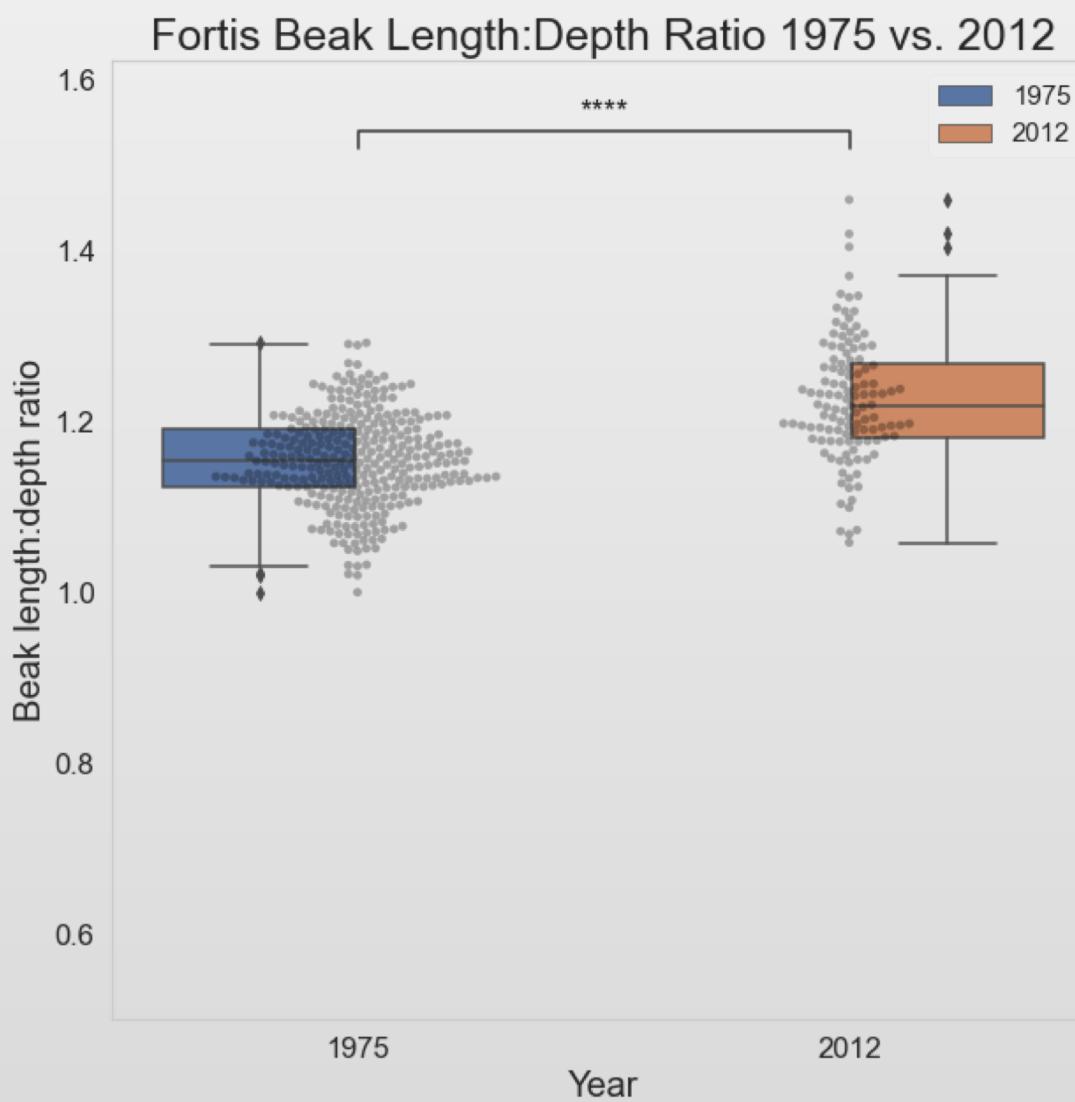
Scandens Beak Length Decreased After 40 Years



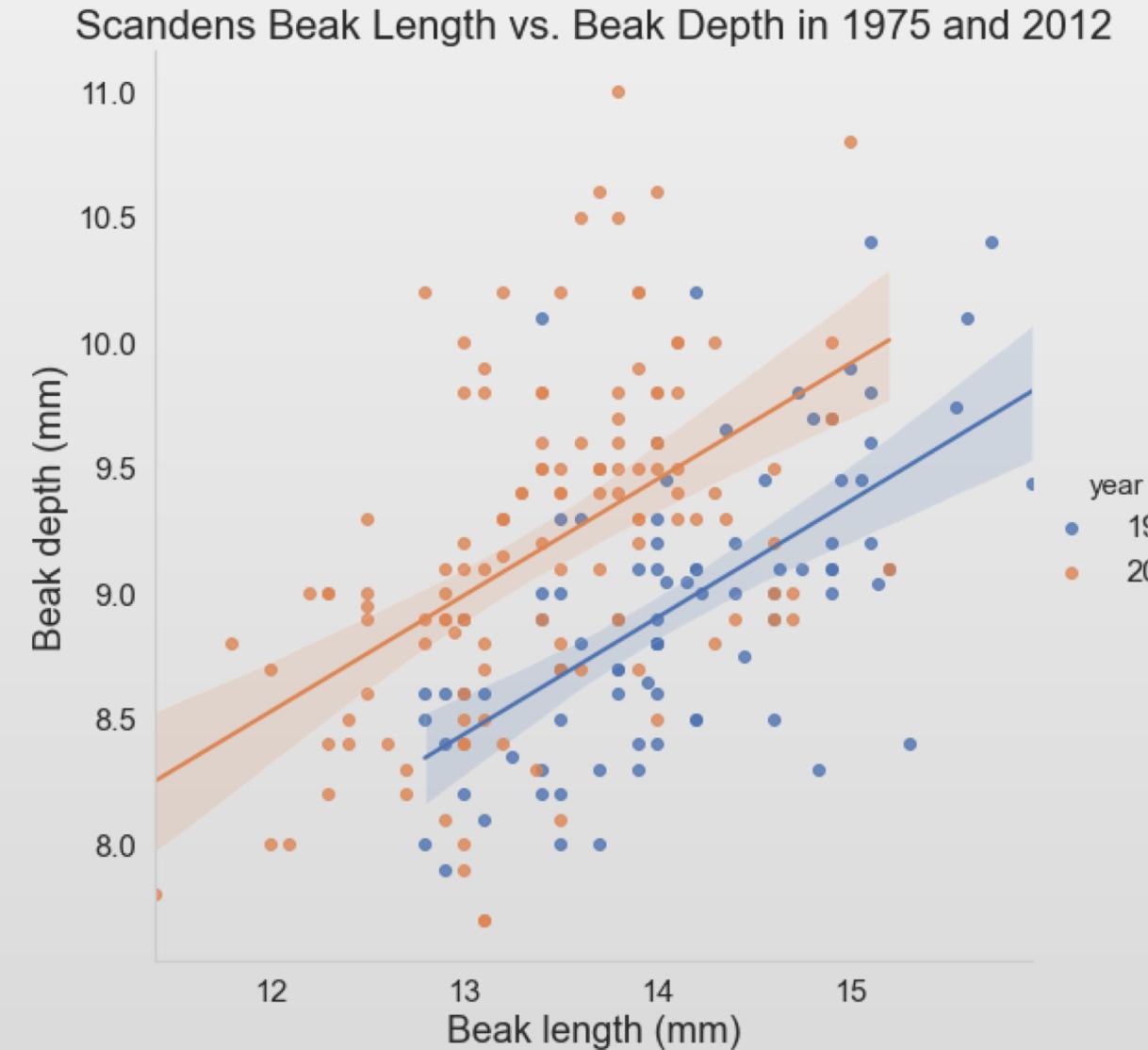
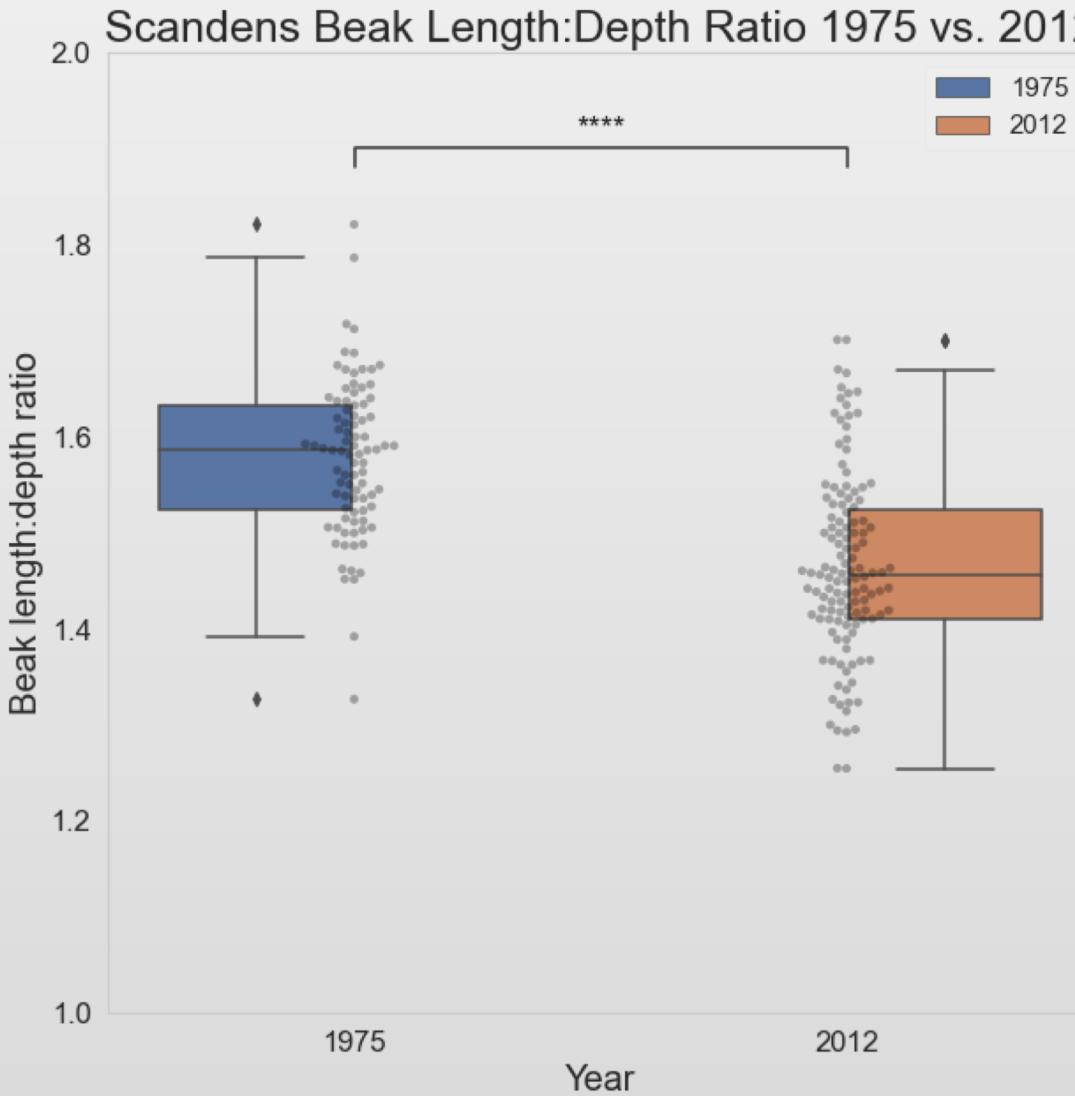
Beak Depth Changed After 40 Years



Relationship Between Fortis Beak Length and Depth



Relationship Between *Scandens* Beak Length and Depth



40 Years of Data Collection – Changes Observed

Geospiza Fortis



Geospiza Scandens



Changes in beak :

- Decrease in beak depth
- Increase in length:depth ratio

Changes in beak:

- Decrease in beak length
- Increase in beak depth
- Decrease in length:depth ratio

Natural Selection

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Charles Darwin

Geospiza Fortis



Geospiza Scandens



Is beak shape inherited?

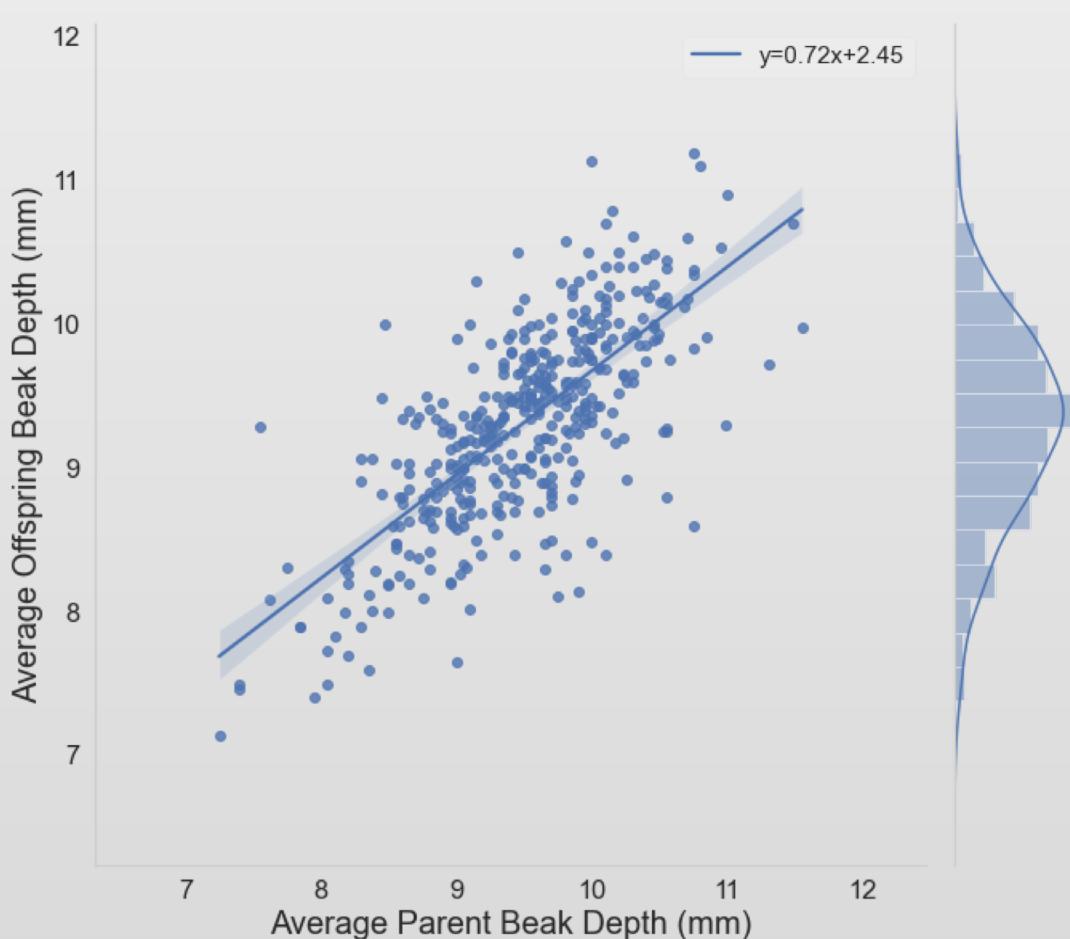
Determining Heredity Through Regression Analysis

“When variation in a trait is heritable, phenotypic means will tend to covary in relatives.”

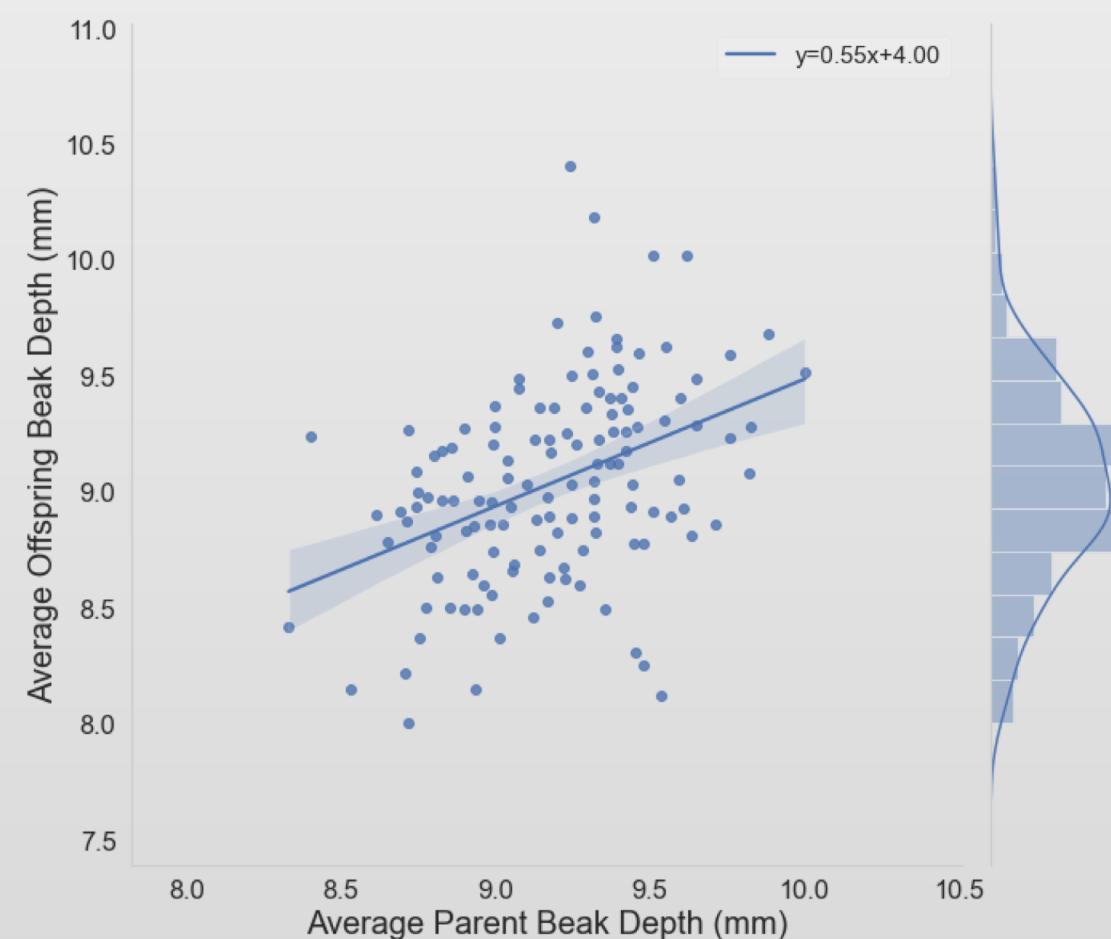
e.g., the beak shapes of parents and offspring will be positively correlated.

Changes in Beak Length and Depth are Inherited

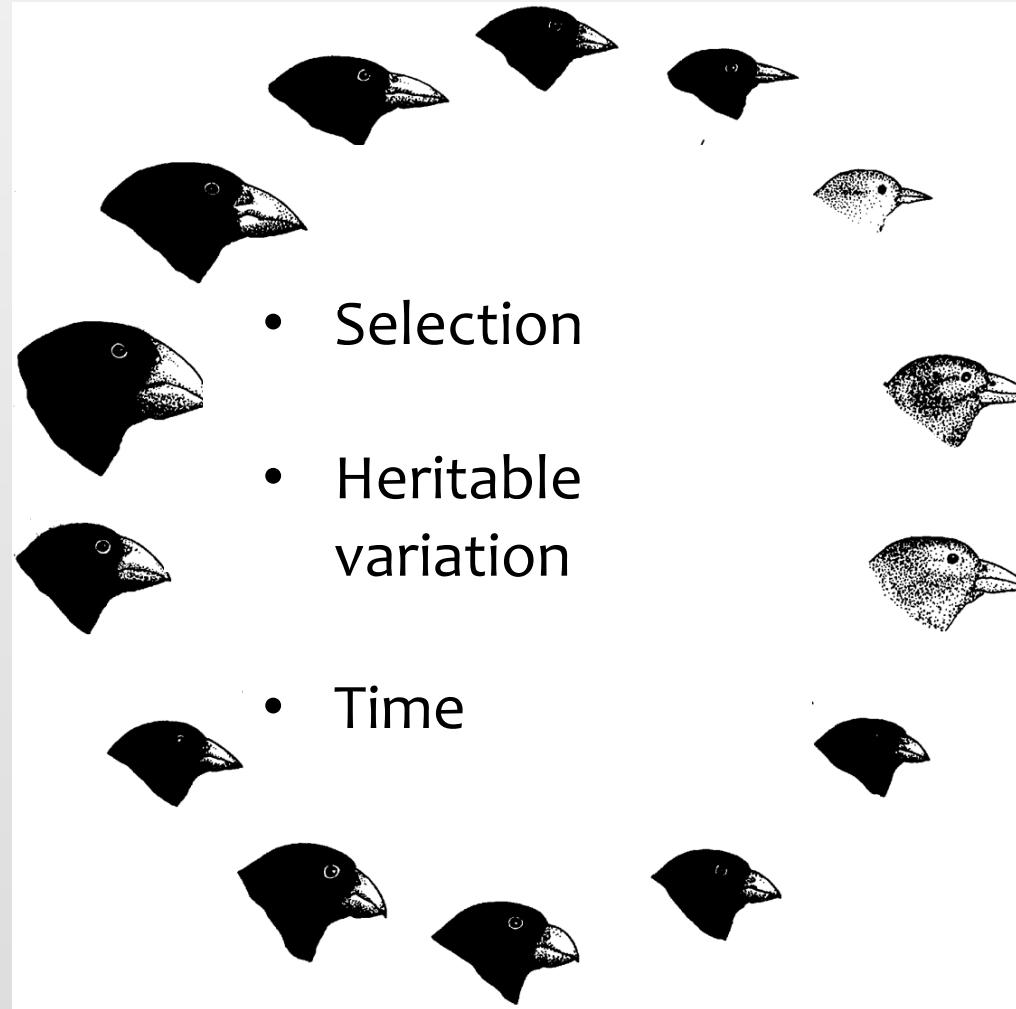
Fortis Parent Beak Depth vs. Offspring Beak Depth



Scandens Parent Beak Depth vs. Offspring Beak Depth



The Fuel of Evolution



Finch beak shape has evolved

Future Directions:

- What environmental changes occurred over the 40 years?
- How have new finch species evolved?
- Which genes are being selected for?