

Tale of Speciation on Daphne Major

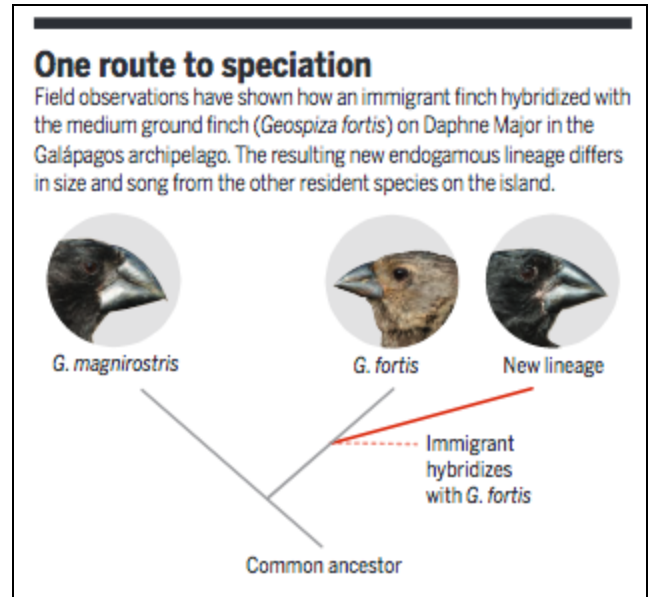
“Speciation, the process by which two species form from one, involves the development of reproductive isolation of two divergent lineages.”

This is an interesting tale of a small population, an immigrant, incest, and isolation. Good thing these are birds. In 1981 a population of finches of the species *Geospiza fortis* lived on the Galapagos island of Daphne Major. An immigrant landed on the island. It was a hybrid of two finch species from another island. Its genetic make up was 66% *Geospiza fortis* and 34% *Geospiza scandens* (another common Galapagos finch species). It came from an unknown island, was **unusually large**, had a huge beak, and sang a strange song.

Over four generations this hybrid bred with other *G. fortis* finches on the island until a drought occurred, wiping out all but one brother and sister.

The brother and sister had no choice but to breed with each other (scandal!!). Their offspring were different from either of them or other finches on the island. The male's song was strange because in learning the song from the father, it was copied incorrectly. But, females of this new population understood the song even though it was wrong. Members of the greater *G. fortis* population ignored the incorrect song and would not mate with the males who sang it. A barrier was in place that originally resulted from one immigrant being separated from its own population somewhere else, and its lineage ended up being behaviorally isolated by an incorrect learned behavior.

1. What kind of speciation do we normally associate with members from one population being geographically displaced to a new, smaller population?
2. What kind of speciation do we normally associate with members of a population that become ecologically, genetically or behaviorally distinct within that population such that they become reproductively isolated?
3. Explain which force of evolution is seen here by a hybrid bird landing on an island that is not its home and breeding with the indigenous population.
4. Explain which force of evolution randomly chooses an individual from a larger gene pool to form a new, smaller population with less genetic variety.



Song Differences - Big Birds Get No Love

There are two main reasons why *Geospiza* birds might not breed with each other: song and body shape. Bird songs in males are a crucial way to attract mates. Being able to recognize the shape of a mate is also very important. Bird songs are learned in a very short window of time in a sensitive period of a young male's life. *G. fortis* only sings one song and although it varies a bit, it is distinct. Females do not sing, but they choose mates based on the song communication.

As members of the interbreeding population were born and learned songs, they learned them incorrectly. Figure 2A below shows sonographs songs of the original immigrant (5110), a son (15830) and a fifth generation descendant (19668), compared with Figure 2B which show three *Daphne G. fortis* individuals that sang a standard form.

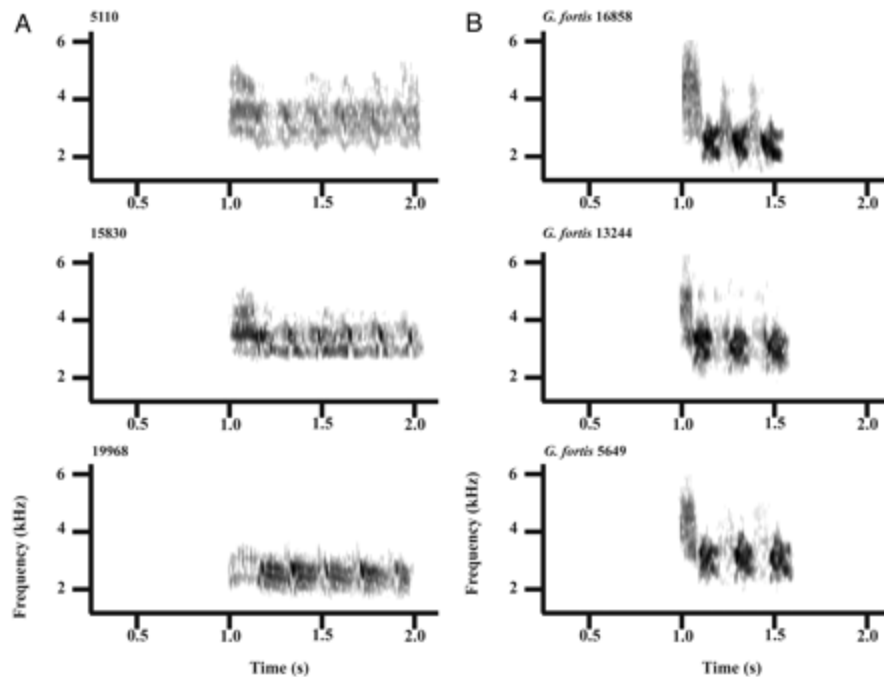


Figure 2: Sonographs showing the immigrant interbred lineage (A) and the native *G. fortis* lineage (B).

In terms of the barriers in place that keep species separate, explain whether song recognition is a prezygotic barrier or a postzygotic barrier.

Explain which type of isolating mechanism this would be once you determine the barrier type.

Discuss why song would be a barrier to mating with another species and having the incorrect song might change your fitness potential.

Beak Shape

In terms of body shape the two populations appear quite different (Figure 3). Beaks are the major adaptation that seem to matter on Daphne Major. In looking at this feature, there is a clear difference in beak size between the immigrant lineage and native *G. fortis* lineages. The Grants nicknamed the immigrant lineage the “big bird” lineage for obvious reasons.

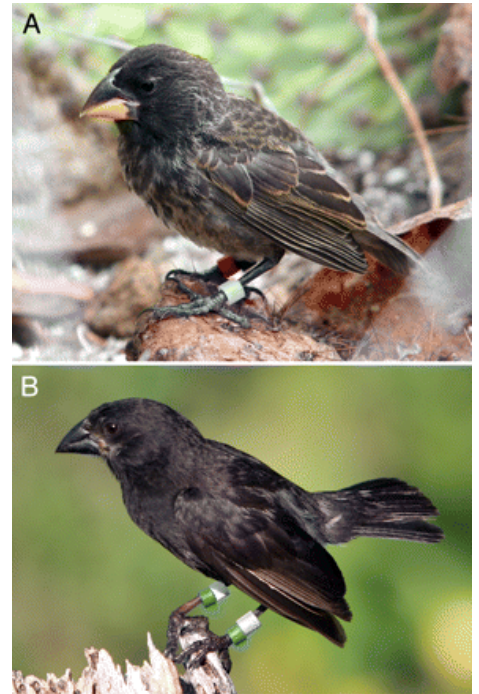
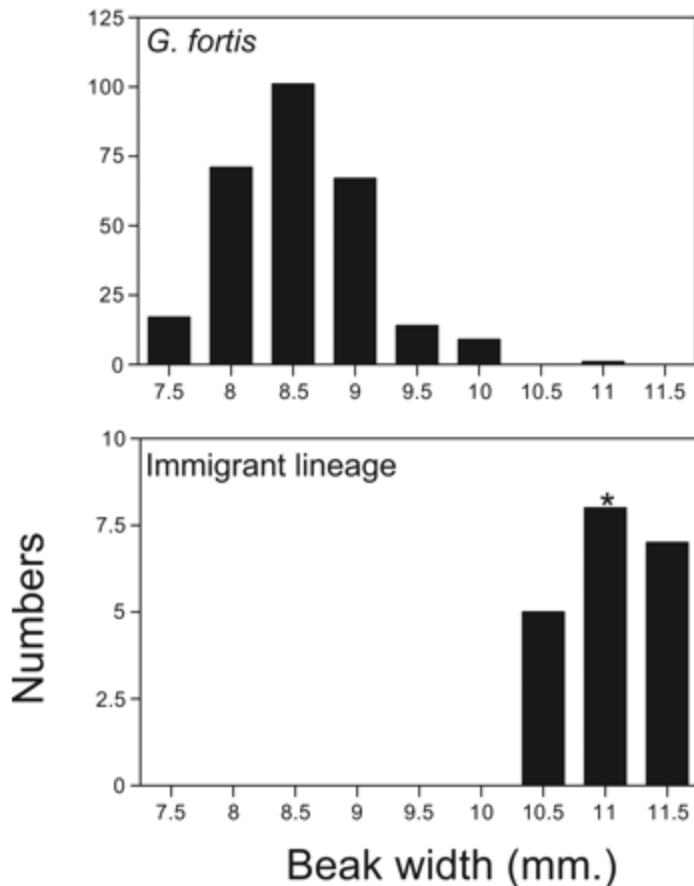


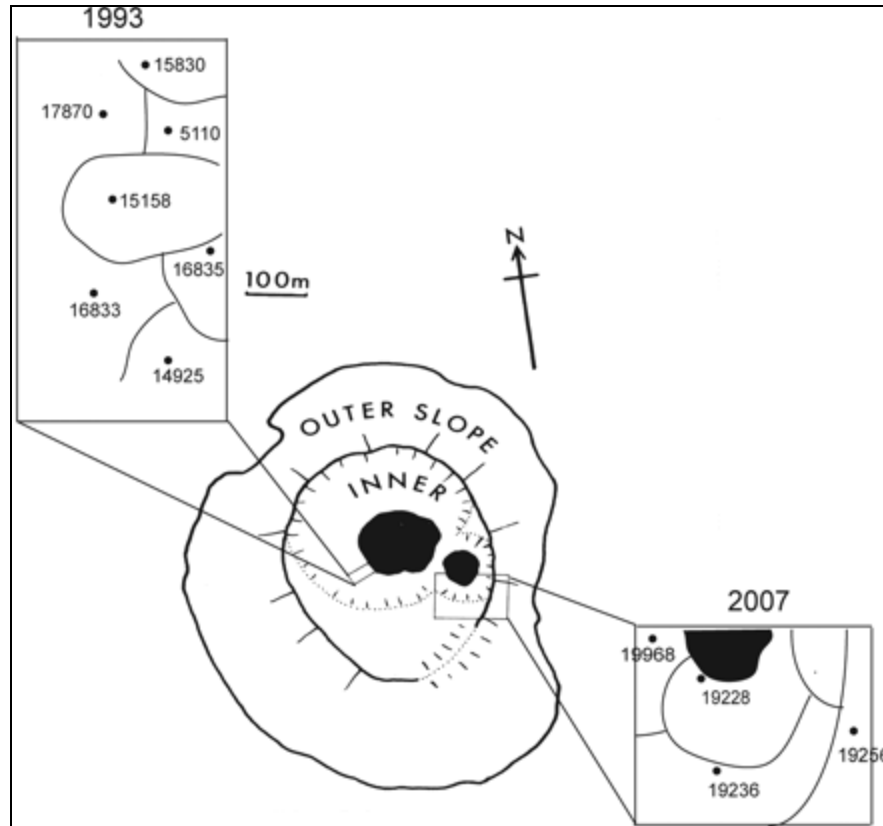
Figure 3 (right): (A) shows a member of the fifth generation offspring of the immigrant. (B) shows a native *G. fortis* resident.

Figure 4: Top figure shows a typical distribution of beak size for native *G. fortis* on Daphne Major. The bottom figure shows the beak size distribution of the immigrant offspring. The original immigrant is designated by the asterisk.

8. The immigrant lineage has only a population of 20 while the native lineage 280 birds sampled. How might the size of the gene pool contribute to the low variety in beak size for the immigrants?
9. Beak shape and size is a recognizable body feature for a species to recognize its own. How does the evidence in figure 4 support beak size as a feature that contributes to isolation?
10. How could low diversity of beak sizes in a small population place the immigrant population at risk if ecological factors (like seed size) change on the island?

Isolation

Figure 5 below shows the nest sites of all members of the immigrant/native breeding population before the drought (1993) and later after interbreeding isolation (2007). The numbered dots show nesting sites and the large black areas show the volcanic craters on the island. Male territories are shown by the lines around each nest.



In the map above, brother and sister mated at nest site 16833. This type of mating is called endogamy. Surrounding nest 16833 are typical *G. fortis* nesting sites.

11. Why do you think the immigrant lineage moved to the nesting sites (2007) away from the original sites?
12. How is this isolation an example of sympatric speciation?
13. After many generations in isolation, would you consider the Big Bird (immigrant) lineage a new species? Why or why not?
14. If the biological species concept implies that organisms of the same species must breed freely in nature and have reproductively, viable offspring, does the Big Bird lineage satisfy this rule even if genetically the birds could produce offspring?

The Grants had these parting thoughts:

“These observations provide important insight into the process of speciation at the beginning of the sympatric phase following divergence in allopatry. They also raise a question that is rarely if ever asked: How many generations of exclusively within-group mating are needed before the group is recognized as a separate species that deserves taxonomic status? There is no non-arbitrary answer. We treat the endogamous group as an incipient species because it has been reproductively isolated from sympatric *G. fortis* for three generations and possibly longer.”