

Seminar Date: 2/14/18

Speakers: Drs. Peter and Rosemary Grant

Title: “40 years of evolution of Darwin’s finches in the Galapagos”

**Observing Evolution in Real Time: Watching the World Change Before
Your Eyes
By: Brianna Ports**

On February 14th, 2018, Duquesne University held its annual Darwin Day celebration honoring the 209th birthday of Charles Darwin, two days earlier on February 12. Every year, the Bayer School of Natural and Environmental Sciences sponsors a speaker to come and discuss their research and highlight the importance of looking at the world through the illuminating lens of evolution. This year we had the pleasure of listening to a presentation by Drs. Rosemary and Peter Grant, emeritus professors from Princeton University. These world-famous scientists are recipients of the Royal Medal (2017), the Kyoto Prize (2009), and the Darwin-Wallace Medal (2009), which is historically awarded only once every 50 years. Their work has been a revolutionary example of what longitudinal study, natural behavioral observation, and environmental awareness can offer biological science as a field.

In the words of Charles Darwin’s fundamental book, *On The Origin of Species*, “One general law, leading to the advancement of all organic beings, namely, multiply, vary, let the strongest live and the weakest die (1).” This concept is the foundation for which Drs. Rosemary and Peter Grant began their own scientific journey. In 1973 on the Galapagos island, Daphne major, the Grants started their research on a small sect of birds; the medium ground finch (*Geospiza fortis*) and the common cactus finch (*Geospiza scandens*), and the environmental forces acting upon them. Just as Charles Darwin had discovered before them, the Grants found an isolated and dynamic location to look at

natural selection in real time. Specifically, the Grants hoped to utilize observational study to identify a relationship between characteristic variation in the finch populations and changes in the environment. To do so, they spent the next 40 years collecting blood samples, observing changes in body and beak sizes, charting environmental events, and analyzing any characteristic they could about the birds on the island.

In their 40 years of data collection, the Grants gathered information on generations of finches allowing them to look at almost every possible variable within the environments. One fact that I found particularly interesting was that each species had their own characteristic song which varied slightly between individuals, but was easily identifiable by the females when choosing a mate. While it was discussed only briefly during their Darwin Day talk, I was immediately compelled to learn more about the topic. Female birds were found to choose mates that sang their species song, but not the same type of song as their father. Through this same study, the Grants discovered that the birds' songs are taught by a parent to its offspring, meaning it is a cultural development, rather than something the birds receive genetically. This makes song a powerful tool in mating as female finches are not only capable of identifying their species via song, but they can discern between individual songs and use that information to keep from mating with close relatives (2).

In 1983, the Grants witnessed the introduction of large ground finches (*Geospiza magnirostris*), a new breeding population that migrated during an el niño year. This development allowed them to have a look into the changes that can occur within populations when a new player is introduced into the environment. In this case, the Grants looked at the changes in all three species' songs, and ultimately their mating habits. They discovered that, in the years following the large ground finch migration, both the small ground finches' and the

common cactus finches' songs increased in speed, ultimately differentiating from the newcomer's song. While the Grants were unable to eliminate all variables because their studies were observational, they hypothesized that this is a result of selection against interbreeding of different species (3). Interbreeding, or hybridization, is something that is found to occur 1-2% of the time, often when young finches are not able to learn their species' song from their father. In these cases, the finches pick up another species' song from a neighboring family of finches and ultimately end up with a mate from the species whose song they have learned. Under most conditions, the offspring of these hybrid crosses were not best suited for survival and died off as their features were more intermediate between the species, making them less suited for eating both smaller seeds and larger seeds. Some hybrids, specifically between small and cactus finches, did survive under fruitful conditions long enough to have offspring. These small hybridizations have led to a crossover between small and cactus finches (4). Other hybridizations have also been successful, most notably between a male large cactus ground finch (*Geospiza conirostris*) that migrated into the region and two female small ground finches. These pairs had offspring which continued to interbreed with one another and outgroup small ground finches. This hybridization has led to divergence of a new lineage that is intermediate between small ground finches and large cactus ground finches, termed the "big bird" lineage. Individuals in the big bird lineage all retain the original male large cactus ground finches' song and continue to interbreed and survive on the island (5). While this is not considered a new species, it is clearly delineating from both parental species and serves as a reminder of the potency of random chance and good timing.

The talk presented by Drs. Rosemary and Peter Grant spoke bounds about the power that passion and determination can have in biological studies. Truly, without their time spent, we would have no idea that these events are occurring, let alone clear documentation of natural selection and early speciation processes in real time. While this alone is enough to make their talk an invaluable experience to have had, the moment of their talk that will most stick with me occurred after their presentation was completed and a student asked, “What advice do you have for students as they pursue research in the sciences?” Dr. Rosemary Grant responded immediately with a simple, but poignant piece of advice, “Follow your heart, it won’t always be easy but there will be magic in it and when you come to a brick wall you will always have done something worthwhile.”

References

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2. Grant B. R, Grant P. R. (1996). Cultural inheritance of song and its role in the evolution of Darwin's finches. *Evolution*. 50, 2471–2487.
3. Grant, B. R., & Grant, P. R. (2010). Songs of Darwin's finches diverge when a new species enters the community. *Proceedings of the National Academy of Sciences of the United States of America*, 107(47), 20156–20163.
4. Grant, B. R., & Grant, P. R. (2008). Fission and fusion of Darwin's finches populations. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 363(1505), 2821–2829.
5. Lamichhaney, S., Han, F., Webster, M.T., Andersson, L., Grant, B.R., Grant, P.R. Rapid hybrid speciation in Darwin's finches. *Science*. 2017.