

Evolution in Small Populations

Peter and Rosemary Grant

2005 Balzan Prize for Population Biology

Balzan GPC Adviser: John Krebs

Project Directors and Main Researchers: Céline Clabaut, Jennifer Gee, Paquita Hoeck, Margarita Ramos-Womack (researchers); David Stern, Lukas Keller, Arkhat Abzhanov (supervisors)

Affiliated Institutions: Department of Ecology and Evolutionary Biology, Princeton University; Zoologisches Museum, Universität Zürich

Period: 2005-2009

Peter Grant is 'Class of 1877' Professor of Zoology and Professor of Ecology and Evolutionary Biology (Emeritus) at Princeton University. Rosemary Grant is Emeritus Professor and Senior Research Biologist in Ecology and Evolutionary Biology at Princeton University. With their second half of the Balzan Prize, the Grants financed four lines of research concerned with mate choice and speciation in species of *Drosophila*; inbreeding and disease in small populations of Galápagos mockingbirds; the molecular basis of species-specific craniofacial patterning in birds; and beak development in an unusual Darwin's finch species, the warbler finch.

For the first line, Margarita Ramos addressed the genetic bases and adaptive significance of morphological evolution in *Drosophila* by focusing on the pigmentation differences between *Drosophila yakuba* and *Drosophila santomea*. She developed and applied a technique for identifying the individual genes responsible for abdominal pigment differences between species. The laboratory research was supervised by Dr. David Stern at Princeton University.

As for the second, Paquita Hoeck tested the hypothesis that reduced genetic variation due to inbreeding lowers the ability of small and inbred populations to respond to infectious diseases. For this purpose, four allopatric species of mockingbirds on the Galápagos Islands were studied, and the genetic variability in populations of different size was determined by using neutral genetic markers (microsatellites). The positive

results are of direct importance to the conservation management of the endangered Floreana mockingbird species. This research was supervised by Dr. Lukas Keller at Universität Zürich.

The third line of research was taken up by then postdoctoral fellow Céline Clabaut, who studied the molecular basis of craniofacial patterning in Darwin's medium ground finches of the Galápagos Islands under the direction of Dr. Arkhat Abzhanov at Harvard University. The main aim of Céline Clabaut's Balzan Foundation fellowship was to study the genetic basis of species-specific Bmp4 expression. Together, they were able to (1) show that the Bmp4 coding sequence in Darwin's Finches is too conserved to be responsible for the species specific expression of Bmp4; (2) start the analysis of cis-regulatory changes; and (3) develop two powerful approaches to identify the enhancers: first, long-range detection of the enhancer activity with transgenic hybrid mice, and second, a more precise search using a lentivirus approach.

Finally, for the fourth line, Jennifer Gee (postdoctoral fellow) worked in the same lab as Clabaut, applying similar techniques to the investigation of differences between the warbler finch (*Certhidea*) and the ground finches (*Geospiza*).

A two-day Balzan Symposium *Population Biology and Evolution*, dedicated to the overall results of the project was held in September 2008 at Princeton University.

Publications

- Grant PR, Grant BR. 2008. How and Why Species Multiply. The Radiation of Darwin's Finches. Princeton (NJ): Princeton University Press.
- Grant PR, Grant BR., eds. 2010. In Search of the Causes of Evolution. From Field Observations to Mechanisms. Princeton (NJ): Princeton University Press.
- Grant P, Grant R. 2010. The First Annual Balzan Lecture: The Evolution of Darwin's Finches, Mockingbirds and Flies. Florence: Leo S. Olschki.
- Hoeck PEA, Beaumont MA, James KE, Grant BR, Grant PR, Keller LF. 2010. Saving Darwin's muse: evolutionary genetics for the recovery of the Floreana mockingbird. *Biology Letters*. 6: 212-215.
- Hoeck PEA, Bollmer JL, Parker PG, Keller LF. 2010. Differentiation with drift: a spatio-temporal analysis of Galapagos mockingbird populations (*Mimus* spp.) *Philosophical Transactions of the Royal Society B*. 365: 1127-1138.

Rebeiz M, Ramos-Womack M, Jeong S, Andolfatto P, Werner T, True J, Stern D, Carroll S. 2010. Evolution of the tan locus contributed to pigment loss in *Drosophila santomea*: a response to Matute et al. Cell. 139, (6): 1189-1196.