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## Introduction

### The Grants. Dreaming Darwin's Dream

*(Ernst Mayr Lecture am 4. November 2004)*

You all will have seen one or another of these lovely cartoons that depict a small island occupied only by a single palm tree and a happy couple residing underneath. The island could well be Daphne Major, a tiny speck in the centre of the Galapagos Archipelago, and the happy couple on it Rosemary and Peter Grant. In one respect, however, this flight of imagination does not fit the cartoon reality: There is no palm tree on Daphne Major.

Nevertheless, Daphne Major has become Rosemary's and Peter's paradise, their natural laboratory for studying evolution in real time. When Peter first arrived there in March 1973, he might not have anticipated that he and Rosemary would spend the most successful and exciting parts of their research careers on this inconspicuous and lonely island; for Daphne Major, the tip of a volcano that has erupted from the floor of the sea and broken the surface of the Pacific a few million years ago, is just a heap of lava rocks covered with sparse vegetation, low shrubs, small trees, and *Opuntia* cactuses. There are no beaches, only steep slopes and rough cliffs. Devoid of any food or water, the island has never been inhabited before. Why should a happy and promising young couple with two daughters aged six and eight decide to spend several months each year on this barren, inhospitable Pacific islet, boring as it is by any touristic means.

To a biologist the reason is obvious. There are finches on this island, exactly these "jet black or brown birds ... with short tails ... and curious gradation in the size of their beaks", which Darwin had described in his notebooks in 1835, when HMS "Beagle" had cruised within the Galapagos Archipelago for several weeks. As we now know, all these finches – "Darwin's finches" – are endemic to the Galapagos Islands, i.e. occur only there and nowhere else in the world. Four of the in total 14 species live on Daphne Major. They are the actors in the play staged by Rosemary and Peter Grant and entitled "Natural Selection in Action". The play is on stage now for 30 years, during which Rosemary and Peter together with an uninterrupted line of adventurous graduate students have observed, banded, counted and pedigreed

these birds, the birds' offspring, the offspring's offspring, etc. for dozens of generations; they have measured the shapes of the beaks and the sizes of the bodies of all the finches on the island; they have recorded the numbers and weights of the eggs in all the clutches and the growth patterns of all the hatchlings; they have computed the relations of finch biomass to food biomass across entire populations during all the seasons of the year; they have collected details about the finches' diet and have arrived, in this context, at numbers as strange as the square root of the product of the depth and hardness of the seeds that the finches eat; they have taken blood samples from the birds, in order to use molecular approaches for determining the amount of genetic variation within species and the level of gene flow between species.

All this painstaking work has been done to turn into reality Darwin's dream of observing evolution in slow motion. Obviously, the Grants have been driven, from the outset, by the conviction that they would be able to establish a link between evolutionary dynamics in contemporary time and patterns of evolution in the past; and it must have been this conviction that made them live for months each year in caves and storm-proof tents. However ambitious this scientific endeavour might have appeared in the beginning, it has now turned out to be amazingly successful. Two years ago, Peter and Rosemary jointly received the Darwin Medal of the Royal Society.

Who are these Darwinian dreamers, the founders and heads of the IFIU, the *International Finch Investigation Unit* or *El Grupo Grant*, as it has been dubbed by the Galapagos people? In short, Rosemary is a geneticist by training with an early interest in ecology, and Peter is an ecologist by training with an early interest in genetics. On the basis of these congenial pre-Daphne interests in evolutionary biology, the Grants could have taken it for granted that an ideal scientific marriage would result – even though he completed his undergraduate studies in England and she did so in Scotland (at the Universities of Cambridge and Edinburgh, respectively). Thereafter, Peter did his Ph.D. work in Canada, at the University of British Columbia, and Rosemary in Sweden, at the University of Uppsala; but finally, almost 20 years ago, they settled down together in the United States, where both are now Professors at Princeton. The rest is history.

Indeed, the famous birds have made Rosemary and Peter celebrities, the gurus of Darwin's finches. Contrary to general belief, Darwin himself while travelling on the "Beagle" did not think these birds were very special. In one case he even failed to store birds from different islands in different bags. Most surprisingly, however, he did not even mention them in his opus magnum the *Origin of Species*. Was it this surprise about Darwin's omission that got Peter Grant startled, when in the early 1970s he had finished working on nutcrackers and mice and was looking for a new research project? Or was he rather turned on by what Darwin actually did write in the *Origin*, namely that natural selection is at work "whenever and wherever opportunity offers", but that "we see nothing of these slow changes in progress, until the hand of time has marked the lapse of ages". Now, after thirty years on Daphne

Major, the Grants have observed such changes in progress within the lapse of years, even months. What many others including Darwin have inferred, the Grants have seen it and studied it in unprecedented detail: the temporal patterns of evolutionary processes under unconstrained natural conditions.

Finally, there is yet another aspect that cannot go unheeded. During their 30-year long studies on Daphne Major the Grants have attracted, supervised, stimulated, and trained several generations of enthusiastic graduate students, who by now are all professors at universities in the United States, Canada, and Europe. Trevor Price in Chicago and Dolph Schluter at the University of British Columbia, to mention just two of the most brilliant ones, have become leading figures in the field of microevolution and speciation, and the youngest of the former Daphne addicts, Lukas Keller, will certainly follow in their footsteps. We just hired him as an Assistant Professor at the University of Zürich. Hence, the fire lit by the Grants in the Galapagos Islands has spread to other regions of the world and to other model organisms. The Grants themselves have recently extended their ecological and evolutionary studies to a variety of animals, for example, fire-flies, 17-year cicadas, and even microorganisms such as avian blood parasites. Furthermore, as one of their most recent articles in *Nature* shows, they have also moved into the field of *evo-devo*, short for evolutionary developmental biology; but what is closest to their hearts and what they actually helped to create, is *evo-eco* (evolutionary ecology) – and in the duet they are now going to play *evo-eco* is the *Leitmotiv* of the music and the libretto alike.