Charles Darwin spent just over a month on the Galápagos Islands in 1835. The peculiar finches he collected there, each species with a distinctive beak shape, helped inspire his theory of evolution by natural selection. In 1973, Peter and Rosemary Grant, a husband-and-wife team of Princeton University biologists, returned to the Galápagos to observe the evolution of Darwin's finches up close. On the volcanic island of Daphne Major, they and their students have been keeping track of every single finch from birth to death, allowing them to quantify the effects of natural selection on the birds. The ongoing study is "one of the true classics of evolutionary biology," says biologist John Burke of Indiana University, Bloomington.

On page 707 of this issue, the Grants review 30 years of evolution among Darwin's finches. Evolution has proven predictable in the short term but unpredictable over the course of decades, they report. Climate change has been a powerful influence guiding the evolution of the finches—and its effects turn out to be surprisingly complex. Natural selection is not the only force altering the birds: So is their promiscuous sex life. The two species on Daphne Major can and sometimes do interbreed, and their hybrids—far from being mulelike reproductive dead ends—are a source of fresh genetic variability. Interbreeding may be one of the secrets to the fast evolution of Darwin's finches, the Grants suggest, adding that hybrids may be an unrecognized factor in the evolution of many other animals.

On Daphne Major the two most common species of Darwin's finches are the medium ground finch (Geospiza fortis) and the cactus finch (G. scandens). Ground finches have blunt beaks that are well suited for cracking small seeds of perennials, and larger individuals can break open the harder, larger seeds of a
plant called the caltrop. The cactus finches have pointier beaks that they use to devour the fruits and pollen of cactus.

Changes in the food supply have made natural selection favor birds with beaks of certain sizes and shapes at different times, the Grants have demonstrated—just as Darwin theorized. In 1977 a La Niña-related drought wiped out the plants that produce small seeds, and most of the ground finches died. But some big-beaked birds survived because they could feed on caltrop seeds. Within a few generations, the average ground finch beak evolved to be 4% bigger. But in 1983 the island was clobbered by La Niña’s soggy twin, El Niño, whose rains triggered a frenzy of small-seed plant growth. Ground finches with small beaks were more efficient at eating the new seeds and had more offspring, shrinking the average beak by 2.5% within a few years.

Cactus finches have evolved as well, although natural selection has acted more weakly on them. When the 1983 El Niño swamped the birds’ favored cactuses, birds with slightly blunter beaks could eat the small seeds of other plants. But the Grants found a paradox: Cactus finch beaks have been getting significantly blunter year after year, even though selection pressures from the birds’ food source have diminished.

The reason, the Grants found, is that cactus finches have been fraternizing with ground finches—and the latter’s genes are shaping the former’s beaks. After the 1983 floods, female cactus finches starved as the larger males drove them away from the few remaining fruits. That left as many as five male cactus finches for every female. A few desperate males mated with female ground finches, which then produced perfectly healthy and fertile hybrids. These hybrids only mate with cactus finches, because they imprinted on the songs of their cactus-finch fathers. "The sons will sing the same song as the fathers sing, and the daughters, having paid attention to the songs of their father, will pick a cactus finch male when they
grow up," Peter Grant explains. As a result, ground finch genes are flowing into the cactus finch gene pool—a process called introgression—making their beaks blunter.

Other biologists are surprised that two distantly related species can produce healthy hybrids that go on to play an important evolutionary role. Introgression is "something that's invisible unless you do work like the Grants have been doing for so long," says David Reznick, a biologist at the University of California, Riverside. "It may turn out to be much more important than people think."

This new source of genetic diversity makes it easier for a species with donated genes to adapt to a changing environment, the Grants claim. At the same time, introgression of the finch genes demonstrates just how leaky the barriers are between species. "It forces people to think of species much more as open genetic systems rather than closed ones with an impermeable membrane," says Peter Grant.

As for the finches' future, the Grants can say only that it promises to be as unpredictable as the past. Will *G. scandens* disappear as it acquires more and more *G. fortis* genes? "I think the fusion is taking place right now," says Peter Grant. As evolution unfolds on Daphne Major, the Grants and their students will be watching.

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