In Search of Darwin's Islands

by Richard Halliburton

Lonesome George, the last surviving tortoise of the Isla Pinta subspecies. (Richard Halliburton)

Every evolutionary biologist must make the pilgrimage to the Galápagos Islands, but I resisted for many years. I feared the possibility of letdown: What if reality did not live up to the myth of this showcase of evolution? Also, I don't like traveling with groups, and that is the only practical way to visit the islands.

But when offered a chance to attend a series of seminars and field trips (code words for an academic junket) with a group of card-carrying evolutionary biologists, I couldn't refuse. So I found myself standing in line at the customs station on San Cristóbal, waiting to be searched (for seeds and insects, not weapons).

Blue-footed Boobies performing a mating dance. (Richard Halliburton)

Charles Darwin spent about five weeks in the Galápagos in 1835. He had been traveling for nearly four years. Lonely and homesick, his first impression of the islands was unfavorable: "Nothing could be less inviting than the first appearance."*

The popular view is that Darwin came to his theory of evolution in a single blinding revelation while in the Galápagos. Alan Moorehead, for example, in his well-known *Darwin and the Beagle* writes, "For the *Beagle*, this was just another port of call in a very long voyage, but for Darwin it was much more than that, for it was here, in the most unexpected way—just as a man might have a sudden inspiration while he is traveling in a car or a train—that he began to form a coherent view of the evolution of life on this planet."

The truth is much less dramatic. It was many years before Darwin understood the significance of these islands to his theory of evolution. Nevertheless, in 1835, travel-weary, lonely, and probably bored, he went about his work, collecting plants and animals, and recording his observations

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and thoughts in his journals.

I have come for similar reasons, though I am neither bored nor lonely. I am equipped with binoculars, cameras, notebooks, and field guides, to observe the plants and animals and to record my own observations to share with my students. Unlike Darwin, I will do no collecting. With more than 40,000 tourists visiting the Galápagos each year, regulations are necessarily very restrictive and penalties severe—I wish to return home on schedule and not be locked up and forgotten in an Ecuadorian jail.

After a couple of hours, we escape from the airport and make our way to the *Estrella del Mar*, our home for the next eight days. The travel brochure describes it as a "superior class" sixteen passenger yacht "perfectly suited for the islands of the Galápagos." I take one look at my smelly, moldy closet of a cabin, and vow to do nothing but sleep in it.

My companions are members of the Society for the Study of Evolution, a scientific society of professional biologists (and others) interested in evolution. The group includes botanists, entomologists, ornithologists, geneticists, and assorted other "-ists." Most are university professors. We come from the U.S.A., Canada, Spain, France, Switzerland, and other countries, and we range in age from 17 to 78. We have in common an intense interest in evolutionary biology and a reverence for the Galápagos as a sacred spot in the history of biology. Only such a group would praise the beauty of flies over lunch.

Darwin recognized that many of the plants and animals in the Galápagos are endemic to the islands. I especially wanted to see some of the unique land birds for which the Galápagos are famous. After lunch, the first bird I see while walking along the rocky shore at Sea Lion Beach is a Yellow Warbler, a common summer resident of New England forests. I had seen it many times on campus and in my own back yard. But *what* a Yellow Warbler this is! A male, bright yellow with a reddish brown cap, dipped its head into a tide pool against a background of nearly black volcanic rocks. I immediately shoot half a roll of film. I begin to realize that, no matter how much film I brought, it is not going to be enough.

Darwin would be embarrassed.

Most famous of all Galápagos birds are, of course, the finches. David Lack first called them Darwin's Finches in 1944, and the name has stuck. Darwin would be embarrassed. He collected thirteen species of finches, and describes them in the first edition of *The Voyage of the Beagle*: "These birds are the most singular of any in the archipelago. They all agree in many points; namely in a peculiar structure of their bill, short tails, general form, and in their plumage...It is very remarkable that a nearly perfect gradation of structure in this one group can be traced in the form of the beak, from one exceeding in dimensions that of the largest gros-beak, to another differing but little from that of a warbler."

Darwin recognized that the finches were unique and that they represented a group of related species. At the time he collected them, however, he did not realize the extent of inter-island variation: "It never occurred to me that the productions of islands only a few miles apart, and placed under the same physical conditions, would be dissimilar." Consequently, he lumped all his specimens together without recording the island from which each individual came. This carelessness has frustrated biologists for over 150 years. While Darwin hinted at the existence of inter-island variation among the finches, he concluded, "But there is not space in this work, to enter on this curious subject." Apparently, in 1839 he thought this variation of little importance.

In the second edition (1845), Darwin inserted the famous sentence, "Seeing this gradation and diversity of structure in one small, intimately related group of birds, one might really fancy that from an original paucity of birds in this archipelago, one species had been taken and modified for different ends." Here, he hints at the real importance of the finches, but does not expand on it. Curiously, he does not even mention the finches in the first edition of *The Origin of Species* (1859). One is left to wonder what Darwin really thought of Darwin's finches.

only God and Peter Grant can tell the finches apart.

Modern biologists have no doubts about their importance. Many scientists since Darwin have studied the finches and added details to our knowledge, making them one of the most studied groups on the planet. Peter and Rosemary Grant, of Princeton University, have devoted much of their scientific lives to studying Darwin's finches, and have built their careers documenting finch evolution in detail unheard of for most other species. As the classic textbook example of adaptive radiation, Darwin's finches make an appearance in virtually all first-year biology courses.

One goal of this trip is to bring back some good finch photographs to show to my students. I should have known better. Like finches everywhere, they are constantly moving, hiding in thick shrubs, always hopping just out of telephoto range. Moreover, most these finches look alike. A common saying among finch workers is that only God and Peter Grant can tell the finches apart. Over several days I spend many hours stalking finches and shoot several rolls of film. I snap only mediocre photographs of several species (which I hope I correctly identified).

I have better luck with the mockingbirds. There are four species of Galápagos mockingbirds and never more than a single species on any given island. Darwin recognized this odd distribution, even though he collected only three species. (He never got to Española, home of the fourth species.) In the first edition of *Voyage of the Beagle*, he writes: "I examined many specimens in the different islands, and in each the respective kind was *alone* present," (Darwin's emphasis). In the first edition of *The Origin of Species*, Darwin cites the mockingbirds, and not the finches, in his discussion of differentiation on islands.

Galápagos mockingbirds are very tame and bold, especially if they are thirsty. On Española I hold out a water bottle. A mockingbird flies over, perches on the rim, and sticks its head into the bottle. I pour some water into my palm, and another lands on my hand to drink. Darwin recounted a similar experience: "One day a mocking-bird alighted on the edge of a pitcher (made of the shell of a tortoise), which I held in my hand whilst lying down. It began very quietly to sip the water, and allowed me to lift it and the vessel from the ground."

The Galápagos are true desert islands. Fifty meters or so from the shore, you find yourself amidst vegetation much like that of other dry regions around the world. Darwin noted that Galápagos vegetation resembled that of the western coast of South America. I'll trust him on that, never having seen the desert coasts myself. I can confirm that the plants I see look much like those found in deserts of the southwestern United States, Mexico, or even Australia. Small in size, with dry leathery leaves, thorns, deep roots, dull, grayish-green colors, regular spacing: These are all are adaptations to a limited water supply and are characteristic of desert plants throughout the world. Some of the genera are the same as I've encountered in the Sonoran Desert: Prickly Pear, the Palo Verde tree. Others are familiar in form, but new in detail: the Palo Santo tree, Saltbush, *Tiquilia*. I am always amazed at the similarity of desert vegetation the world over. But I know this is exactly what I should expect if Darwin's theory is true.

A broken field of black basaltic lava is everywhere covered by a stunted brushwood

I hike up the hot, dry, volcanic slopes of Bartolomé. All I see is *Tiquilia*, small grayish shrubs with tiny leaves, individual plants widely spaced so that all partake of the almost nonexistent water in the soil. These are among the first plants to colonize dry rocky slopes. Darwin again: "A broken field of black basaltic lava is everywhere covered by a stunted brushwood, which shows little signs of life. The dry and parched surface, having been heated by the noonday sun, gave the air a close and sultry feeling, like that from a stove: we fancied even the bushes smelt unpleasantly."

Apparently, some of my companions have not read Darwin, or even the guidebooks for that matter. Hiking up the dry slopes in the heat of day, I overhear someone say, "It never dawned on me to bring a water bottle." I mutter to myself that commercial tour operators are interfering with natural selection.

The only other plant common to these volcanic slopes is the lava cactus (*Brachycereus nesioticus*), a genus endemic to the islands. It is a small, yellow-orangish cactus that grows close to the ground. Like *Tiquilia*, it is among the first plants to gain a foothold on volcanic slopes.

One night, over a beer, we decide to find out.

Two other genera of cacti are found in the Galápagos. I am most interested in *Opuntia* (prickly pear cacti), a group native to the Americas, and introduced into many other parts of the world. Several species of prickly pears are endemic to the Galápagos. Prickly pears are very important to evolutionary biologists because of several species of fruit flies that breed in rotting prickly pear pads. The ecology and development of these flies have been studied in great detail, and they comprise the most thoroughly understood community in evolutionary ecology. I spent a year in Australia studying the population genetics of one of these fruit fly species introduced from South America. To my knowledge, only four or five scientists in the world study this particular species. In one of those remarkable coincidences too implausible to be invented, two of us are on this trip. We both are

Darwin recognized that many of the birds, like this Masked Booby, are endemic to the islands. (Tom Cockrem)

The nest of a Blue-Footed booby, scratched out of a broken field of basaltic lava. (Richard Halliburton)

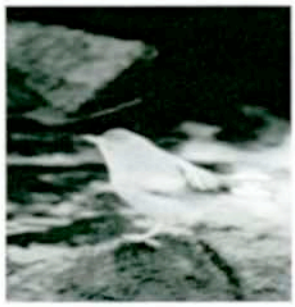
Marine iguanas spend much of their time submerged in the ocean, searching for food. (Tom Cockrem)

Albatrosses are often sighted by the more than 40,000 tourists who visit theGalápagos each year. (Tom Cockrem)

Given the hordes of tourists and the pressure to accommodate even more, the Galápagos National Park Service does a remarkable job of preserving the environment. (Tom Cockrem)

curious to know if any fruit flies breed in the Galápagos prickly pears. Neither of us is aware of any such studies.

One night, over a beer, we decide to find out. The next day, on South Plaza, we hang back from the group, pretending to photograph a cactus. Once alone, we sneak off the trail, check to make sure no one is watching, then rip apart a rotting prickly pear pad. Inside, we find several kinds insect larvae, including maggots, large and small, but none that look like fruit fly larvae. Just as we decide that the pad is too dry and that our experiment is inconclusive, we are surprised by a guide from another group standing above us. He politely reproves us, firmly insisting that we stay on the trail and with our guide. We apologize sheepishly and hasten to catch up with our group. Privately, I am pleased the guide is enforcing the regulations.



A few days later, we attempt to attract fruit flies with a bucket of rotting, fermenting bananas, a standard technique. We catch nothing.

Darwin also had little luck collecting insects: "I took great pains in collecting the insects, but I was surprised to find, even in the high and damp region, how exceedingly few they were in number. The forests of Tierra del Fuego are certainly much more barren, but with that exception I never collected in so poor a country...although I perseveringly swept under the bushes during all kinds of weather..." The truth is, there are more than 1000 species of insects in the Galápagos; most are small, inconspicuous, and nocturnal, spending the day in dark, hard to reach places. It takes a special effort to collect more than a few species. Darwin didn't look hard enough.

Undoubtedly, the most conspicuous animals of the Galápagos are the marine iguanas. They are so abundant on virtually every rocky coastline that you can hardly take a step without tripping over one. Fortunately, iguanas are vegetarians and harmless—or there would be fewer visitors.

Iguanas feed primarily on algae on the ocean floor. Swimming out to sea, they spend much of their time submerged searching for food. When not underwater, they bask on the rocks, sunning themselves along the shore. I spend some of my time doing the same. The coast is essentially the only place where one may wander freely without a guide. I take advantage of this, and walk off among the rocks to be alone with the iguanas. They pay no attention to me unless I get too close. Then they move off to a nearby rock and resume ignoring me. Whatever I do, the iguanas never enter the water. I think of Darwin's experiments. He noticed that, even when frightened, the iguanas avoided the water: "One day I carried one to a deep pool left by the retiring tide, and threw it in several times as far as I was able. It invariably returned in a direct line to the spot where I stood." Darwin speculated that this strange behavior might arise from fear of possible predators in the water (sharks). "Hence, probably urged by a fixed and hereditary instinct that the shore is its place of safety, whatever the emergency may be, it there takes refuge." No one since has come up with a better explanation.

Since their discovery (in 1535 by a lost sailor), the Galápagos have been exploited. For 300 years or more, pirates hid out on the islands, while whalers and sealers hunted in the surrounding seas. Many ships dropped anchor to take on water and fresh food. The giant tortoises were much favored. Thousands were taken, as their meat was good, and they could be kept alive for months. A local inhabitant informed Darwin that a single ship might take aboard as many as 700 tortoises. Harvesting on this scale reduced the tortoise population dramatically, even in Darwin's time. Since then, the situation has only gotten worse, and several races are gone forever, while others face with extinction.

Scientists have presented George with females from other islands. He is not interested.

We visit the Charles Darwin Research Station. There we meet "Lonesome George," the last surviving tortoise of the Isla Pinta subspecies. Desperate to preserve some remnant of the race, scientists have presented George with females from other islands. He is not interested. George sits there in his pen, back to the world, seemingly resigned to his fate. He shows no interest in the females, his food, or the world around him. He lives out his days, the last of a race stretching back through time.

Flashback to a happier scene: Darwin not only studied the tortoises, but also had a bit of fun with them: "I frequently got on their backs, and then, upon giving a few raps on the hinder part of the shell, they would rise up and walk away; but I found it very difficult to keep my balance." Perhaps Darwin had spent too much time with the gauchos in Argentina.

Islanders told Darwin that the

tortoises were different on each island. "Mr. Lawson [the governor of the colony] maintained that he could at once tell from which island any one was brought." It is hard to know what Darwin thought of this statement. (I have been told by reputable scientists that it is not strictly true.) Darwin mentions tortoise variation without comment in the first edition of the *Voyage* (1839). Only in later editions (1845 and later) does he insert a discussion of inter-island variation, using tortoises as a main example. But they are not mentioned at all to in the first edition in of *The Origin of Species* (1859). Once again, I am left wondering what Darwin really thought of the animals of the Galápagos.

The problem, as usual, is greed

Tourism is both the lifeblood of and a major threat to the Galápagos. Over 40,000 tourists visit annually, spending money on guide services, food, lodging, souvenirs, etc. They also trample the vegetation, erode the slopes, and molest the wildlife. It is the classic "love it to death" problem.

Natural history tourism is potentially an economic boon to third world countries. When properly conducted, it is non-extractive, and most of the money spent by tourists goes into the local economy. This benefits local residents, and assures a continuing source of income by preserving the flora and fauna that tourists come to see. Competent guides and tour leaders also educate visitors about ecological, political, and economic issues, and bolster support for intelligent conservation programs.

The problem, as usual, is greed. Seeing easy money, unscrupulous tour operators bring in oversized, unsupervised groups, ignore environmental safeguards, and fail to enforce rules designed to protect plants and animals. With no concern for long-term effects, they fail to educate the tourists and allow them to erode the landscape, disrupt animal behavior, and collect specimens. The result is a degraded experience for all, and increasing demands for environmentally unsound activities.

Raoul, our guide, tells us that wealthy tourists are now pressuring the Ecuadorian government to allow 5-star hotels, offshore casinos, and luxury cruise ships in the Galápagos. While in the Galápagos, I saw two giant cruise ships, and have since seen ads on the internet for luxury yacht cruises to the islands. Last year, the *Galápagos Explorer,* a giant cruise ship, ran aground near San Cristóbal. Fortunately, the fuel tanks did not rupture. No oil spilled—this time.

There are increasing signs of overcrowding. In just two hours on South Plaza, we ran into several other groups. It was like a crowded day in Yellowstone—or Disneyland. I saw numerous signs of erosion from tourists wandering over the island. The Galápagos National Park Service has recently established clearly marked trails, and the guides appear to be fairly conscientious about keeping people on them. Nevertheless, South Plaza is noticeably scarred.

The Galápagos National Park Service formerly restricted the number of boats operating, and regulated itineraries. Theoretically, this prevented several boats showing up at a given spot at the same time. One wonders how strictly this regulation was enforced. It definitely no longer is—I counted nine tour boats at Bartolomé.

Given the hordes of tourists and the pressure to accommodate even more, the Park Service has done a remarkably good job of preserving the Galápagos environment. Currently, a licensed Ecuadorian guide must accompany all visitors. Guides undergo a rigorous training program and do their best to keep people on the trails and limit their impact. Even bringing food onto the islands is prohibited (a safeguard to keep foreign seeds and insects away), and smoking is not allowed. Guides enforce these regulations and pick up litter. As a result, most areas are remarkably clean.

arson, vandalism, tortoise killings, and threats to tourists

Nevertheless, the most serious threat to the Galápagos, is from those seeking to exploit and extract the islands' resources. Greed and lawlessness have escalated into acts of arson, vandalism, tortoise killings, and threats to tourists. Conservation problems in the Galápagos have reached a crisis.

In January 1995 armed fishermen, protesting the government's closure of the sea cucumber fishery in the Galápagos, seized the Charles Darwin Research Station. They held employees and their families hostage for three days. A similar incident occurred in September 1995, after Ecuador's president vetoed a bill that would have weakened ecological safeguards in the Galápagos. In March 1997, a park warden was seriously wounded in a shootout with sea cucumber fishermen on Isabela.

The Galápagos Marine Resources Reserve was established in 1986, to protect marine life within fifteen miles of the islands. In practice, this protection is nonexistent. Commercial fishermen, from mainland Ecuador and foreign countries, illegally harvest sharks, sea cucum-

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bers, lobsters, and other species without restriction. Furthermore, sport fishing became legal in 1995, posing a danger to shark, tuna, and dolphin fish populations. This move toward exploitative activities and away from minimal-impact activities (nature watching, photography, etc.) sets a dangerous precedent.

Fishermen can cause harm to the islands beyond their commercial activities. They set up illegal camps, often bringing in dogs, cats, and goats. Some animals escape and become feral: a dog was sighted on Fernandina; a cat on Venecia. Fishermen discard fruits and vegetables and inadvertently introduce rats, ants, and other alien species. Domesticated vegetables were found growing near an abandoned campsite on Fernandina. On Fernandina and Isabela, the fishermen cut down mangroves to hide their equipment and dry sea cucumbers. These mangroves are the only habitat of the Mangrove Finch, the rarest of Darwin's finches. The Charles Darwin Foundation has found that over 500 sites show signs of illegal camping by fishermen. The observations on Fernandina are particularly disturbing, because Fernandina is the largest island in the world still free of introduced vertebrates. History abundantly documents the grim fate of native species once aliens are introduced to an island ecosystem.

Charles Darwin could ride a bucking tortoise and throw iguanas into the sea.

In attempts to solve these problems, the Ecuadorian government closed the sea cucumber fishery. The president vetoed a law that would have significantly reduced protection of terrestrial and marine environments. The government has appointed a commission to come up with new laws to protect the Galápagos. The Galápagos National Park Service has been equipped with a new high-speed patrol boat and is stepping up patrol and enforcement of park regulations. In January 1996, eight sea cucumber fishermen were arrested on Isabela. Since then, more arrests have been made, several illegal fishing camps raided, and at least one boat seized. But relentless political and economic pressures to sacrifice the Galápagos for short-term gains will continue. The government must be convinced that the long-term economic benefits of carefully managed tourism far outweigh the short-term benefits of exploitation.

I fear for the future of the Galápagos.

One hundred and sixty years ago, Charles Darwin could ride a bucking tortoise and throw iguanas into the sea. Today, I can photograph tortoises and iguanas, but cannot touch them. I can only hope that in another hundred and sixty years, my descendants will still be able to see these tortoises and iguanas, and the other remarkable wildlife of this unique and wonderful place. I fear for the future of the Galápagos.

*All quotations of Darwin are from the first edition of *The Voyage of the Beagle* (1839), unless otherwise indicated.