Hardly any place on the planet evokes a sense of mystique and wonder like the Galápagos Islands (Figure 1). They are the cradle of evolutionary thought. They also are home to an unusual menagerie of animals, such as prehistoric-looking iguanas that feed on algae, giant tortoises, the only species of penguin to live on the equator, a flightless cormorant, a group of unique an famous finches, furtive and shy rice rats, sea lions and fur seals. Visitors have to be careful not to step on the oxymoronically extremely tame wildlife. Endemic plants, such as tree-like cacti, *Scalesia* trees and shrubs (relatives of sunflowers and daisies), and highland *Miconia* shrubs cover different island life zones. Around the world, people may not have heard much of Ecuador, the small South American country that proudly calls the islands its own, but they likely have heard of the famed Galapagos. Apart from the extraordinary sensation of experiencing wildlife up close, however, what makes these islands so special?

To answer this question, it is worthwhile to compare the Galápagos Islands to other islands of the Pacific region. The most obvious comparison is with the Hawaiian Islands, an archipelago of similar geological hotspot origin but older. Although there are many examples, I focus here on two related groups of birds. Although others taxonomic groups mirror the general trends seen in these birds. In Hawaii as in the Galápagos, a group of finches has evolved and diversified by adaptive radiation. No matter which way one chooses to look at these birds, the Hawaiian honeycreeper (*Fringillidae: Drepanidinae*) radiation is by far the more spectacular: about 40 colorful species of birds, some of which do (or did) not bear any resemblance to a ‘typical’ finch, occupy a variety of niches, feeding on nectar, snails, insects, fruits, leaves or combinations thereof. Despite the magnificence of honeycreepers, the more commonly known example of adaptive radiation is that of the Galápagos finches (*Thraupidae*). A look at the current conservation status of these two groups of birds may reveal why. Of the 35 species of honeycreeper listed by the IUCN, representing only the historically known species, 16 are extinct, 12 are critically endangered, two endangered, and the remaining five vulnerable. In practical terms, this means that you can visit the Hawaiian Islands without seeing a single honeycreeper. In contrast, the Galápagos Finches are all still very much extant and, with important exceptions, quite numerous. In fact, you can easily see five of the 14 species of Galápagos Finches during a morning stroll through the town of Puerto Ayora. The Galápagos finches thus allow for fine-grained and intricate analyses of their evolutionary history. In contrast, a recent phylogenetic study on the Hawaiian honeycreeper was limited in scope by the lack of genetic material from the extinct species (Figure 2).

**Fig. 1.** The Galápagos Islands are an archipelago of volcanic islands distributed on either side of the Equator in the Pacific Ocean surrounding the centre of the Western Hemisphere, 906 km west of continental Ecuador, of which they are a part.
Fig. 2. A female Common Cactus-Finch (Geospiza scandens) watches the author at lunch in Puerto Ayora, Santa Cruz Island.
In nearly every taxonomic group the pattern is the same: on the Galápagos Islands, far fewer extinctions have taken place and the populations of the extant species tend to be larger. Why are the finches and fellow endemic species on the Galápagos in better shape than their Hawaiian counterparts? The short answer is people. Polynesians colonized the lush tropical Hawaiian archipelago with nutrient rich volcanic soils about 1600 years ago. Over the last two centuries, the human population there has even grown to an estimated population of 1,428,557 people by 2016. In contrast, humans have shunned the dry, spiny, and desert-like Galápagos Islands for a long time. If Polynesians ever made it to the Galápagos Islands, they did not stay around. Nowadays, only 3% of the surface area of the islands can be settled by people, and the remaining Galapagos 97% being protected as a national park. A total of 25,244 people were registered during the 2015 census. Now, the human population is tightly controlled on the Galápagos. Even for an Ecuadorian citizen, a trip to the islands feels more like an international trip than a national one. The little appeal the Galápagos had for people in the past is the main reason the flora and fauna is still quite intact (Figure 3).

Only about 13 species of terrestrial vertebrates have become extinct in historic time, although entire populations of some species have been extirpated on some islands. In the broad spectrum of human impact among all Pacific islands, the Galápagos are perhaps the least impacted. At the other extreme, having passed through a devastating anthropogenic cataclysm, we have the Easter Islands whose terrestrial ecosystems have been nearly completely transformed. The Hawaiian Islands fall somewhere in between.

The fact that the islands are still largely intact should not be viewed with passive complacency. Anthropogenic processes have already been set in motion that are starting to threaten this fragile island ecosystem. First among them are introduced species that are displacing, infecting or eating native plants and animals. According to the Charles Darwin Station, there are now nearly 2000 introduced species, some of which are wreaking serious havoc on the islands. For example, going back to the finches, one of the introduced parasites is now seriously threatening the famous Galápagos Finches, especially the critically endangered Mangrove Finch (Camarhynchus heliobates). The parasitic fly Philornis downsi has been identified as the main threat to survival of several finch species. It may also be responsible for the extinction of the newly confirmed species of San Cristóbal Vermillion Flycatcher (Pyrocephalus dubius). In an attempt to eradicate invasive species, authorities are sometimes resorting to drastic measures. For example, tens of thousands of goats have been eliminated from several islands at great cost. This well-meaning measure has had its ecological backlash, however. Officials from the Ministry of Agriculture, Fishing and Livestock have noted that in the absence of the introduced herbivore, the first plants to recolonize goat-ravished areas are introduced, invasive species which are outcompeting the native species. In addition, populations of Galápagos Hawks (Buteo galapagoensis) have diminished as changes in habitat structure due to goat removal have made hunting for these animals more difficult. Introduced species are perhaps the gravest problem, but the World Heritage Committee identified illegal and unsustainable fishing, tourism, immigration, lack of education, and problematic governance as major threats as well. Clearly, the islands require a creative and holistic approach for solving conservation problems. (Figure 4).

The Galápagos Islands are unique because of the limited damage people have done to its native flora and fauna. At the same time, they are increasingly under pressure from anthropogenic causes. In order to safeguard the islands into the future, a new generation of natural resource managers needs to be trained that is capable of using the latest technology and insights in the natural and social sciences to properly solve the problems faced by the island's biota. In addition, the full potential for the islands to become a unique natural laboratory has not been realized yet. The Galápagos require modern laboratories in addition to an intellectual research environment that is wholly based on the islands. National and foreign scientists can contribute to safeguard the islands, not only by creating and sharing knowledge, but also by increasing awareness in the population, and attracting funds for research and conservation. For this to happen, the scientific community not only needs the right incentives (particularly ease of access) to invest in the islands, but they also need qualified islanders who can at some time run the future labs. Perhaps it is time for a "University of the Galápagos Islands?"

All birds pictures used in this articles belongs to the author Markus P. Tellkamp
The Galápagos Islands: relatively untouched, but increasingly endangered

Las Islas Galápagos: relativamente intactas, pero cada vez más amenazadas

Fig. 4. A female Common Cactus-Finch (Geospiza scandens; left) and a female Medium Ground-Finch (Geospiza fortis; right) looking for scraps just after patrons of restaurant left, Puerto Ayora, Santa Cruz.

Referencias bibliográficas