Social and Ecological Interactions in the Galapagos Islands

Diego Quiroga
Ana Sevilla
Editors

Darwin, Darwinism and Conservation in the Galapagos Islands

The Legacy of Darwin and its New Applications

Springer

Social and Ecological Interactions in the Galapagos Islands

Diego Quiroga • Ana Sevilla
Editors

Darwin, Darwinism and Conservation in the Galapagos Islands

The Legacy of Darwin and its New Applications

Springer

Editors
Diego Quiroga
Colegio de ciencias biológicas y ambientales y Colegio de ciencias sociales y humanidades
Universidad San Francisco de Quito
Quito, Ecuador

Ana Sevilla
Colegio de Ciencias Sociales y Humanidades
Universidad San Francisco de Quito
Quito, Ecuador

ISSN 2195-1055 ISSN 2195-1063 (electronic)
Social and Ecological Interactions in the Galapagos Islands
ISBN 978-3-319-34050-0 ISBN 978-3-319-34052-4 (eBook)
DOI 10.1007/978-3-319-34052-4

Library of Congress Control Number: 2016953665

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG Switzerland

Foreword

On February 15, 1835, during a short stopover in Australia, Charles Darwin mailed a letter to his cousin William Darwin Fox, in which he wrote, "I hate every wave of the ocean, with a fervor, which you, who have only seen the green waters of the shore, can never understand." The voyage of HMS Beagle was one of the most important scientific expeditions in history, but Darwin was seasick most of the time. Although the voyage lasted 5 years, Darwin's travelogue shows that he spent only about a year and a half onboard, disembarking as soon as he could to explore on land and to keep away from the ship.

Few months after Darwin sent his letter, the Beagle arrived to the Galapagos. The buccaneers, whalers, and explorers that had visited the islands had produced good navigation charts and partial descriptions of their flora and fauna, but nothing had prepared Darwin for what he saw as they approached San Cristobal. "The Bay swarmed with animals; Fish, Shark & Turtles were popping their heads up in all parts," Darwin wrote in the *Beagle Diary*. However, when he disembarked he dismayed. "Nothing could be less inviting than the first appearance. A broken field of black basaltic lava is everywhere covered by a stunted brushwood, which shows little signs of life. The country was compared to what we might image the cultivated parts of the Infernal regions to be." Darwin visited only 4 of the 18 islands, and soon overcame his initial disappointment, and spent his time taking notes, speculating about the geological history of the archipelago, drawing animals and plants, birds, and lizards, and collecting specimens, which were promptly sent to England.

Like others before him, Darwin was impressed by the huge populations of iguanas. "I cannot give a more forcible proof of their numbers, than by stating that when we were left at James island, we could not for some time find a spot free from their burrows on which to pitch our single tent," he wrote in *The Voyage of the Beagle*. He particularly enjoyed the company of the fearless finches, iguanas, and tortoises, which he mistakenly thought were not native to the islands. The development of his ideas about biological evolution lay ahead in the future, but he realized that the distribution of the islands' flora and fauna was the outcome of past migrations and understood that the evolutionary transformations of the different species were the

result of their adaptation to the new environments when the original populations had been divided by independent migrations to the different islands.

After 5 weeks, the Beagle sailed away from the Galapagos, never to return. Ships continued to stop at the islands to pick up living tortoises, which was a rather convenient way to keep fresh victuals during the long sea voyages. In 1841, another whaling ship arrived to the archipelago. Onboard was Herman Melville, a talented young 22-year-old sailor who 10 years later published his extraordinary novel *Moby Dick*. At first, Melville was disappointed and wrote that the islands seemed "five and twenty heaps of cinder dumped here and there in an outside city lot." Many years later, he published a short story describing his visit to the Galapagos, which he described as "an evilly enchanted ground" populated with hideous reptiles. Like Darwin before him, he was quite taken by the giant tortoises. "It was after sunset when the adventurers returned. I looked down over the ship's high side as if looking down over the curb of a well, and dimly saw the damp boat deep in the sea with some unwonted weight. Ropes were dropped over, and presently three huge antediluvian-looking tortoises, after much straining, were landed on deck. They seemed hardly of the seed of earth," wrote Melville, "behold these really wondrous tortoises—none of your schoolboy mud turtles, but black as widower's weeds, heavy as chests of plate, with vast shells medallioned and orbed like shields, and dented and blistered like shields that have breasted a battle, shaggy, too, here and there, with dark green moss, and slimy with the spray of the sea. These mystic creatures, suddenly translated by night from unutterable solitudes to our peopled deck, affected me in a manner not easy to unfold. They seemed newly crawled forth from beneath the foundations of the world. Yea, they seemed the identical tortoises whereon the Hindu plants this total sphere. With a lantern, I inspected them more closely. Such worshipful venerableness of aspect! Such furry greenness mantling the rude peelings and healing the fissures of their shattered shells. I no more saw three tortoises. They expanded—became transfigured. I seemed to see three Roman Coliseums in magnificent decay. Ye oldest inhabitants of this or any other isle, said I, pray, give me the freedom of your three-walled towns. The great feeling inspired by these creatures was that of age: dateless, indefinite endurance."

By the time Melville published his story, Darwin was already a well-known highly respected naturalist living in Down, never to leave the Great Britain again. Always a cautious thinker, in 1844 he wrote to his friend and confidant Joseph Hooker "at least gleams of light have come, & I am almost convinced (quite contrary to the opinion I started with) that species are not (it is like confessing a murder) immutable." The interest in the archipelago grew as a result of the publication in 1859 of *The Origin of Species*, and the number of visitors to the islands increased. As summarized by Edward J. Larson in his 2001 book *Evolution's Workshop*: *God and Science on the Galapagos Islands*, soon a veritable looting started. Over the years, dozens of ships sailed to the Galapagos, collecting thousands of dead and living specimens for museums, botanical gardens, and private collectors. The list of visitors included adventurers, entrepreneurs, and eccentrics like the Baroness Elisa von Wagner, who in the early 1930s decided to find a beach resort in Floreana. She arrived in the company of 3 gentlemen that were soon joined by 22 Norwegian

sailors, whom she welcomed in total nudity. Undoubtedly, the weather was fine, but the atmosphere was charged. The adventure did not last for long, and after the tragic death of several men of her group, the Baroness, together with two of her male friends, embarked in a small boat and disappeared in the ocean.

The unrestricted flux of visitors to the Galapagos has taken its toll. The geological forces that shaped the islands are still at work, but the whalers and buccaneers that used to visit them have been replaced by hordes of tourists, including the rich and famous. As summarized in this volume, decades of careless visitors and failed colonists have left many unwelcomed visitors like donkeys, black rats, pigs, goats, and raspberry plants that pose a risk for the indigenous flora and fauna. The wise decision to celebrate the centenary of the publication of *The Origin of Species* with the creation in 1959 of the Galapagos National Park, followed by the 1978 UNESCO recognition of the islands as a World Heritage Site, has resulted in a carefully controlled visitors policy that facilitates the preservation and recovery of the islands' extraordinary biodiversity.

As Darwin wrote in his autobiography, "the voyage of the Beagle has been by far the most important event in my life and has determined my whole career." He would have agreed in full with Samuel Johnson's statement that "a ship is worse than a gaol," but remained emotionally and intellectually attached to the Galapagos. Ten years after visiting the archipelago, he wrote in his *Journal of Researches* that "the archipelago is a little world within itself, or rather a satellite attached to America, whence it has derived a few stray colonist, and has received the general character of its indigenous production. Considering the small size of these islands, we feel more astonished at the number of their aboriginal beings, and at their confined range. Seeing every height crowned with its crater, and the boundaries of most of the lava-streams still distinct, we are led to believe that within a period geologically recent the unbroken ocean was here spread out. Hence both in space and time, we seem to be brought somewhat near to that great fact—that mystery of mysteries—the first appearance of new beings on this earth"—as indeed we are, as demonstrated by this volume.

Mexico City, Mexico Antonio Lazcano

Series Foreword

It is with pleasure and pride that we welcome this book, Darwin, Darwinism and the Galapagos (Diego Quiroga & Ana Sevilla, Editors), into the Galapagos Book Series, Social and Ecological Interactions in the Galapagos Islands edited by Stephen J. Walsh & Carlos F. Mena for Springer Science + Business Media. Launched in 2013 with the book, Science and Conservation in the Galapagos Islands: Frameworks and Perspectives (Stephen J. Walsh & Carlos F. Mena, Editors), it was quickly followed also in 2013 with the book, Evolution from the Galapagos: Two Centuries after Darwin (Gabriel Trueba & Carlos Montúfar, Editors). In 2014, book #3 was published, The Galapagos Marine Reserve: A Dynamic Social-Ecological System (Judith Denkinger & Luis Vinueza, Editors). In addition to this volume, we are planning several others in the Galapagos Book Series that will examine, for instance, sustainability energy, invasive species, and tourism.

The Galapagos Book Series is dedicated to the study of the Galapagos Islands and, through comparison and context, other similarly challenged island ecosystems around the globe. While the conceptual lens may vary and the perspectives change, the consistent emphasis of the Book Series is on the Galapagos Islands, the coupled human-natural systems that exist there, the iconic flora and fauna as well as endemic, native and introduced species that exist there, and the challenges to conservation and sustainability that is recognized across the archipelago and around the globe.

Cognizant of the exogenous forces and endogenous factors that shape and reshape the Galapagos Islands, the Galapagos Book Series seeks to understand the social, terrestrial, and marine sub-systems that occur within the Galapagos Islands and their linked effects by addressing the “voyage of discovery” in the Galapagos Islands that is achieved by disciplinary and interdisciplinary scientists who are committed to the generation of new knowledge and a richer understanding of the social

and ecological forces of change in the Galapagos Islands, the historical context, and the environmental, socio-economic, demographic, and political implications for alternate futures for these “Enchanted Islands.”

Chapel Hill, NC — Stephen J. Walsh
Quito, Ecuador — Carlos F. Mena

Series Preface

Galapagos Book Series, "*Social and Ecological Sustainability in the Galapagos Islands*"

When we developed the Galapagos Book Series and selected the initial book topics to launch the Series, we hoped that guest editors and authors would cooperate to represent important and fascinating elements of the Galapagos Islands early in the Series. While Book #1, "*Science and Conservation in the Galapagos Islands: Frameworks & Perspectives*," Stephen J. Walsh & Carlos F. Mena, editors (2013), advocates an interdisciplinary perspective for addressing many of the most compelling challenges facing the Galapagos Islands that extend across the social, terrestrial, and marine subsystems; Book #2, "*Evolution from the Galapagos: Two Centuries after Darwin*," Gabriel Trueba & Carlos Montufar, editors (2013), advances our understanding of evolution, a key element of life and adaptation in the Galapagos Islands; Book #3, "*The Galapagos Marine Reserve: A Dynamic Social–Ecological System*," Judith Denkinger & Luis Vinueza, editors (2014), addresses the nature of the coupled human–natural system in the Galapagos Islands and describes some of the key factors that affect social and ecological vulnerability, dynamics, and island sustainability, and, now, Book #4, "*Darwin, Darwinism and the Galapagos*," Diego Quiroga & Ana Sevilla, editors (2016), examine the meaning and essence of Darwin and Darwinism in the Galapagos and beyond. His ideas shook the world of science and continue to give meaning and explanations of life and the adaptive capacity of species in the Galapagos and around the globe.

It was not until Charles Darwin's famous visit in 1835, which helped inspire the theory of evolution by natural selection that the Galapagos Archipelago began to receive international recognition. In 1959, the Galapagos National Park was formed, and in 1973, the archipelago was incorporated as the 22nd province of Ecuador. UNESCO designated the Galapagos as a World Heritage Site in 1978, a designation to honor the "magnificent and unique" natural features of the Galapagos and to ensure their conservation for future generations. These islands were further deemed a Biosphere Reserve in 1987, and the Galapagos Marine Reserve was created in

2001. The Marine Reserve was formed as a consequence of the 1998 passage of the Special Law for Galapagos by the Ecuadorian government that was designed to "protect and conserve the marine and terrestrial resources of the Islands."

Development of the tourism industry has more than tripled the local population in the past 15 years, thereby exerting considerable pressure on the Galapagos National Park and the Marine Reserve. The residential population has grown from approximately 10,000 in 1990 to nearly 30,000 residents today, and national and international tourism has increased from approximately 40,000 visitors in 1990 to now in excess of 225,000. The impacts of the human dimension in the islands have been both direct and indirect, with consequences for the social, terrestrial, and marine subsystems in the Galapagos Islands and their linked effects. Further, the historical exploitation of lobster and sea cucumber, globalization of marine products to a national and international market, and the challenges imposed by industrial fishing outside of the Reserve and illegal fishing and shark-fining outside and inside the Reserve combine to impact the social and ecological vulnerability of the Galapagos Marine Reserve in fundamental ways. In addition, exogenous shocks, such as ENSO events as a disturbance regime on Galapagos corals and marine populations, national and international policies and institutions on regulation and management, and the "pushes" and "pulls" of economic development and population migration, including tourism, shape and reshape the Galapagos Islands—its resources, environments, people and trajectories of change.

The adaptive capacity of social and ecological systems and their interactions are associated with the concept of Island Biocomplexity and the tenets of adaptation and change advocated by Darwin. *Island Biocomplexity* is a theoretical perspective that explicitly integrates human-environment interactions, feedback mechanisms between social and ecological systems, and the impacts of exogenous forces and endogenous factors on resource conservation and economic development. *Island Biocomplexity* involves the properties emerging from the interplay of behavioral, biological, chemical, physical, and social interactions that affect, sustain, or are modified by living organisms, including humans. Non-linear relationships between people and environment, occurring through important feedback mechanisms, often with space and time lags, are observed in coupled human-natural systems, typical in island settings. In this Book, Quiroga & Sevilla have crafted a view of Darwin and Darwinism that is fascinating in its theory, context, and explanation of life in today's world as it was in the 1800s.

Chapel Hill, NC Stephen J. Walsh

Contents

List of Contributors

Elizabeth Hennessy History Department, Nelson Institute for Environmental Studies, University of Wisconsin—Madison, Madison, WI, USA

Diego Quiroga Colegio de ciencias biológicas y ambientales y Colegio de ciencias sociales y humanidades, Universidad San Francisco de Quito, Quito, Ecuador

Günther Reck Colegio de ciencias biológicas y ambientales, Universidad San Francisco de Quito, Quito, Ecuador

Gonzalo Rivas Colegio de ciencias biológicas y ambientales y Colegio de ciencias sociales y humanidades, Universidad San Francisco de Quito, Quito, Ecuador

Ana Sevilla Colegio de ciencias sociales y humanidades, Universidad San Francisco de Quito, Quito, Ecuador

Elisa Sevilla Departamento de historia, Pontificia Universidad Católica del Ecuador, Quito, Ecuador

Arturo Argueta Villamar Regional Center of Multidisciplinary Research, National Autonomous University of Mexico, Mexico City, Mexico

Chapter 1
Darwin's Galapagos Myth

Diego Quiroga and Ana Sevilla

In 2009 when the Western world celebrated the 200 years commemoration of Darwin's birthday, the Universidad San Francisco de Quito organized a meeting of evolutionary biologists in its academic extension and research center in the Island of San Cristobal in the Galapagos. In a previous meeting organized by USFQ, the convention center of the Capital of the Galapagos was rebuild by the university and renamed by the Municipality of San Cristobal, the Charles Darwin Convention Center. In San Cristobal, as well as in the Galapagos in general, Charles Darwin has become a name that is associated with science, conservation, and tourism. During the year of the bicentennial of Darwin's birth, a statue was placed in Frigate Bird Hill, the place where Charles Darwin first landed in the Galapagos during his legendary voyage. Although until recently and to some extent, even today there are opposing and conflictive views of the islands and of science, evolution, and conservation, for most people Charles Darwin is being metonymically linked to the Galapagos. As previously discussed (Quiroga 2009), many of the local residents—colonists who came from the mainland of Ecuador during the last 200 years—perceive the Galapagos as a frontier, a place where their ancestors migrated to dominate nature and make a living. In contrast, there is a global view of the islands that perceives the Galapagos as a natural laboratory where Charles Darwin developed his views and his ideas, a place of high endemism, where one can see adaptive radiation and where conservationists are looking at novel and often successful solutions to deal with major threats.

D. Quiroga
Colegio de ciencias biológicas y ambientales y Colegio de ciencias sociales y humanidades, Universidad San Francisco de Quito, Quito, Ecuador

A. Sevilla (✉)
Colegio de ciencias sociales y humanidades, Universidad San Francisco de Quito, Quito, Ecuador
e-mail: asevilla@usfq.edu.ec

D. Quiroga, A. Sevilla (eds.), *Darwin, Darwinism and Conservation in the Galapagos Islands*, Social and Ecological Interactions in the Galapagos Islands,
DOI 10.1007/978-3-319-34052-4_1

As local people are increasingly more involved in tourism and conservation, there is a new hybrid perspective emerging. This new perspective is based on the idea that tourism should benefit the residents of the Galápagos. For them, a sort of shallow Darwinism has been constructed, a way of looking at evolution and nature striping away all the materialistic and secular dimensions of scientific Darwinism. This commoditization of Darwin is also the result of a strategy created by the large tourism companies to promote their trips as part of an experience of a lifetime following on the footsteps of Charles Darwin.

The visit of the HMS Beagle to the Galapagos has been narrated as a key moment in the history of Western cosmology, the climax of a process of secularization, and the beginning of the scientific understanding of our origin as living organisms. Furthermore, Darwin's visit to the Galapagos is understood as a moment of discovery. Several authors have questioned the standard narrative; Frank Sulloway (1982a, b, 1983), for example, has proposed that the connection between a particular moment that occurred during Darwin's visit to the island and his formulation of the theory of evolution is a fabrication. Elizabeth Hennessy in Chap. 5 identifies the construct as being located after the biological synthesis in the early twentieth century as an effort to produce policies for the management of the Galapagos. In this book we will deal with the connection between Darwin, Darwinism, Conservation and the Galapagos by exploring the way in which Darwin's legendary and mythologized visit to the islands influenced not only our views about the evolution of life but also how it has affected the socioecosystems of the Galapagos and the way in which we can manage these systems and better conserve the very same ecosystems and evolutionary processes that inspired Darwin.

The production of myths about scientific discoveries allows the simplified and linear mapping of complex processes that constitute most scientific revolutions. Several authors in this volume point out that the reality of this discovery is more complex and more interesting than the simplistic idea that great discoveries depend on a single eureka-like moment. As has been indicated by several authors, Darwin's allegedly instantaneous conversion from creationism to evolutionism in the Galapagos never occurred (Sulloway 1982a, b). The myth, as traditionally told, locates the Galapagos as the scene where Darwin had his major revelation, a place where all his insights began or were confirmed. In this way, the popular history of biological science, whose discourse has been used by conservationists and the tourism industry, has created in the minds of the Global North a Galapagos where even today one can observe, just like Darwin, the processes and mechanisms of evolution at work (Hennessy and McCleary 2011).

However, the manner in which Darwin arrives to his conclusion, far from being a specific eureka-like moment linked to the Galapagos Islands, should be interpreted more as a long and complex process of analysis and reflection. The process by which the Darwinian paradigm later becomes the dominant view was a slow and conflictive debate that helped create the construct of Galapagos as a natural laboratory. Darwin's revolutionary idea flourished inside his mind, but an array of environments, social interactions, readings, and tools were crucial for this idea to come together. Besides having an important ability as collector and observer, Darwin's

mind characterized itself by a sensibility to intuition and synthesis: "a ship, an archipelago, a notebook, a library, a coral reef" (Johnson 2010: 17); the reading of previous scholars and a capitalist Victorian society were all crucial factors that influenced Darwin's thought.

In 1835, Darwin arrives to the Galapagos Islands on board the HMS Beagle, under the command of Captain Fitzroy. The ship had been surveying the South American coast for the past 3 years, and during its stay on the islands, Captain Fitzroy would carefully chart the archipelago. Darwin's visit of the Galapagos lasts for 5 weeks, on which he spends only 19 days in land and visits only 4 of the 12 large islands: San Cristobal, Floreana, Santiago, and Isabela. While the Beagle methodically moved round the archipelago, Darwin took every opportunity to go ashore.

Before sailing to the Galapagos, Darwin was very excited about going to the islands, as he mentions in a letter written to his sister Caroline from Lima. He declares that the geology and zoology could not fail to be interesting (Darwin 1835a). He also writes to his cousin W. D. Fox stating that he "looks forward to the Galapagos, with more interest than any other part of the voyage" (Darwin 1835b). Among other reasons he had been inspired by one of the few books that he took with him on the trip: *New Voyages Around the World*. The author, the pirate William Dampier (1697), made his first visit to the Galapagos in 1679 and returned twice more with other famous privateers, such as Cowley who made one of the first maps of the Galapagos. Dampier's book became a best seller and was translated to different languages. Other books that competed for space in the small cabin that he shared with Fitzroy were Alexander Von Humboldt's *Personal Narrative* and Charles Lyell's *Principles of Geology*.

In his *Voyage of the Beagle*, Darwin (1839) dedicates an entire chapter to the description of his visit to the Galapagos Archipelago (Chapter XVII). The narration of the first time he sets foot on one of the islands shows his disappointment and contrasts drastically with the expectations he had expressed in his correspondence. For the English naturalist, "nothing could be less inviting than the first appearance" (Darwin 1839: 373) of Chatham Island. In fact, the scattered hillocks with remains of former craters and the broken fields of black basaltic lava completed a very poor scenario that showed "little signs of life." It was precisely life and its diverse forms that Darwin was seeking. Despite this inhospitable scenario, Darwin diligently tried to collect as many plants as possible and concluded sadly that he succeeded in getting very few: "such wretched-looking little weeds would have better become an arctic than an equatorial Flora" (Darwin 1839: 374). But as the weeks went by and Darwin discovered these "small, barren, and rocky islands," he is astonished by "the amount of creative force" (Darwin 1839: 398) displayed on them. He noticed that "by far the most remarkable feature in the natural history" of the archipelago is that, to a considerable extent, "the different islands are inhabited by a different set of beings" (Darwin 1839: 393–394). As described by Ana Sevilla in Chap. 3, the importance of the Galapagos Islands has to be understood inside the framework of the distribution of species that Darwin considers as one of the strong points of his theory (Darwin 1859).

The scientific revolution that resulted from Darwin's transformative thinking and writings generated a discussion in the West that had profound implications for modern cosmology. A vision in which life forms and species were no longer the result of God's intervention but rather evolved from previous forms through mechanistic processes of natural selection. This cultural transformation resulted in the creation of a mythicized history as the lives of key people and places were narrated.

This visit also resulted in an increased visibility of the islands in the West, which lead eventually to changes in the social, symbolic, and biological reality of the Galapagos. After the arrival of the Beagle, few Spanish expeditions, a couple of British Ships, and several pirates and privateers introduced some exotic species and removed others such as tortoises from the islands. Later, many whalers, mostly from the United States, benefited from the islands' resources: they were not only interested in whales, but they also hunted tortoises that they consumed as they sailed around the world. Finally, the archipelago would be transformed by the interest of the newly created Ecuadorean State that begun to incorporate the Galapagos to a central administration and sent colonists to inhabit one of the islands (see Ana Sevilla Chap. 4). These colonists saw the Galapagos as a frontier territory and hoped to transform the islands into a humanized territory that could satisfy their most basic needs.

Darwin's visit motivated a succession of trips by scientists to confirm or more often to question the veracity of his claims and his troubling conclusion. The series of discussions, writings, and trips of post-Darwinian scientists resulted in the creation of a narrative of the Galapagos as a natural living laboratory (Quiroga 2009). This construct of the Galapagos, as Elisa Sevilla indicates in chap. 4., is not only the result of the visit of Darwin but of the effects of the publication of *On the Origin of the Species* and his other controversial books. The theory was attacked as depicting a world ruled by materialistic and reductionist principles and lacking meaning and purpose, and as such, it worried many and resulted in one of the most intense conflicts that had emerged in the history of Western sciences. Many scientists expressed their concerns and opposition to Darwin's ideas (Larson 2001); some, as is the case of Louis Agassiz, were creationists and followers of Georges Cuvier, while others like George Baur and Albert Gunther (Larson 2001) were followers of Jean Baptiste Lamarck. They shared a dislike for the premises and implications of Darwinism. These and other scientists were able to move financial, academic, and human resources to explore the islands and their unique fauna and flora. It was these constant scientific visits that created the idea of the Galapagos as a natural laboratory (Larson 2001; Quiroga 2009).

It was also a time when for many, the best way of conserving animals and plants was to preserve specimens in jars in museums and private collections of the industrialized countries. Conservation of natural resources was not an extension of biological sciences until well into the twentieth century. Many of the collections of the natural and cultural world reflected power relations between different countries. Powerful countries had, as an important part of their symbolic capital and colonial presence, large collections of natural and cultural importance. The desire by wealthy

patrons such as Walter Rothschild and by institutions such as the California Academy of Science to amass large collections of Galapagos animals resulted in the extraction of many specimens from the islands (Larson 2001; James 2010).

The mythicized connection between Darwin and the Galapagos has had real, enduring, and paradoxical effects in the islands. This construct of the Galapagos as the cradle of Darwin's theory and insights resulted not only in the identification of the Galapagos as a living natural laboratory but also in the production of a series of conservation practices and the reshaping of the Galapagos as a tourism destination with an increasingly important flow of tourists. Darwin's trip around the world and his short visit to the Galapagos have become a sort of heroes' journey of science and of modern secular Western culture. This connection between Darwin and the Galapagos was the base on which many scientific, conservationist, and touristic sojourns to the islands were justified in the beginning of the twentieth century. As Günther Reck describes in Chap. 7. part of the inspiration for the creation of the Charles Darwin Foundation in 1959 was the idea that the Galapagos was the point where Darwin's conversion occurred and the discourse about conservation of the islands is still often based on the intention of preserving imagined pristine zones and islands where evolutionary processes are still present as when Darwin first arrived. Darwinian scientists such as Julian Huxley, the grandson of Thomas Huxley, Darwin's bulldog, played a key role in the twentieth century in further developing the plan for the conservation of the Galapagos. Once this powerful link between the Galapagos and Darwin was established, tourism companies profited and fostered this connection creating massive publicity campaigns. Numerous brochures, web pages, and other advertisement schemes have used the image of Darwin to promote the Galapagos as a special destination, one that not only sells unique animals and spectacular sceneries but also the experience of being a Darwinian naturalist. This experience is directly connected to the sojourns of Darwin in his visit to the islands. The early development of tourism in the Galapagos in the 1960s and 1970s by Ecuadorian and International companies was connected in many ways to the image, theories, and the traveling of Darwin.

At present the image of Darwin has multiple readings. Although for a long time the main emphasis has been in the development of a sense that the islands are part of what we call the Darwinian experience, there has been a subtle change in the way of selling these experiences. Conversations with guides and operators suggest that there is a shift toward what can be called a shallow Darwinian experience, an emphasis on the gazing of nature in a rather superficial manner without the theoretical views and some of the more troubling implications of Darwinism. This shift in the marketing and the type of tourist reaching the islands has implied many changes in the management of tourism such as the increase offerings of land-based accommodations and services and changes in the itinerary of the boats and in the training of guides and has even had implications in the establishment of conservation priorities (Grenier 2002). Furthermore, the creation of a product that is more appealing to a wider audience has resulted on an increasing number of people that are going to the islands.

The Darwin-Galapagos myth has shaped and has been shaped by conservationists and scientists in the middle of the twentieth century. Hennessy in Chap. 5 argues that Darwin's mythical association with the Galapagos was the result of the efforts of scientists in the first half of the twentieth century. After the Modern Evolutionary Synthesis had triumphed, these scientists received attention and funding in their efforts to conserve the Galapagos as a tribute to Darwin. They wanted to protect the islands as a living laboratory and to maintain the Galapagos as Darwin saw them. Since the creation of the Charles Darwin Station and the Galapagos National Park, Ecuadorians colonists living permanently in the Archipelago have been perceived as a major threat to the islands (see Reck Chap. 7 and Hennesy Chap. 5), a threat to the existence of a pristine natural space where one can observe and study Darwinian evolution in action. This Darwinian framing of the Galapagos has had several different implications, one of the most important ones being the creation of institutions dedicated to restoration and conservation efforts to maintain a pristine area. However, many of these efforts to control the social and biological emergent processes have been unsuccessful.

Paradoxically, this idea of a Darwinian living laboratory is threatened by the success of the very same constructs that promote its conservation. As argued above, the Galapagos as a tourist attraction owns much to Darwin and his legacy. This mythicized association contributed to the allure of the island in the imagination of the Global North and the creation of an ever-increasing flow of international tourists to the islands. This flow has attracted international and national investors and migrants from mainland Ecuador. As a consequence of this increase connectivity with the mainland, a flow of introduced species has created a serious threat to the survival of the valuable endemic species. This has resulted in several programs and projects to eradicate these species and restore the imagined pristine conditions that Darwin encountered and that made the islands famous. In Chap. 9, Quiroga and Rivas consider the successes and failures of conservation organizations and the Galapagos National Park to guarantee the continuity of the imagined natural laboratory. These failures question, at least at the level of management practices, many of the dichotomies that have been created to understand nature and its conservation and the arbitrary line dividing human artificial processes from purely Darwinian natural evolution. The failure of the efforts to restore ecosystems in the case of some invasive species of plants, animals, and insects has led different scientists to believe that a new approach is now needed. We argue that the problem with this view of the Galapagos as pristine natural laboratory is that it represents a narrow reading of Darwin that is partially based on the Darwinian myth and does not take into account many of the more profound conclusions of the dynamic process that characterize Darwinian systems.

The observations that Darwin made in the Galapagos, in South America, as well as in other places during his trip around the world created the basis for a major paradigm shift in the Western world, from a static world in which species represented a divine plan and complex design was evidence of God's intervention to one in which natural selection, diversity, and time explained the current imperfect order. In a mythicized series of events, the connection between Darwin and the Galapagos was

linked to a transformative eureka moment. The shift in paradigm actually occurred through a series of observations and thoughts during and after Darwin's trip which lead to the questioning not only of the idea that God created the world of the natural order but also to reinforce the existing idea that in the social world, imperfect order can be created through emergent processes.

References

Dampier, W. (1697). *A new voyage round the world: The Journal of an English Buccaneer*. London: Hummingbird.

Darwin, C. (1835a, 9–12 August). Darwin, C.R. to Fox, W.D. Darwin Correspondence Database. Retrieved May 19, 2014, from http://www.darwinproject.ac.uk/entry-282. Darwin correspondence project.

Darwin, C. (1835b, 19 July–12 August). Darwin, C.R. to Darwin, C.S. Darwin Correspondence Database. Retrieved May 19, 2014, from http://www.darwinproject.ac.uk/entry-281. Darwin correspondence project.

Darwin, C. (1839). *Journal of researches into the geology and natural history of the various countries visited by H.M.S. Beagle*. London: Henry Colburn.

Darwin, C. (1859). *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*. London: John Murray.

Grenier, C. (2002). *Conservación contra natura. Las islas Galapagos*. Quito: Ediciones Abya-Yala.

Hennessy, E., & McCleary, A. L. (2011). Nature's Eden? The production and effects of 'pristine' nature in the Galápagos Islands. *Island Studies Journal, 6*(2), 131–156.

James, M. J. (2010). Collecting evolution: The vindication of Charles Darwin by the 1905–06 Galapagos expedition of the California academy of sciences. *Proceedings of the California Academy of Sciences, 61*((Supplement II), 197–210. Retrieved May 6, 2013.

Johnson, S. (2010). *Where good ideas come from: The natural history of innovation*. New York: Riverhead Books.

Larson, E. (2001). *Evolution's workshop. God and science on the Galapagos Islands*. London: Penguin Press.

Quiroga, D. (2009). Galápagos, laboratorio natural de la evolución: una aproximación histórica. *Ciencia para la sostenibilidad en Galápagos: el papel de la investigacón científica y tecnológica en el pasado, presente y futuro del archipiélago*. W. Tapia, P. Ospina, D. Quiroga, G. J. A. and C. Montes. Quito, Parque Nacional Galápagos. Universidad Andina Simón Bolívar, Universidad Autónoma de Madrid y Universidad San Francisco de Quito, 13–64.

Sulloway, F. (1982a). Darwin and his finches: The evolution of a legend. *Journal of the History of Biology, 15*, 1–53.

Sulloway, F. (1982b). Darwin's conversion: The Beagle voyage and its aftermath. *Journal of the History of Biology, 15*, 325–396.

Sulloway, F. (1983). The legend of Darwin's finches. *Nature, 303*, 372.

Chapter 2
On the Origin of Species and the Galapagos Islands

Ana Sevilla

In his introduction to *On the Origin of Species*, Darwin talks about the Voyage of the Beagle (1831–1836) and how his impressions of South America, mainly the distribution of its inhabitants and the geologic relationship between the past and present populations of the continent, struck him greatly. He then allows his undeniable talent as a writer to run free and launches one of the best-known expressions of the history of science:

> These facts seemed to me to throw some light on the origin of species - that mystery of mysteries as it has been called by one of our greatest philosophers. (Darwin 1859: 1)

Darwin is referring to John Herschel (1792–1871), a famous English astronomer whose phrase "that mystery of mysteries," came from a letter written in 1836 from Cape Colony, while the astronomer was engaged in surveying the Southern heavens, to his friend Charles Lyell (Cannon 1961). On these opening lines, Darwin surely sets the stage for a lasting impression. His text engages the reader with strong images and emotions. If you think of his Victorian audiences, they will first be mesmerized by the idea of faraway and exotic lands such as the enigmatic South American territory. Before recovering from their amazement, they would quickly be surprised again by the unfathomable mystery of all mysteries: "the first appearance of the new beings on this earth" (Darwin 1845: 378).

After this well-written introductory paragraph, Darwin comes down to business. He speaks about the process of elaborating his theory. The tone of the text changes dramatically as he switches from a tale of exciting adventures and enigmas to a more orthodox narration of discipline and patience. He states that, on his return home from the Voyage of the Beagle, in 1837, it occurred to him "that something

A. Sevilla (✉)
Colegio de ciencias sociales y humanidades, Universidad San Francisco de Quito, Quito, Ecuador
e-mail: anasevillaperez@gmail.com

D. Quiroga, A. Sevilla (eds.), *Darwin, Darwinism and Conservation in the Galapagos Islands*, Social and Ecological Interactions in the Galapagos Islands,
DOI 10.1007/978-3-319-34052-4_2

might perhaps be made out on this question by patiently accumulating and reflecting on all sorts of facts which could possibly have any bearing on it" (Darwin 1845: 378). Darwin spends 5 years in this quest of reflection and accumulation of data and only then he allows himself "to speculate on the subject" and draws his 1844 sketch of conclusions. From then to the publication of the *On the Origin of Species* (1859), he "steadily pursued the same object." He finally apologizes for this long explanation of his methods and insists that he wants to show that he has not "been hasty in coming to a decision."

After so many long years of patiently gathering evidence, he suddenly rushes. Wallace, Hooker, Lyell, etc. the Linnean Society, the description of this episode feels like an avalanche. Darwin needed 2 or 3 more years to publish, but the intellectual conditions of the time did not allow for this to happen. He finally circulates his ideas under the form of an abstract, a summary. Darwin qualifies what is today considered one of the defining works of our age, as imperfect and hasty. It lacks references and authority and it includes too many errors. Darwin asks the reader to trust in his facts. He offers to publish further details and arguments.

What is Darwin's "abstract" about? The complete title of the book is *On the Origin of Species by Means of Natural Selection*, *or the Preservation of Favored Races in the Struggle for Life*. Darwin addresses the question of the origin of species from a very specific vantage point. He begins by stating, "if a naturalist considers the origin of species it is very likely that he will come to the conclusion that each species has not been independently created but has descended from another species." But this conclusion doesn't even begin to answer the question. It is not satisfactory for Darwin. The key of his argument is to understand *how* species were modified to "arrive to the perfection of structure and coadaptation that makes us feel admiration." Darwin focuses on mechanisms of adaptation and modification, an obscure problem. He turns to the world of domesticated animals and plants. As the title of his first chapter announces: "Variation under domestication" becomes a defining ingredient in the theory he methodically elaborates.

According to Bowler (Bowler 2009), this is precisely the great element of originality in Darwin's work. In fact, he studies patterns and draws conclusions that had been rejected by other naturalists. The great debate to which Darwin's innovative and controversial method alludes is the subject of reversion. The assumed statement in Darwin's intellectual milieu was that "domestic varieties, when run wild, gradually but certainly revert in character to their aboriginal stocks." Hence, the argument followed that no deductions could "be drawn from domestic races to species in a state of nature." Darwin states that he "in vain endeavored to discover on what decisive facts the above statement has so often and so boldly been made." He finally concludes that there is "great difficulty in proving its truth." In fact, "very many of the most strongly-marked domestic varieties could not possibly live in a wild state" (Darwin 1859: 14).

Gould (1977: 41) wittily reflects on the contents of Darwin's first chapter in comparison with our expectations of it and rightly states that there is a certain dissonance. "One would think that the first chapter of a book as revolutionary as *On the Origin of species* would deal with cosmic questions," says Gould. We could add to

Gould's appreciation that one would also expect Darwin's first chapter to transport us to exotic and inhospitable lands, as the first paragraph of his introduction so marvelously anticipates. But Darwin's first chapter doesn't do any of these things: it talks about domestic pigeons! In fact, considering that it is always best to study a specific group, Darwin takes up domestic pigeons. He keeps every breed he could purchase or obtain and collects skins from several quarters of the world. Darwin also works together with several eminent fanciers and joins two of the London Pigeon Clubs (Darwin 1859: 20). What about Galapagos finches or Darwin's finches as they are popularly known since David Lack's (Lack 1947) work? Would they fit Gould's "cosmic" expectations? Why didn't Darwin write a first chapter based on unknown and mysterious little birds from faraway lands?

The Galapagos Islands and Darwin´s Visit: One of the Most Famous Few Weeks in the History of Science

In 1835, the HMS Beagle, under the command of Captain Fitzroy, arrives to the Galapagos Islands with Charles Darwin as a naturalist. His visit of the Archipelago lasts for 5 weeks, from 15 September to 20 October 1835, on which Darwin spends only 19 days in land on the islands of Chatham, Charles, Albemarle, and James.

> After three years of surveying the South American coast, the HMS Beagle reached Chatham Island (San Cristobal) in September 1835. During its stay on the islands Captain Fitzroy would carefully chart the archipelago. His map was extremely accurate and remained in use until de U.S.S. Bowditch recharted the area in 1942. In fact, Fitzroy made the first recommendation that the Beagle should visit the Galapagos back in 1831 to Admiral Beaufort, Hydrographer to the Royal navy, who was responsible of issuing the Admiralty's instructions for the voyage (Fitzroy 1831, September 6). These instructions suggested that the Beagle "should run for the Galapagos, and, if the season permits, survey that knot of islands" (Fitzroy 1839: 33). It is impossible to deny the intimate relationship between science and empire in the development of Darwin's career as a naturalist. The Beagle sails to the Pacific in search of accurate mapping data, just after the independence movements of the very young Latin American nations.

The voyage of the Beagle should be interpreted inside this framework of imperial negotiations and the possibility of defining new zones of influence for European powers.

Before sailing to the Archipelago, Darwin anticipates his anxiety for the Galapagos Islands in a letter written to his sister Caroline from Lima. He declares that the geology and zoology cannot fail to be interesting (Darwin 1835b (19 July–12 August)). He also writes to his cousin W. D. Fox stating that he "looks forward to the Galapagos, with more interest than any other part of the voyage" (Darwin 1835a (9–12 August)).

While the Beagle methodically moved round the archipelago, Darwin took every opportunity to go ashore where he made several observations about the geology and biology of the islands. These observations were recorded on one of his field notebooks; the one he uses on the Galapagos is labeled "Galapagos. Otaheite Lima."

The Galapagos records consist of one succession of 34 pages were Darwin's captivation with the volcanic formations and his determination to make important collections of plants and animals is made clear. The notes clearly show what an active observer Darwin was and how he was constantly comparing and investigating while he surveyed the islands (Chancellor and Keynes 2006). He was particularly struck by the difference between the inhabitants of the various islands. He began to ponder about the question of species, their distribution, and their place in the "economy of nature." Nevertheless, there is a debate regarding the impact of the islands Darwin saw and their contribution to his becoming an evolutionist (Sulloway 1982). In fact, Darwin started to ripen his theory of evolution by natural selection within 2 years of the Beagle's return to England.

So what exactly did Darwin do while in the Galapagos and how did his revolutionary insight regarding species change come after a number of wide-ranging observations and many times hurried and incomplete collections? The importance of the Galapagos Islands has to be understood inside the framework of the distribution of species that Darwin (1859: Chaps. 11 and 12) considers as one of the strong points of his theory just as he considers the imperfection of the geological record and the organs of extreme perfection as difficulties of his theory (Darwin 1859: Chap. 6).

Darwin's teacher and promoter at Cambridge University Professor John Henslow had initiated him in the study of the geographical distribution of species. There was a need for an explanation of how organisms came to be distributed across the Earth's surface. One option was to think that species colonized new land by floating as seeds across the ocean. Another possibility was to think that long-vanished land bridges were a more likely explanation. In fact, this discussion had an enduring tradition in Britain where many different interpretations had been suggested to understand animal and plant distribution patterns over the globe. As Browne (1992) proposes, these inquiries were intimately related to the developing ideology of colonialism, both in the way samples were obtained and in actual practice and theory. The imperial functions of exploratory voyages such as the Beagle played a crucial role in this respect. Furthermore, centers of accumulation such as the Royal Botanical Gardens at Kew became crucial for establishing patterns between ideas of biogeographical regions and a growing imperial ethos. Biogeography emphasized the idea of regions or "nations" of plants and animals. It was a science driven by the concern of discovering species useful to the motherland, and as such, it strongly echoed the growth of the British Empire during the late eighteenth and nineteenth centuries (Brockway 1979).

Darwin understood the information he needed to gather in order to further appreciate the strange links between the flora and fauna of oceanic islands and continents. He was fascinated by the geographic connection between the South American coasts and its neighboring islands, including the now famous Galapagos Archipelago. He puzzled over why species on nearby islands were similar to those on the continent. Traditional explanations, which were put forward by leading naturalist of the day such as Harvard's Louis Agassiz, were not satisfactory for Darwin. Agassiz defended the idea that each organism was specially created for its geographic setting. Eventually, Darwin's theory of natural selection would challenge

the principles of special creation theory. To solve the puzzle of oceanic islands, Darwin suggested that it was possible for species to be transported from the mainland to the islands. In the 1850s he embarked on a number of experiments to prove that a variety of cross-oceanic dispersal methods were possible (Darwin 1857, 1882).

The Galapagos were a clear case for broadening the understanding of these relations. Darwin's main interest had to do with geographic distribution: "I shall be very curious to know whether the Flora belongs to America, or is peculiar" (Darwin 1836). He made an effort of collecting specimens and announced to Henslow having "worked hard" on the islands. He writes that he "collected every plant (he) could see in flower" and hoped his collection could be of some interest to Henslow. In fact, throughout the 5 years of Darwin's round-the-world expedition, he maintained constant correspondence with his former Cambridge professor. These letters have many instructions from Henslow on packing, labeling, and collecting (Henslow 1833):

> Avoid sending *scraps*. Make the specimens as perfect as you can, *root*, *flowers & leaves* & you can't do wrong. In large ferns & leaves fold them back upon themselves on *one* side of the specimen & they will get into a proper sized paper. *Don't* trouble yourself to stitch them—for they really travel better without it— and a single label *per month* to those of the same place is enough except you have plenty of spare time or spare hands to write more.

Despite Henslow's involvement during the voyage, he described only a small part of Darwin's Galapagos plant collection; Hooker described the remaining plants in 1846.

The Beagle anchored first off Chatham Island. Captain Fitzroy spent 8 days surveying the coast, and Darwin made five landings near what is today called Puerto Baquerizo Moreno. He collected many plant species and was very impressed by the reptile life. Darwin also noticed the likeness between the mockingbirds of the island and those he had become familiar with in the west coast of South America. Darwin links the Galapagos birds with its equivalents on the mainland and enquires whether there might be more similarities between the plants of the continent and those of the archipelago. These are crucial questions that raise the issue of global relations of species and their geographical distribution.

The Beagle then sailed to Charles Island. Darwin had 3 days to collect in land. He had a conversation with the English vice-governor Nicholas Lawson about the giant Galapagos tortoises. Lawson told Darwin that the tortoises showed slight variations in the form of the shell. The governor claimed that he could "on seeing a tortoise, pronounce with certainty from which island it has been brought" (Keynes 2000: 291). A few days later, the Beagle reached Albemarle Island, and Darwin went ashore for collecting new specimens.

The Beagle then sailed to survey the coasts of Abingdon, Tower, and Bindloe. They finally reached James Islands where Darwin went ashore for a stay of 9 days. During this time, the extraordinary number of giant tortoises struck Darwin.

Ten years later, in the second edition of the Voyage of the Beagle (Darwin 1845: 394), Darwin explains that when he compared the numerous specimens of mockingbirds, he discovered, for his astonishment, that all of those from Charles Islands belonged to one species, all from Albemarle Island to another, and all from

James and Chatham to a third. The mockingbird seemed to be singular in each island. Darwin would link this fact to the conclusion he had gathered from Lawson's remark, that is that every island manifests a different type of tortoise shell. This parallel would become an important piece of evidence for what Darwin had in mind: the idea of conceivable patterns in the way species are distributed in the animal kingdom. The following statement shows this important discovery (Darwin 1845: 394):

> I never dreamed that islands about 50 or 60 miles apart, and most of them in sight of each other, formed of precisely the same rocks, placed under a quite similar climate, rising to a nearly equal height, would have been differently tenanted; but we shall soon see that this is the case.

He ends his description of this insight with an ironic remark, when he speaks of the "fate of most voyagers, no sooner to discover what is most interesting in any locality, than they are hurried from it." He nevertheless confirms that he should be thankful because he obtained "sufficient materials to establish this most remarkable fact in the distribution of organic beings." In fact, as Sulloway (1982: 19) states Darwin seemingly continued to treat the vice-governor's remark about the tortoises and his own findings with regard to the mockingbirds as isolated irregularities. If he would have appreciated fully the groundbreaking inferences of these facts, he would never have permitted his shipmates to engulf and later throw away all 30 adult tortoises brought on board the ship as a source of fresh meat for the navigation across the Pacific (Fitzroy 1839: 498).

Darwin's description of the islands contrasts with Captain Fitzroy's interpretation. In fact, where Darwin sees gradations and variation, Fitzroy sees fixity. The captain of the Beagle states that "all the small birds that live on these lava-covered islands have short beaks, very thick at the base, like that of a bull-finch." He describes this characteristic as "one of those admirable provisions of Infinite Wisdom by which each created thing is adapted to the place for which it was intended" (Fitzroy 1839: 503). Darwin, on the other hand, suspects that these birds that differ slightly in structure and fill the same place in nature should be considered as varieties and not species. This fundamental change of paradigm allows the naturalist to envision that the zoology of archipelagoes could produce important information that would undermine the stability of species.

Darwin needed an ornithologist to analyze his Galapagos bird collection. He wanted to find out if the different Galapagos mockingbirds belonged to the same species or could be counted as separate species. The young bird illustrator and ornithologist John Gould would be in charge of analyzing the collection. Different from Henslow, Gould responded quickly to Darwin's insights and confirmed that there were three species of mockingbirds in the collection. He also pointed out to Darwin that a number of birds that he had collected often without recording the specific islands to which they belonged should be grouped as "a series of Ground Finches, so peculiar in form that he was induced to regard them constituting an entirely new group, containing 14 species, and appearing to be strictly confined to the Galapagos Islands" (Gould 1837: 4). As Sulloway (1982) has argued, Gould's report was the first relation in the intricate story of "Darwin's finches" which has biased the understanding of Darwin's work in the Galapagos. Contrary to the legend

in the history of science that has linked Darwin's finch collection to his earliest theoretical views on evolution, what Sulloway (1982: 32) demonstrates is that it was actually the other way around. That is, it was Darwin's evolutionary views that eventually allowed him to comprehend the complex case of the finches.

In 1837, Darwin deepens his thoughts on the debate about the fixity or mutability of species. The implications of the Galapagos mockingbird and tortoises are then reassessed. He starts his first notebook on "transmutation of species" where he refers to his Galapagos impressions:

> Let a pair be introduced [to an area] and increase slowly, from many enemies, so as often to intermarry; who will dare say what result? According to this view, animals on separate islands ought to become different if kept long enough apart, with slightly different circumstances. Now Galapagos tortoises, mockingbirds, Falkland fox, Chiloe fox, English and Irish hare. (Darwin 1837–1838: 7)

And many pages later he draws his well-known branching diagram which illustrates how different species could be linked to each other by common descent (Darwin 1837–1838: 172–180).

But the question would still be left unanswered. Even though Darwin would become increasingly confident on the heuristic power of his developing theory, the evidence on which it was based was still insufficient. As Chancellor and Keynes (2006) phrase it, "three species of mocking-birds on three Pacific islands would not be enough to persuade." Darwin turned to his Galapagos plant collection that was still waiting for Henslow's analysis. In 1843, Darwin decided to ask the botanist Joseph Dalton Hooker to take over. Darwin's inquiries had to do with geographical distribution: how many of the Galapagos species where parallel to the South American findings and how many were unique to the islands. Where there any plants exclusive to a single island?

Hooker established that Darwin's specimens showed clear links to South American collections, and his conclusions on the particularity of the archipelago's flora were striking: of a total of 217 species collected, he found that 109 were confined to the archipelago and 85 of those were confined to a single island (Darwin 1845: 395–397).

Darwin had now something to work on. He could draw important conclusions from his first insights about the birds, the plants, and the geology of the Galapagos and their relationship to South American flora and fauna. As we have stated earlier, he would turn these hypotheses into one of the key elements to support the theory of natural selection: geographic distribution.

The Galapagos Islands and *On the Origin of Species*

Darwin mentions the Galapagos Islands in two sections of his book. In fact, in comparison with other sources of data, the information from the Galapagos is dimly treated in Darwin's major work. This fact contrasts with contemporary historiography and folk culture that give such a central role to the Archipelago in Darwin's

thinking. The first mention is in Chap. 2 "Variation under nature." He is discussing the difficulty of determining whether a form should be ranked as a species or a variety. He mentions the Galapagos as an example:

> Many years ago, when comparing, and seeing others compare, the birds from the separate islands of the Galapagos Archipelago, both one with another, and with those from the American mainland, I was much struck how entirely vague and arbitrary is the distinction between species and varieties. (Darwin 1859: 48)

The second section where Darwin speaks about the Galapagos Islands is in Chap. 12: "Geographic distribution—continued" under the subtitle "on the inhabitants of oceanic islands" (Darwin 1859: 388–406). Darwin's argument revolves around the consideration of different facts that "bear on the truth of the two theories of independent creation and of descent with modification." The discussion of insular productions plays a crucial role in this respect. He begins by observing, "species of all kinds which inhabit oceanic islands are few in number compared with those on equal continental areas." Following this fact, Darwin describes a fundamental difficulty of the theory of independent creation:

> He who admits the doctrine of the creation of each separate species, will have to admit, that a sufficient number of the best adapted plants and animals have not been created on oceanic islands. (Darwin 1859: 388)

The lack of many plants and animals in oceanic islands is aggravated by the actions of men in the dispersal of living forms. Darwin mentions "man has unintentionally stocked" oceanic islands with various animals and plants "far more fully and perfectly than has nature." This proves that islands can support different types of plants and animals. He also speaks of endemism in oceanic islands where, although the number of kinds of inhabitants is scanty, the proportion of species that are nowhere else found in the world is often extremely large. In this case, he uses once again Galapagos as an example. He compares the number of endemic birds with the number found on any continent and then compares the area of the islands with that of the continent, in order to prove that the proportion of endemic animals is very large. Darwin affirms that this curious fact is intelligible under his theory of natural selection since "species occasionally arriving after long intervals in a new and isolated district, and having to compete with new associates, will be eminently liable to modification, and will often produce groups of modified descendants" (Darwin 1859: 389).

The deficiency in certain classes of animals is another trait that draws Darwin's attention. Other inhabitants apparently occupy these empty spaces in the economy of nature of oceanic islands. In the Galapagos Darwin mentions reptiles that take the place of mammals. Regarding plants, Darwin cites Hooker's findings on the proportional numbers of the different orders: they are very different from what they are elsewhere. Darwin accounts these cases not only to the physical conditions of the islands but also to the facility of immigration.

Darwin continues this section of *On the Origin* describing the "many remarkable little facts" that could "be given with respect to the inhabitants of remote islands." He speaks of the "beautifully hooked seeds" of the endemic plants of certain islands

not tenanted by mammals, even though hooked seeds are an adaptation for seed transport by the wool and fur of quadrupeds. This puzzle presents no difficulty on Darwin's view:

> For a hooked seed might be transported to an island by some other means; and the plant then becoming slightly modified, but still retaining its hooked seeds, would form an endemic species, having as useless an appendage as any rudimentary organ. (Darwin 1859: 392)

He also mentions the existence of trees or bushes belonging to orders, which elsewhere include only herbaceous species. Trees, different from herbaceous plants, due to their tendency to confined ranges would be little likely to reach distant oceanic islands. Hence, a herbaceous plant when established on an island would compete with herbaceous plants alone. In this scenario, it might readily gain an advantage by growing taller and taller and overtopping the other plants:

> Natural selection would often tend to add to the stature of herbaceous plants when growing on an island, to whatever order they belonged, and thus convert them first into bushes and ultimately into trees. (Darwin 1859: 392)

Another remarkable fact is the absence of whole orders on oceanic islands. This is the case, for example, of Batrachians (frogs, toads, newts), which "have never been found on any of the many islands with which the great oceans are studded." Darwin affirms to "have taken pains to verify this assertion": he found it to be true. Since this general absence cannot be accounted for by their physical conditions (islands are peculiarly well fitted for these animals), Darwin alleges that they do not exist on oceanic island because there is great difficulty in their transport: these animals and their spawn are immediately killed by seawater. He concludes this section reflecting once again on the limits of the theory of creation:

> But why, on the theory of creation, they should not have been created there, it would be very difficult to explain. (Darwin 1859: 393)

Oceanic Islands, like the Galapagos, and their "remarkable little facts" (Darwin 1859: 392) not only play a crucial role as counter arguments for the theory of special creation, they also allow Darwin to contest the concept of land bridges as an explanation for the dispersal of living creatures. All the previous remarks on the inhabitants of oceanic islands, namely, the scarcity of kinds; the richness in endemic forms in particular classes; the singular proportions of certain orders of plants; herbaceous forms having been developed into trees; the absence of whole groups, as of batrachians, etc., are explained by Darwin by the concept of occasional means of transport having been largely efficient in the long course of time. He considers that the view of all oceanic islands having been formerly connected by continuous land with the nearest continent is substantially incorrect. If this would have been the case, the migration of animals and plants would probably have been more complete, and we would not find the empty spaces in the economy of nature that are characteristic of oceanic islands.

The discussion of land bridges leads Darwin to the "most striking and important fact" (Darwin 1859: 397) in regard to the inhabitants of islands: their affinity to those of the nearest mainland, without being actually the same species. He uses the

Galapagos Islands again as an example to illustrate these findings. The Galapagos Archipelago is situated under the equator, between 500 and 600 miles from the shores of South America. In this group of islands, Darwin remarks, "almost every product of the land and water bears the unmistakable stamp of the American continent" (Darwin 1859: 398). Darwin reflects on Gould's assessment of the Galapagos birds. The ornithologist ranked 25 out of the 26 land birds, as distinct species. Are these birds supposed to have been created on the islands even though they bear a close affinity to American species? This question applies to the other animals and to nearly all the plants, as Hooker shows in his memoir on the flora of the Galapagos that Darwin qualifies as an "admirable" work.

Darwin ponders on the paradox of looking at the inhabitants of these volcanic islands in the Pacific, distant several hundred miles from the continent and yet feeling that he is standing on American land:

> Why should this be so? Why should the species which are supposed to have been created in the Galapagos Archipelago, and nowhere else, bear so plain a stamp of affinity to those created in America? (Darwin 1859: 398)

This puzzle is even more perplexing by the fact that there is "nothing in the conditions of life, in the geological nature of the islands, in their height or climate, or in the proportions in which the several classes are associated together, which resembles closely the conditions of the South American coast." There actually exists a "considerable dissimilarity in all these respects" (Darwin 1859: 398). Nevertheless, Darwin compares the Galapagos Islands with Cape Verde Archipelago which he also visited during his voyage on board the Beagle and arrives to the conclusion that "there is a considerable degree of resemblance in the volcanic nature of the soil, in climate, height, and size of the islands" between these two groups of islands: "but what an entire and absolute difference in their inhabitants!" What strikes Darwin is that the inhabitants of the Cape de Verde Islands are related to those of Africa, like those of the Galapagos to America. Darwin speaks of this difference as a "grand fact" and asserts that it "can receive no sort of explanation on the ordinary view of independent creation," whereas on the view of maintained on his theory:

> It is obvious that the Galapagos Islands would be likely to receive colonists, whether by occasional means of transport or by formerly continuous land, from America; and the Cape de Verde Islands from Africa; and that such colonists would be liable to modification;—the principle of inheritance still betraying their original birthplace. (Darwin 1859: 398)

From these observations, Darwin deduces an "almost universal rule" which states "that the endemic productions of islands are related to those of the nearest continent, or of other near islands" (Darwin 1859: 399).

The Galapagos Islands seem to offer an even more interesting scenario for understanding these peculiar dynamics of dispersal. In fact this law which causes the inhabitants of an archipelago, though specifically distinct, to be closely allied to those of the nearest continent, is displayed in the Galapagos on a small scale, "in a most interesting manner, within the limits of the same archipelago." Darwin describes how the several islands of the Galapagos are occupied, "in a quite marvelous manner," by very closely related species. He observes how the inhabitants of each

separate island, "though mostly distinct, are related in an incomparably closer degree to each other than to the inhabitants of any other part of the world." This is just what might have been expected on the view that Darwin is trying to defend since the islands "are situated so near each other that they would almost certainly receive immigrants from the same original source, or from each other" (Darwin 1859: 400).

Darwin also notes that this dissimilarity between the endemic inhabitants of the islands may be used as an argument against his views. In fact, the naturalist notes that it may be asked, "how has it happened in the several islands situated within sight of each other, having the same geological nature, the same height, climate, etc., that many of the immigrants should have been differently modified, though only in a small degree." For many years, Darwin mused over this problem. It long appeared to him as a great difficulty until he realized that the apparent enigma arises "from the deeply-seated error of considering the physical conditions of a country as the most important for its inhabitants" (Darwin 1859: 400). In contrast with this consideration, Darwin's thinking contemplates the nature of other inhabitants with which each has to compete as a much more important element of success.

Darwin explains what he saw in the Galapagos Islands by ways of a principle, which determines the general character of the fauna and flora of oceanic islands. He considers this principle to be of the widest application throughout nature. Darwin's concept includes elements of migration, colonization, exposure to diverse conditions of life, and subsequent modification and adaptation in order to become better fitted to their new homes. In this sense, he notes that the inhabitants of the Galapagos Archipelago, which are found in other parts of the world, show a considerable amount of difference in the several islands. This difference is expected on the "view of the islands having been stocked by occasional means of transport—a seed, for instance, of one plant having been brought to one island, and that of another plant to another island" (Darwin 1859:400). Hence when an immigrant settles on any one or more of the islands, it would inevitably be exposed to diverse conditions of life: it would have to compete with different sets of organisms. If then the immigrant varied, natural selection would probably favor different varieties in the different islands.

The Galapagos Archipelago is exceptional to Darwin's criteria because it manifests a "really surprising fact": the new species formed in the separate islands have not quickly spread to the other islands even though the islands are in sight of each other. Darwin describes in a vivid way the distribution of the islands of the Archipelago and why the conditions of the sea create a broader distance between them:

> But the islands, though in sight of each other, are separated by deep arms of the sea, in most cases wider than the British Channel, and there is no reason to suppose that they have at any former period been continuously united. The currents of the sea are rapid and sweep across the archipelago, and gales of wind are extraordinarily rare; so that the islands are far more effectually separated from each other than they appear to be on a map. (Darwin 1859: 401)

The information collected on the Galapagos points to the question of the "probability of closely allied species invading each other's territory, when put into free intercommunication" (Darwin 1859: 402). Darwin stresses that there is a common

misrepresentation regarding this issue. It is true that if one species has any advantage whatsoever over another, it will in a short time supplant it. Many species that have been naturalized through man's agency, for example, spread with astonishing swiftness over new territories. These forms, which become naturalized in new countries, are not closely related to the aboriginal inhabitants, but are usually distinct species. What the Galapagos shows is that if two species are equally well fitted for their own dwellings in nature, they will probably hold their own places and keep separate for almost any length of time. Darwin gives the example of Galapagos birds that even if they are well adapted for flying from island to island, they are distinct on each. He speaks of the three closely allied species of mocking thrush, each confined to its own island. He proposes a mental experiment regarding the distribution of these birds:

> Now let us suppose the mocking-thrush of Chatham Island to be blown to Charles Island, which has its own mocking-thrush: why should it succeed in establishing itself there? We may safely infer that Charles Island is well stocked with its own species, for annually more eggs are laid there than can possibly be reared; and we may infer that the mocking-thrush peculiar to Charles Island is at least as well fitted for its home as is the species peculiar to Chatham Island. (Darwin 1859: 402)

From these considerations, Darwin concludes that we should "not greatly marvel" at the endemic species that occupy the numerous islands of the Galapagos Archipelago, not having spread from island to island. He suggests that "preoccupation" plays an important role in "checking the commingling of species under the same conditions of life." Finally, Darwin closes this section on the inhabitants of oceanic islands by stressing that the facts that have been discussed are "utterly inexplicable on the ordinary view of the independent creation of each species, but are explicable on the view of colonization from the nearest and readiest source, together with the subsequent modification and better adaptation of the colonists to their new homes" (Darwin 1859: 403).

Darwin makes this concluding claim in order to position himself against the argument of a creator, who could make species to begin with, and who could also create specific individuals in situ, anywhere on the globe. Did species become widely distributed by various probable and improbable means of dispersal over geological time, or were they located where we see them today by divine action? In Darwin's context, claiming that all members of the same species descended from the same ancestral parents was a strong material argument that contrasted with explanations of supernatural agency.

The publication of *On the Origin of Species* revolutionized biological sciences and also made Darwin into an eminent intellectual idol. Sulloway (1987) traces the heroic history that has been built around Darwin's figure. As he states, myths and legends gravitate around the problem of origins and Darwin's insights and discoveries and subsequent "triumph" as a valid interpretation of our natural history, all include the appropriate ingredients to become a heroic history. In the wake of Darwin's scientific accomplishments, a specific legend has been constructed regarding the relationship between Darwin and the Galapagos islands. Sulloway describes the legend as being composed of three fundamental elements. The first myth is that

Darwin had a "eureka-like" conversion during his brief visit to the Galapagos Islands. This myth would suggest that the English naturalist tossed away the restraints of his creationist thinking when he was confronted with the overwhelming evidence of the Galapagos. The second myth associated with Darwin and the Galapagos is that the islands provided Darwin with a basic paradigm for his theory. This conception would suggest that Darwin's evolutionary argument, as finally presented on the Origin, was built extensively on the collection of evidence made by Darwin during his visit to the Archipelago. The third and last myth is built around the idea that Darwin singlehandedly deduced almost everything there is to know about evolution in the Galapagos.

On the Origin of Species is the product of 24 years of thinking and further research (1835–1859), not the 5 weeks that Darwin spent in the Galapagos Islands or the 5 years he spent on board the H. M. S. Beagle around the world. The Galapagos surely provided Darwin with some decisive clues, but Darwin's complete understanding of natural selection and the Galapagos required as long as it took him to publish *On the Origin* (Sulloway 1987: 84). As Sulloway (1987: 79) explains "when and how Darwin solved this "great mystery of mysteries" and particularly the role his Galapagos visit played in this regard, have become the subject of a considerable legend in the history of science."

References

Bowler, P. J. (2009). Darwin's originality. *Science, 323*(5911), 223–226.

Brockway, L. (1979). *Science and colonial expansion: The role of the British Royal Botanic Gardens*. New York: Academic.

Browne, J. (1992). A science of empire: British biogeography before Darwin. *Revue d'histoire des sciences, 45*(4), 453–475.

Cannon, W. F. (1961). The impact of uniformitarianism: Two letters from John Herschel to Charles Lyell, 1836–1837. *Proceedings of the American Philosophical Society, 105*(3), 301–314.

Chancellor, G., & Keynes, R. (2006). Darwin's field notes on the Galapagos: 'A little world within itself'. Darwin Online.

Darwin, C. (1835, 9–12 August). Darwin, C.R. to Fox, W.D. Darwin Correspondence Database. Retrieved May 19, 2014, from http://www.darwinproject.ac.uk/entry-282. Darwin correspondence project.

Darwin, C. (1835, 19 July–12 August). Darwin, C.R. to Darwin, C.S. Darwin Correspondence Database. Retrieved May 19, 2014, from http://www.darwinproject.ac.uk/entry-281. Darwin correspondence project.

Darwin, C. (1836). Darwin, C.R. to Henslow, J.S. *Kew Henslow letters: 29*. Darwin Correspondence Database. Retrieved May 19, 2014, from http://www.darwinproject.ac.uk/entry-295. Darwin correspondence project.

Darwin, C. (1837–1838). *Notebook B: Transmutation of species* (1837–1838). Transcribed by Kees Rookmaaker, Darwin Online. Retrieved from http://darwin-online.org.uk/. CUL-DAR121.

Darwin, C. (1845). *Journal of researches into the natural history and geology of the countries visited during the voyage of H.M.S. Beagle round the world, under the Command of Capt. Fitz Roy*. London: John Murray.

Darwin, C. (1857). On the action of sea-water on the germination of seeds. *Journal of Proceedings of the Linnean Society of London (Botany), 1*, 130–140.
Darwin, C. (1859). *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*. London: John Murray.
Darwin, C. (1882). On the dispersal of freshwater bivalves. *Nature, 25*, 529–530.
Fitzroy, R. (1831, September 6). Letter from Fitzroy to Beaufort, Admiralty Hydrographic Office.
Fitzroy, R. (1839). *Narrative of the surveying voyages of His Majesty's Ships Adventure and Beagle between the years 1826 and 1836, describing their examination of the southern shores of South America, and the Beagle's circumnavigation of the globe. Proceedings of the second expedition, 1831–36, under the command of Captain Robert Fitz-Roy, R.N*. London: Henry Colburn.
Gould, J. (1837). Remarks on a group of ground finches from Mr. Darwin's collection, with characters of the new species. *Proceedings of the Zoological Society of London, 5*, 4–7.
Gould, S. J. (1977). *Darwin's sea change, or five years at the captain's table. Ever since Darwin: Reflections in natural history*. New York: W.W. Norton.
Henslow, J.S. (1833). Letter to Darwin. C. Darwin. Darwin Correspondence Project.
Keynes, R. E. (2000). *Charles Darwin's zoology notes & specimen lists from H.M.S. Beagle*. Cambridge: Cambridge University Press.
Lack, D. (1947). *Darwin's finches*. Cambridge: Cambridge University Press.
Sulloway, F. (1982). Darwin's conversion: The Beagle voyage and its aftermath. *Journal of the History of Biology, 15*, 325–396.
Sulloway, F. (1987). Darwin and the Galapagos: Three myths. *Oceanus, 30*(2), 79–85.

Chapter 3
The Galapagos Islands and the Ecuadorian State: Early Encounters

Ana Sevilla

The reception of Darwinism among Ecuadorians following the publication of *On the origin of species* is an arena where very little historiographical work has been carried out. Even though there has been an important turn toward Latin America in the field of Darwinism that begun in 1996 with the Mexico symposium on the reception of Darwinism in the Iberian world,[1] Ecuador has remained outside the debates. With the exception of Paraguay, all of the countries of the Iberian world have a Darwinian historiography (Glick 2010), and their comparative study has shown national approaches to Darwinism according to the prevalence of Spencerian positivism (Argentina) and Comtean positivism (Chile), the relative power of the Roman Catholic Church, and the application of social Darwinism to minority groups. The lack of information on the Ecuadorian reception of Darwinism not only limits the plurality of all these topics, but it has also benefited the construction of a Eurocentric concept of the Galapagos Islands, its human history, and conservation struggles.

Through this dominant perspective, the islands are mainly seen as part of an international community and its efforts to maintain a pristine laboratory of natural selection: the islands that Darwin saw. Any connection to the Ecuadorian State is futile and irrelevant. Edward Larson's "Evolution's workshop" (Larson 2001) is a vivid example of this tendency. Larson constantly links the history of the Galapagos to international (and mainly scientific) interests without engaging with the fact that the Galapagos have been part of Ecuador's territory since 1832 and that the Ecuadorian State, its elites, and migrating populations from mainland Ecuador and

[1] The papers at the Cancun meeting were published in Glick, T., Miguel Angel Puig Samper and Rosaura Ruiz. 2001. *The reception of Darwinism on the Iberian World*. Dordrecht: Kluwer Academic Publisher

A. Sevilla (✉)
Colegio de ciencias sociales y humanidades, Universidad San Francisco de Quito, Quito, Ecuador
e-mail: anasevillaperez@gmail.com

D. Quiroga, A. Sevilla (eds.), *Darwin, Darwinism and Conservation in the Galapagos Islands*, Social and Ecological Interactions in the Galapagos Islands,
DOI 10.1007/978-3-319-34052-4_3

elsewhere have also forged the fate of the islands. Additionally, the islands have played a role in local politics and the discourses of the Ecuadorian State.

In fact, if we think of the challenges of nation-building in nineteenth-century Ecuador, two important regions of the country could be categorized as *terra incognita*: the Galapagos and the Amazon region (Sevilla Perez 2013). Of these two uncharted territories, the Amazon was the most difficult one because it included aboriginal populations that potentially threatened the idea of the nation-state, no map could describe it, and neighboring Peru constantly challenged its sovereignty. Galapagos, on the contrary, had no aboriginal populations, had good maps, and was not challenged by any other country. Despite these differences, the Ecuadorian State commanded systematic examinations of the Galapagos and delayed its involvement with its vast Amazon region. We will argue in this chapter that this peculiar strategy was largely inspired by the reception of Darwin's ideas in Ecuador.

We will analyze the voyages and publications of Theodor Wolf (1841–1924), a German scientist who was employed as State Geologist by the Ecuadorian government. He was largely influenced by Darwin's ideas, which not only drove him to travel and investigate on the Galapagos Archipelago but also shaped the attitude of the local government toward the administration of the islands.

Darwin and Wolf

> Darwin is not exaggerating when he says that there are over 2000 volcanic craters on the islands (…) some places are littered with these holes, like the skin of someone who has had smallpox; these places present the most singular and grotesque appearance that you could imagine: hundreds of cyclopean forges built of huge chunks of harsh and black lava (…) Everything in this landscape is bizarre and extravagant, and nevertheless, the inorganic and organic parts of this picture are in perfect harmony with each other, and sometimes recall the antediluvian landscapes, which geologists usually painted in their fossil descriptions. (Wolf 1892b: 470)

This quote is taken from Theodor Wolf's 1892 "Geography of Ecuador."[2] A voluminous work that accompanied Ecuador's second official national map[3] and was commanded by the Ecuadorian State to Theodor Wolf, a German scientist who was employed as State Geologist since 1875 (see Fig. 3.1).

Wolf is a key figure for analyzing the relationship between the Ecuadorian State and elites with the Galapagos Islands. Wolf makes three publications in Spanish regarding his studies of the Galapagos that shape the attitude of the local government

[2] Wolf, T. (1892). Carta Geografica del Ecuador por Dr. Teodoro Wolf, publicada por orden del Supremo Gobierno de la Republica y Trabajada Bajo las Presidencias de los EE. Senores Dr. D.J.M. Placido Caamano y Dr. D. Antonio Flores. Leipzig: Instituto geográfico de H. Wagner & F. Debes

[3] Wolf, T. (1892). *Geografía y Geología del Ecuador publicada por orden del Supremo Gobierno de la República por Teodoro Wolf, Dr. Phil, antiguo profesor de la Escuela Politécnica de Quito y geólogo del Estado*. Leipzig: Tipografía de F. A. Brockhaus

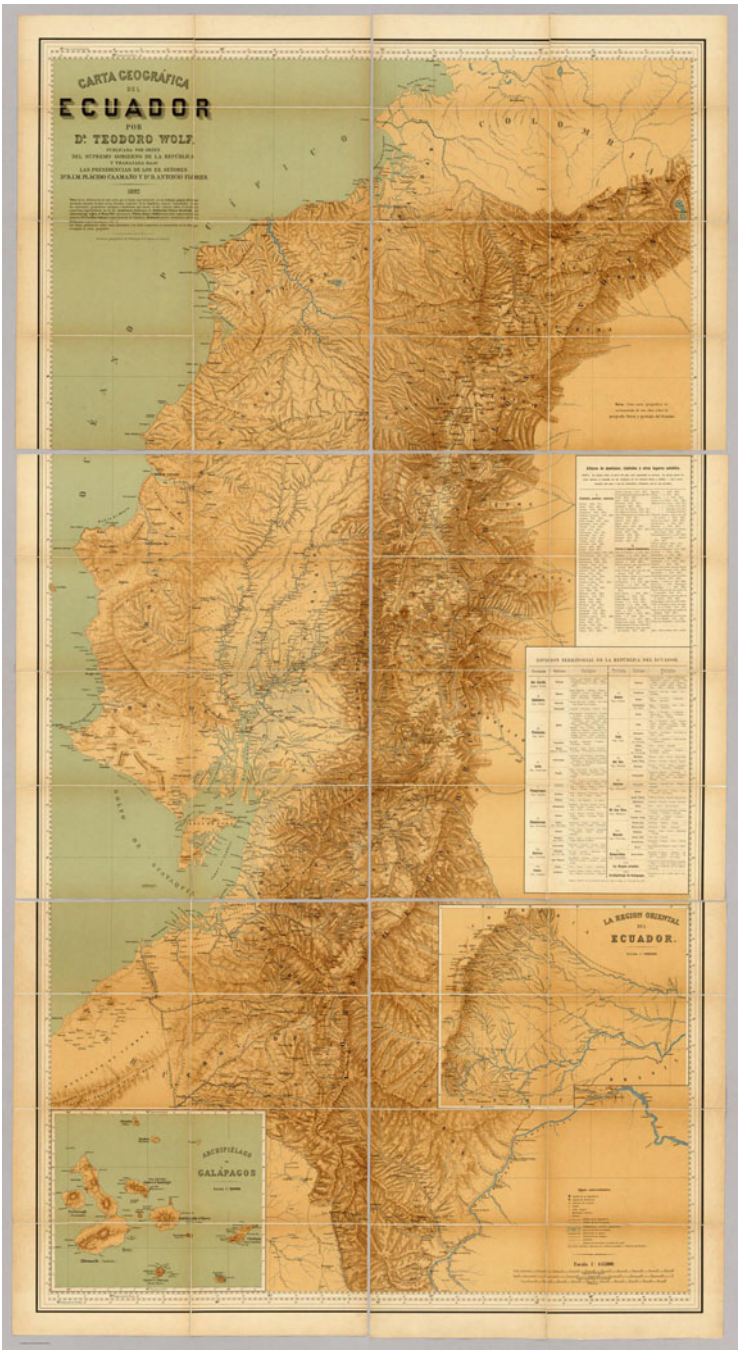

Fig. 3.1 Wolf, T. 1892. Carta Geografica del Ecuador por Dr. Teodoro Wolf, publicada por orden del Supremo Gobierno de la Republica y Trabajada Bajo las Presidencias de los EE. Senores Dr. D.J.M. Placido Caamano y Dr. D. Antonio Flores. Leipzig: Instituto geográfico de H. Wagner & F. Debes. This is a huge and detailed map of Ecuador. Inset maps show the Galapagos Islands and Ecuador's Amazon region. Source: Aurelio Espinosa Polit Archive (Quito)

toward the administration of the Islands.[4] We will analyze these articles in this chapter. Wolf's first article is published in 1879 in the Bulletin of the Astronomical Observatory of Quito (Wolf 1879a). His second article is published by the Government of Ecuador in 1887 (Wolf 1887), and his third article is the chapter regarding the Galapagos on his "Geography of Ecuador." Where did Wolf's knowledge of the Galapagos come from and did he have any influence in the attitude of the local government toward the administration of the islands? Did Darwinism have anything to do with this dynamic?

Wolf (1892a, b) begins his description of the Galapagos Archipelago by stating that in 1832 the newly formed Ecuadorian State took formal possession of the islands (by initiative of General Villamil) and has exercised since then jurisdiction over the islands without interruption and in peace. Villamil started to colonize with lots of enthusiasm Charles Island that he renamed "Isla Floreana" in honor of the Ecuadorian President-in-Office General Flores. In September 1835, Darwin saw in this island a small population of 200–300 souls. But this colony disappeared, and its rapid descent was probably due to the fact that the Ecuadorian government transformed the islands into a place for deporting criminals, which made the subsistence of honorable people impossible. After this, the islands stayed as before, only the object of transitory speculative activities such as the orchilla business and the hunt for whales and sea lions. In 1885 the Ecuadorian National Congress included the islands to the province of Guayas (where the main port of Guayaquil is) and established authorities in Chatham Island.

In his 1892 map, Wolf represents the 13 main islands that make up the Galapagos Archipelago but does not include the numerous smaller islets surrounding these islands. Two of these islets, called before 1892, Culpepper and Wenman (situated within 27 miles NW of Abingdon) were renamed in 1892[5] into "Darwin" and "Wolf." These secluded islands have been embodied in geography as a silent sign of a connection that determined the lives of these two scientists and today are held together in the middle of the Pacific Ocean. This connection has to do with a

[4] He makes four additional publications in German and English:

Wolf, T. (1879b). Ein Besuch der Galápagos-Inseln. *Sammlung von Vorträgen für das deutsche Volk* 1 (9/10), 257–300

Wolf, T. (1879c). Bemerkungen über die Galapagos Inseln, ihr Klima und ihre Vegetation, nach Beobachtungen in den Monaten August bis November 1875. *Verhandlungen der berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte* 6, 245–256

Wolf, T. (1895a). Die Galapagos Inseln. *Verhandlungen der Gesellshaft für Erdkunde zu Berlin. Transacciones de la Sociedad para el eje de la Geografía a Berlín* XXII, 246–265

Wolf, T. (1895b). The Galapagos islands. *Geographical Journal London—Royal Geographical Society* VI(6), 560–564

[5] English buccaneers in the seventeenth century named the islands for the first time as Galapagos Archipelago. British naval captains then determined other names during the eighteenth and nineteenth centuries. These first names celebrated European kings, statesmen, scientists, etc… As part of a global ceremony celebrating the 400th anniversary of the discovery of America, Ecuador renamed the islands in 1892 (McEwen 1988: 234) and renamed the islands with designations that were considered more appropriate to the language and history of the country Larrea (1952) and Black (1973)).

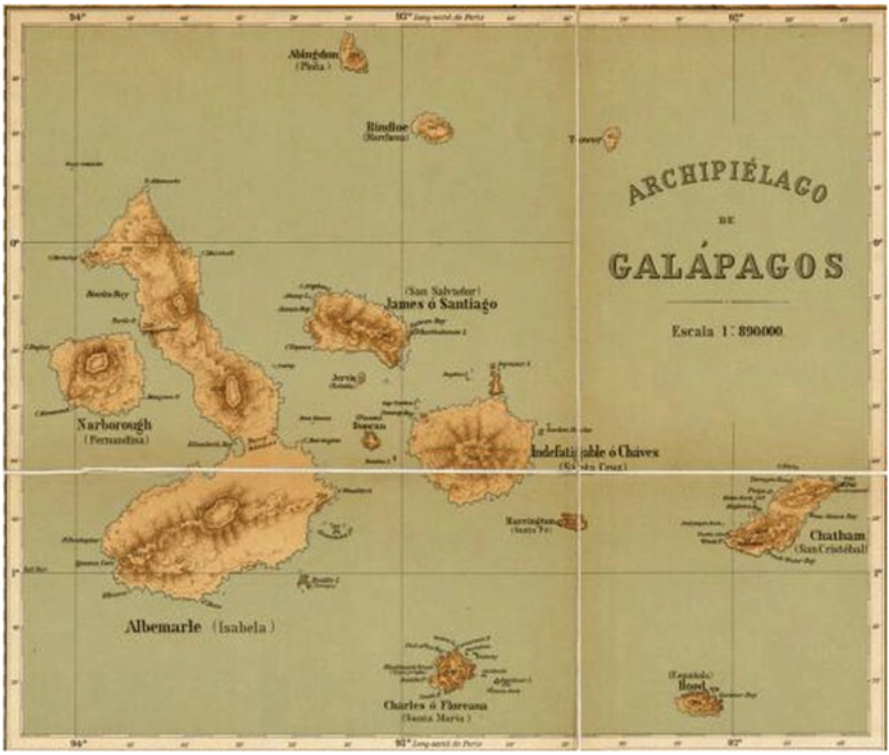

Fig. 3.2 Wolf, T. 1892. "Archipiélago de Galapagos" en Carta Geografica del Ecuador por Dr. Teodoro Wolf, publicada por orden del Supremo Gobierno de la Republica y Trabajada Bajo las Presidencias de los EE. Senores Dr. D.J.M. Placido Caamano y Dr. D. Antonio Flores. Leipzig: Instituto geográfico de H. Wagner & F. Debes. Source: Aurelio Espinosa Polit Archive (Quito)

fascination with the natural world and an intrigue in understanding its logic and its elements. It also has to do with a willingness to do science in remote places that offer innovative perspectives that would not be possible to see from Europe. Finally, this connection is also exploring the possibility of breaking with conventional ways of seeing the world and understanding it (see Fig. 3.2).

The Reception of Darwin's Ideas in Ecuador

Darwin's ideas arrived in Ecuador by way of a member of the Society of Jesus (Cuvi et al. 2014). In 1870, the young German-Jesuit Theodor Wolf traveled to Ecuador to take an active part of the project of President Gabriel Garcia Moreno (1821–1875). The president wanted to include in his nation-state-building project of "Catholic modernity" (Demelas and Saint-Geours 1988; Maiguashca 1994) a strong emphasis

on scientific education.[6] He commissioned education in schools in the hands of the Spanish Jesuits who returned to Ecuador in 1864 and brought German-Jesuit scientists specifically to open a Polytechnic University in Quito, the capital of Ecuador. From the beginning, the relationship between these two groups was tense. For the traditional clergymen, science was seen as a distraction, a diversion, and even a blasphemy, while Jesuit scientists battled between the ignorance that the clergy promised them and the lights of science. The following reflections made by one of the Jesuit scientists, Father Menten (1872: 13), illustrates these tensions:

> The clergy like all other classes of society are not all equal in knowledge, and you will find inside its ranks (who could doubt it?) individuals whose skills aren't as desirable as one would expect. But this obvious fact should not undermine the foundation of the entire class (…). Many of its individuals shine in the scientific community inspired by their knowledge of the progress in the arts and sciences.

Jesuits-scientists were faced with the dilemmas of the time regarding specific scientific theories and their divergence with the provisions of the Bible. These contradictions were threefold: (1) Laplace's theory of creation of the solar system, (2) Lyell's long geological timescales, and (3) Darwin's theory of natural selection. Regarding the third, Fernós (2005: 195) argues that it is surprising how early these ideas were discussed in Latin America despite the fact that the translation of *On the origin of Species* to Spanish did not occur until 1876. Initially, in the Hispanic world, the version that circulated was not Darwin's original work, but its philosophical interpretation established by Ernest H. Haeckel. In Ecuador, just like in many other parts of Latin America, German university professors mainly guided exposure to Darwinism.[7] This predominance may be due to the fact that Germany was one of the first European countries to accept Darwinism, unlike France and Spain where these ideas encountered active resistance.

Inside this troubled scenario, Garcia Moreno created a Polytechnic University in Quito, the capital of the country, where many scientific ideas, such as Darwinism, were discussed for the first time in Ecuador (Cuvi et al. 2015). In 1871, the Polytechnic School began lecturing on Darwinism. The program of that year announced public lectures on scientific issues such as Darwinism, the age of the human race, the geology of Ecuador, etc. (Escuela Politécnica 1871). This is repeated in the 1872 program that says, "we will touch on some of the most interesting questions of modern science, such as Darwinism and all the subjects which are connected with the creation of species" (Escuela Politécnica 1872). The programs

[6] Demelas and Saint-Geours consider Garcia Moreno's project as a hybrid between religious conservatism and a belief in progress and modernization, "mathematician and mystic, traditionalist and technician, Garcia Moreno is the man of paradoxes assumed in a strange synthesis" (1988: 145). Maiguaschca's thesis considers the Garcian project as a distinct form of modernity; a "Catholic modernity" (2005: 234).

[7] Rodolfo A. Philipi, for example, was the first to discuss Darwinism in Chile in 1866. Otto Wucherer, a German parasitologist who worked at the Brazilian School of Medicine, discussed the issue in the same year, while Adolfo Ernst, a German naturalist, discussed Darwinism for the first time in 1867 in Venezuela (Fernós 2005: 195).

in the following years omitted the direct allusion to Darwinism, but maintained a focus on geologic time and the study of fossils.

Despite the initial openness of the Polytechnic School for divulging these controversial issues, the tension between science and religion did not stay dormant to the point of provoking a confrontation with Wolf's ideas "that defined (…) the future of the wise professor" (Martínez 1934/1994: 259). The event has been recorded in the form of an anecdote told by one of Wolf's students: Augusto Martínez (1994: 259). In 1874, Martinez attended one of Wolf's lectures on geology in front of "an audience, although very scarce, consisting of notable gentlemen of the capital." Martinez recalls with humor that he attended these conferences with absolute punctuality although he did not understand much. He describes that Wolf exposed the foundations of Darwinian theory, never heard in Ecuador, until then, when he noticed at the door of the room two priests who were afraid to come in. They were the canons Dr. Leopoldo Freire and Nicolas Tobar, high dignitaries of the Metropolitan Church. It seems that this improper act, to say the least, of the canons, exalted Wolf's anger and moodiness to an indescribable degree. The German geologist, according to Martinez's account, cut the thread of the conference and yelled in an angry voice: "Gentlemen if you come as disciples come inside. If you want to argue with me about the scientific doctrines that I am discussing in these lectures, I am also ready for it, but not here in my classroom!" Without saying a word, the canons turned and left. After this skirmish, the Archbishop of Quito received news of Wolf's anti-Catholic doctrines, and a few months later, Wolf abandoned forever the Society of Jesus.

Wolf taught at the Polytechnic University for 4 years (between 1870 and 1874) and gave various courses in geology, zoology, mining, paleontology, mineralogy, and Darwinism. He was also in charge of building a museum of natural history and mineralogy. He traveled extensively around the country, under the President's orders, to gather geological and geographical information of the unexplored territory. Every trip was accompanied by a detailed description published in Spanish in the official Newspaper "El Nacional" and also published in a slightly modified German version in different European Journals. Over time, these expeditions found increasing opposition among the more orthodox Jesuits, who considered that Wolf was doing too much science and saw with suspicion the intimacy between him and the government. This tension unfolded in 1873 when Wolf wrote a letter to Rome asking for an authorization to organize a scientific expedition to the Galapagos Islands. In Rome, Father Anderledy, Wolf's former promoter in Germany, who had become the Assistant of the Father General in Rome, in a letter dated May 30, 1873, left the decision in the hands of the Jesuits in Ecuador. Anderledy's letter clarified that permission should not be given if the trip was considered to be harmful to Wolf's religious spirit. He considered Wolf to be a man of strong will but "perhaps too addicted to natural history and without an appreciation for philosophy that is truly necessary precisely for those who in our time are devoted to the physical sciences" (Miranda 1972). The Jesuits in Ecuador finally denied the permission for the trip to the Galapagos Islands alleging arguments over the negative imbalance between Wolf's spiritual and scientific fervor.

Wolf and the Galapagos Islands

In November 1874, a little over 3 years after having arrived to Ecuador, Wolf's resignation to the Jesuit Order was formalized. In the Jesuit Archives in Rome, in the register book of all the letters sent from the Superior General to the different provinces in South America, there is a reaction from the Superior General Father Beckx to Wolf's desire to leave the Order (Beckx 1874a, 18 Septiembre). Beckx manifests his concern for Wolf's decision and says he finds no valid reason in Wolf's argument. He finishes the letter hoping that his prayers will be answered and that no matter how hardened Wolf's mind is, he will be able to destroy the illusion that deceives him. Regarding the context around his decision to leave the order, Wolf (1904–1911) would describe, years later, in a letter to the German geologist Hans Meyer, that he left under sad conditions to face an uncertain future. He describes himself as "being subject to internal and external hard struggles after having made and executed the decision to break all corporate relations at any price and establish a new and free existence."

After resigning from the Order, Wolf traveled to Guayaquil and, as an independent man, planed his first voyage to the Galapagos Islands. This German ex-Jesuit would become part of a wave of post-Darwinian scientific travel to the islands. In fact, after Darwin's visit to the Galapagos, scientific expeditions continued to arrive to the islands in increasingly intense intervals (Sulloway 1982: 40). In 1838, Sir Edward Belcher from the English navy visits the islands. Six years later, in 1846, Thomas Edmonstone lands on the islands and takes specific instructions from Darwin to make separate collections for each island. However, Edmonstone dies during the trip. The naturalist Berthold Seemann was also aboard, and he observes in Charles Island many dogs, pigs, goats, and wild cows that Darwin had not mentioned in his writings. In the same year, a French expedition, led by Henri Louns, arrives to the archipelago. In 1868, Simeon Habel sails from New York and makes extensive collections that he sends to Vienna where Osbert Salvin who corresponds with Darwin analyzes them. In 1873, Louis Agassiz, director of the Museum of Comparative Zoology of Harvard University, visits the islands for 9 days. In 1875, W. E. Cookson collects tortoises in Abingdon by order of the British Museum curator, Albert Günther. In 1891, George Baur visits the islands and makes extensive collections (Donohue 2011: 104–105). Sulloway (1982: 40) argues that already in the 1870s, the Galapagos Islands are considered within the European ornithological circle as "classic ground" for research. In fact, in his monograph published in 1876 on the avifauna of the Galapagos archipelago, Osbert Salvin speaks of the islands as a "classic" in the history of biology. It was there, Salvin says, that Darwin made a number of observations and deductions whose importance for the study of the natural sciences is unmatched (Salvin 1876: 461).

Wolf's expeditions to the Galapagos sailed from mainland Ecuador. He had great interest in the study of geology, botany, and zoology of these islands, and his intention was to write a whole book on them accompanied by maps and plates. Unfortunately, this work was never carried out. More pressing occupations delayed

the project of publication, and besides some scattered fragments, published on scientific journals in Europe; his notes; and collections were buried under the dust (Wolf 1887: 3). The German naturalist makes two trips to the Galapagos Archipelago (August–November 1875 and June–August 1878). In total, he spent 6 months on the islands, a privileged amount of time considering the scarce 19 days that Darwin ventured on the Galapagos. What is important about Wolf's career in our discussion on Darwinism and the Galapagos is that his positive reaction to Darwin's ideas not only drove him to travel and investigate on the Archipelago, but it also shaped the attitude of the local government toward the administration of the islands. In fact, Wolf's expeditions differ from other scientists who traveled during the mid- and late nineteenth century in three important ways.

As a result of his explorations, Wolf published six articles in Spanish, English, and German specifically related to the natural history and geology of the archipelago (Wolf 1879a, b, c, 1887, 1895a, b). Apart from these publications, and as we mentioned earlier, Wolf (1892a, b) devoted an entire chapter of his *Geography and Geology of Ecuador* to the Galapagos region.

The first major difference between Wolf's expedition and expeditions like Darwin, Agassiz, or Baur is that the logistics of the trip is organized from a place other than the scientific centers of the time: they either came from European centers of knowledge (like the English navy or the British Museum) or North American Institutions (e.g., Harvard or Yale). Wolf's trips are a window to understand how science is done from the "periphery."[8] How is it funded? What are its interests?

When Wolf decided to organize his first trip to the Galapagos Islands, his condition was very vulnerable and unpredictable (Sevilla 2013). As we have already stated, some months earlier (in November 1874), he had made official his departure from the Jesuit Order. This meant that he would lose all institutional and political support in Ecuador. He would no longer have the protection neither of the Jesuits nor of the President of the Republic who was his very enthusiastic sponsor. Immediately after leaving the Order, Wolf, who was in a very poor health state, made the long and demanding journey from Quito to the port of Guayaquil from where he intended to reorganize his life. He arrived in Guayaquil penniless and under extreme physical weakness (Wolf 1904–1911). After a few months of convalescence, he regained his strength and started planning his voyage to the Galapagos Islands. Unlike all the other expeditions that Wolf made inside the Ecuadorian territory (between 1871 and 1878), the geologist states that the purpose of his first visit to the archipelago was solely that of a naturalist. Wolf's report of this voyage makes

[8] The core/periphery antinomy has been largely criticized as a productive point of departure in the history of science. See Raj, K. (2013). "Beyond Postcolonialism … and Postpositivism: Circulation and the Global History of Science." *Isis* 104(2), 337–347.

I question the validity of such a model even though there is some truth to it. In fact, Wolf did consider Ecuador as an extremely peripheral location. This feeling is exemplified in a letter written in 1871 to his Jesuit friends in Germany (Wolf 1871). Wolf writes that in Europe, the highlands of Quito are generally considered as one of the strangest parts of South America. He considers this to be right from every point of view. And he insists that there are few countries of which the Old World knows so little about.

clear his great admiration for Charles Darwin. He described Darwin as the sharpest naturalist observer of our century for whom it was reserved to make known in the scientific world that singular archipelago that excelled the attention of geographers, botanists, and zoologists alike. Wolf admits that Darwin's relations were the main motivation of his trips, believing that these islands, where he made so many important observations in a few weeks, should provide an immense field for science (Wolf 1887: 5). Finally, he declares that several naturalists after Darwin visited the Galapagos Islands, but none has made a systematic exploration of them regarding diverse scientific inquiry fields (Wolf 1892/1975: 517–518).

How does a penniless German naturalist travel from Guayaquil to Galapagos in the late nineteenth century? He at least needs a ship and a considerable budget. Wolf solves the logistical problem through the services of Mr. José Valdizán. A Spanish businessman who some years earlier (1870) had won a contract with the government of Garcia Moreno to exploit orchilla, a lichen appreciated in dyeing, in the Galapagos Islands. Wolf states that for some years now, you can travel regularly, every 2 or 3 months, from the port of Guayaquil to the islands. Valdizán owned his own boat ("Venice") under the direction of Captain Petersen from the city of Flensburg (Wolf 1879d: 2). According to Martinez, one of Wolf's pupils at the Polytechnic School, the economic problem is financed with money raised after giving ten popular scientific lectures with great applause in Guayaquil (Martínez 1994: 270). Unfortunately, we have not yet found archival information to support this statement.

For the second trip (1878), Wolf's situation is substantially different. On his return from his first voyage, the new President of the Republic Antonio Borrero (Garcia Moreno was assassinated while Wolf was on the Galapagos) appoints Wolf as State Geologist. His second journey not only meets his personal interests but also seeks to answer questions raised by the State administration. The main purpose of the trip was to seek guano as a productive activity for potential colonizers of the archipelago. Wolf did not find guano nor phosphates on any of the islands, and he was in fact not surprised by this negative result he had expected in advance taking into consideration the weather and heavy winter rains (Wolf 1892a, b: 476).

On this second trip, Wolf also traveled on board Mr. Valdizán's boat. With direct support from the government or not, on his two expeditions Wolf depended on the logistics of Galapagueño settlers. Just like Darwin whose tour of the islands was conditioned by the schedule established by Captain Fitzroy and defined by the interests of the British Navy to map the Pacific coast, Wolf's route depended on the priorities of the orchilla business. In this sense, Wolf declares that although you cannot expect to obtain important scientific results in an occasional trip, on which it is not possible to follow your own plan, he is especially thankful to the kind attention of Captain Petersen and to Mr. Valdizán's goodwill: he could see more of the island than he had expected (Wolf 1879d: 2). This intimate relationship between scientific expeditions and local issues provides a novel insight into the human problem of the Galapagos Islands. Wolf's reports include various details about the potential for migration projects in the islands. He also discusses the issue of introduced animals, an element that is briefly treated in Darwin's description of the islands 40 years earlier.

The German naturalist states that since the first attempt at colonization by General Villamil, the fauna of the islands has substantially increased by the many introduced animals that are now perfectly acclimatized (1887). He concludes that in the time that Darwin visited the islands, these domestic animals should not have spread and naturalized in the archipelago, since this "exact observer" would not have stayed silent on such an interesting fact.[9] An extended part of his bulletin is dedicated to the description of these animals. He states that the bull, goat, donkey, dog, cat, and chicken are "completely naturalized" and live in a wild state in the archipelago. He speaks of these animals, as he found them in his travels (1875 and 1878), and ignores what has changed in this regard in the last ten years. Wolf reports that cattle lived in large herds in the highlands and mountains of Floreana and Chatham, and some heads had been found in the mountains of Albemarle, no one knew how they had come there. In Floreana, he calculated their number at 800 to 900 and in Chatham at 2000 to 3000 heads. He described it as a beautiful and large breed of bulls that sometimes rammed and chased men. Wild asses were abundant in the time of Wolf's travels in Floreana, Chatham, Indefatigable, James, and Albemarle. The "orchilleros" and many "aceiteros" caught the asses and tamed them easily. Wolf also reports that goat population had fallen sharply, despite the fact that the weather and terrain seemed very suitable for them. He saw a small herd on Floreana, one in Chatham, and some isolated individuals on the barren island of Barrington. It is believed, he declares, that wild dogs bring the population of goats down. Feral pigs are in all the major islands, but are more numerous in Santiago or James. It is said that their hunt is not without danger; herds assail men. Wolf saw a few already domesticated, and they were no different from the ordinary race of the mainland. Equally spread out is the dog which lives in families or small groups. Although it belongs to a large and strong breed, Wolf describes it as quite cowardly. He also talks about wildcats and points that all the animals he has seen on Floreana and Chatham were black. The color caught his attention, because it is extremely rare in cats of Guayaquil and the coast of Ecuador. He describes them as beautiful and large animals living in lava caves near the sea. Hens were found so far only in the mountains and more remote forests of Floreana Island. Wolf concludes that all these domestic animals thrive in a state of wild freedom, thanks to the absence of enemies and the mild climate, which also promotes the health of men, for endemic diseases are unknown in the archipelago (1887: 20–21).

The second difference between Wolf's travels and earlier expeditions organized from centers of knowledge is that Wolf had the opportunity to analyze in situ a nature unknown to modern science. Wolf admits that it is not surprising that since coming to Ecuador he has harbored the desire to know these islands to which he was closer than many of his colleagues (Wolf 1879d: 1). The idea of being closer or having the opportunity to really see nature in action and not in museums is reinforced with the following description translated from the original Spanish version:

[9] In his Beagle voyage, Darwin does mention the introduced species in a short commentary: "The inhabitants (of Charles Island), although complaining of poverty, obtain, without much trouble, the means of subsistence. In the woods there are many wild pigs and goats; but the staple article of animal food is supplied by the tortoises" (Darwin 1839: 457).

> "The sea was partially covered with jellyfish, some of which had a diameter of one foot. These animals should be seen not only on land, where they are just gelatinous masses, or preserved in alcohol, discolored and shrunken, displayed in museums, but you have to see them in their natural element; the tropical ocean, for understanding the charm of the sea providing its color and its delicate tentacles. They float in large groups." (Wolf 1879d: 3)

Wolf collected specimens on all his trips. His botanical collections were extensive. On the botany of the Galapagos, the German naturalist says that despite being still very far from knowing all the plants of the archipelago, Hooker and Anderson have made important contributions to this subject. Anderson mentions his collection had 374 vascular plants, of which more than half (190) were endemic. Then he affirms that his own collection was quite full and had 400 specimens (Wolf 1892a, b: 481–482). Similarly, he refers to his ornithological collections and compares them with Darwin's, which included 26 species of land birds. Wolf stresses that his own collection contained more than 30 species but was sure it was not yet complete (Wolf 1892a, b: 485). Wolf's only collections that we know were actually analyzed are those of land snails (Wolf 1892a, b: 488).

There are certainly benefits of doing science from a place so close to the Galapagos Islands, but one of the major drawbacks is the problem of preserving botanical and zoological collections. In fact, in one of his last articles of the Galapagos (1895), Wolf laments losing his specimens due to mishandling or neglect in the city of Guayaquil:

> Unfortunately I have imprudently kept my collections poorly packed for 15 years in the hot and humid climate of Guayaquil, instead of sending them directly to Europe. When I wanted to repack them for returning to Europe, I found out that insects had already done the work. My extended herbarium, the entire collection of birds and insects had been destroyed, alcohol preparations had been ruined. It is not an excuse, as is the case of certain travelers whose collections that never really existed and had been "lost." In this case, extremely valuable material was lost which is demonstrated for example by my collection of land snails which insects could not eat because of the hard shell. This collection increased the number of snail species of the Galapagos Islands from 19 to 40. From more than a 1000 specimens collected, corresponding to 33 species, 21 were new and also endemic to the islands. (Wolf 1895a)

Through this issue of the loss of Wolf's collections, we can discuss the problem of museums in the periphery. As Foucault and Miskowiec (1986: 26) state, "the idea of accumulating everything, of establishing a sort of general archive, the will to enclose in one place all times, al epochs, all forms, all tastes, the idea of constituting a place of all times that is itself outside of time and inaccessible to its ravages, the project of organizing in this way a sort of perpetual and indefinite accumulation of time in an immobile place, this whole idea belongs to our modernity" and is characteristic of western culture of the nineteenth century. A hot and humid climate full of destructive insects does not fit into this western idea of a place isolated from the effects of time. Apparently, if we assess Wolf's experience, there is little possibility of accumulation of knowledge in the periphery, in the sense inferred by Latour (1987). In fact, in 1847, several years before the arrival of Wolf to Ecuador, the geographer Manuel Villavicencio (1847/1958) insisted to the government that was then chaired by Vicente Ramón Roca that it should draw attention to the urgent need of improving the Museum of Quito. He suggested that the few European scientists

residing in Quito (the botanist William Jameson and the engineer Sebastian Wisse) should be actively involved in this initiative. Villavicencio also mentioned in his letter the unsuccessful and frustrated efforts of Dr. José Manuel Espinosa to gather a scientific society in Ecuador. He finally concluded that no advancement had been achieved in Ecuadorean science even though it draws enormous attention from European governments and academics.

The third and final difference between Wolf's travels and earlier expeditions organized from centers of knowledge is the fact that Wolf spent a privileged amount of time in the islands. As we have stated earlier, he lived 6 months on the archipelago: more than any other scientist during the nineteenth century. Additionally, Wolf is the only one who makes two trips. This fact responds to three life circumstances that allowed these long expeditions to be possible. The first reason has to do with the proximity between Ecuador's mainland and the Galapagos Islands; the trip takes only 8 days. The second element, which we discussed earlier, is Wolf's broken commitments with the Society of Jesus. His expeditions to the Galapagos are part of a larger story concerning the clashes between science and religion in Ecuador (Cuvi et al. 2014). Finally, the third element contributing to Wolf having the opportunity to spend a special time in the Galapagos Islands is his link to the Government of Ecuador, which recognized the usefulness of science for the administration of the territory and its population. Hence, Wolf's reports and articles are rich with analysis and findings that are intended to facilitate the incorporation of the Galapagos territory to a central administration, which at the time still struggled to exert its influence throughout the country. Issues such as the exploitation of potential sources of wealth (such as gold, guano, and orchilla) and the interest in migration projects fit into this scenario. Wolf sees the Galapagos Islands as an opportunity not only for science, but also from a political point of view, he analyses the islands from the interest of the State. He thinks of administration policies and discusses issues of legislation for wildlife management. For example, Wolf refers to the Galapagos tortoises and anticipates that with the colonization of the archipelago these helpless animals would probably disappear, unless measures for their conservation and rational exploitation are taken, for example, prohibiting the slaughter of young individuals that have not reached a certain size (Wolf 1887: 18).

We will analyze, as an example, Wolf's 1887 "Memoria sobre las Islas Galapagos" that is a 28-page bulletin printed by the Government of Ecuador which claims to inform those interested in colonization projects in the Galapagos about the country they will live in. Wolf is emphatic about the neutral point of view he wishes to communicate. He writes against certain "exalted enthusiasts" who have described the archipelago in a fantastic and exaggerated way (Wolf 1887: 3). This text is very explicit about the utility of scientific knowledge at the service of the State administration that wishes to begin a strategy to populate the abandoned islands. The text mentions the different "imperfect" initiatives of colonization of the islands. The geologist summarizes human history of the islands as determined by "transitional speculation" (as the orchilla trade) but concludes that the forthcoming opening of the Panama Canal will inaugurate a "new horizon of future" (Wolf 1887: 4). This section mentions Darwin who met on his journey (September 1836) on Floreana

Island "a village of 200 or 300 inhabitants." This interrupted history of human contacts has determined the circulation of "the most extravagant and contradictory news" on the islands (Wolf 1887: 5). One of these fallacies, for example, has to do with the total area of the archipelago. Wolf estimates that there are about 240 leagues of land while some have estimated an area up to 800 miles^2.

The author stresses the importance of the sea in the description of an archipelago: from the sea and weather conditions, communication facilities are explained. These are two essential elements for the evaluation of migration projects. Regarding the weather, Wolf states: "the climate of the Galapagos Islands is one of the healthiest and most pleasant in the world" (1887: 8). The cold Humboldt Current plays a fundamental role in this fact as a "cooling principle" over the islands (1887: 9). Wolf considers that it would be difficult to find anywhere else in the world, under the equinoctial line, a healthier and more enjoyable weather, free from the extremes of continental climate (Wolf 1887: 27). The article is full of pragmatic suggestions regarding how life on the islands could be. For example, Wolf recommends that steamships and small boats are the best vehicles for both communications with the coast and between the islands. He insists that they need not be very large, because the sea is regularly tame and chances are rare that it could not be crossed in open boats. He also suggests the Post Office Bay in Floreana to be indisputably the best and most beautiful harbor in the entire archipelago (Wolf 1887: 7).

Then Wolf writes three sections that talk about geology, botany, and zoology. The argument he develops, as in many of his writings, follows a chain structure: the description of the sea allows for the understanding of climate, and, in turn, the plants of the archipelago "are closely related to climate" (1887: 11). Geology in conjunction with climate determine the botany and zoology of the islands, and, finally, this analysis can be used to evaluate the feasibility of migration projects. Can the archipelago sustain a considerable human population? The first great advantage that Wolf highlights regarding what he calls the question of the "colonization of the Galapagos" (Wolf 1887: 26) is that the archipelago occupies on the world map a very advantageous position, as the only group of large islands between South America and Polynesia, as well as between North and South America (Wolf 1887: 27). Wolf explains that this advantage in the geographical position could be further exploited once the Panama Canal is opened.

Wolf wonders about the future of a colony of immigrants and quickly discards agriculture as a source of livelihood. "I have shown—he states—that all the low and arid regions are entirely uncultivable" (Wolf 1887: 27). In fact, Wolf assesses that out of the 240 miles^2 that make up the archipelago, only 20 could be cultivated. In order to maintain a colony, Wolf recommends that not everyone should engage in agriculture and suggests several areas of economic activities: livestock, viticulture, horticulture, fisheries, and finally administering a naval station for the operation of commercial flow related to the Panama Canal.

This chapter uses Theodor Wolf's published articles on the Galapagos Islands as an introduction to understanding the relationship between the Ecuadorian State and the Galapagos. Wolf's desire to travel to the archipelago is directly linked to his admiration of Charles Darwin's ideas. This intellectual stimulation is of great importance since one of the most significant changes in Wolf's life (his separation

from the Jesuit Order) was in part caused by this sensibility (Cuvi et al. 2014). Darwin's insights also open a window of opportunity for Wolf who is lucky enough to live near the Galapagos Islands and to be able to organize two extended scientific expeditions to the archipelago. This puts Wolf in a privileged position within the European scientific community in which the debate on Darwinism is in full rumble. It is curious then that Wolf did not take advantage of these circumstances to publish a complete work on the Galapagos Islands. The conditions of social and political instability that he found on his return from his first trip in 1875 (fruit of the assassination of President Garcia Moreno) could have contributed to the difficulty of writing a detailed study (Cuvi et al. 2014, 2015).

The importance of Wolf's admiration for Darwin also points to the puzzle we mentioned in the introduction regarding the uncharted territories of Ecuador: the Galapagos and the Amazon. We argue that, even though the inclusion of the Amazon seemed more pressing because of its lack of maps, "savage" inhabitants, and hostile neighbors, the State never promoted scientific expeditions to this region. In fact, Theodor Wolf, who worked as State Geologist for more than 20 years, never organized an expedition to the Amazon. He even drew the Amazon region, on his 1892 map, in a much smaller scale, with very little detail and with a big title that crossed the entire map stating "Uncharted regions inhabited by savage Indians!" (Sevilla 2013). Why did Wolf not travel to the Amazon while he did travel twice to the Galapagos? The relationship with Darwin and with a scientific community associated with these new theories suggests that the Galapagos Islands were already on the map of science and promised much as a field of study for the young scientist, while the systematic study of the Amazon did not offer those same opportunities. This may be the reason why Wolf did not consider the Amazon as a place that would position him within the debates of the time and therefore was not willing to suffer great physical and economic sacrifices. In Wolf's eyes, the Amazon, different from the Galapagos, was a place for adventurers not for scientists.

Finally, the study of Theodor Wolf also contributes to the effort of getting out of a Eurocentric view of Galapagos. Wolf is an interesting character because he is operating from the "periphery," but he also admires Darwin and wants to walk in his footsteps, as do the other Europeans. His report about potential colonization of the islands for the Ecuadorian State is a major way in which his work differs from other perspectives on the Galapagos. Wolf's work shows how Darwin's ideas not only drove scientists from different latitudes to travel and investigate on the archipelago, but they also shaped the attitude of the local government toward the administration of the islands.

References

Beckx, P. (1874a, 18 Septiembre). Carta a P. Wolf. *Inventario della Nuova Compagnia. Parte Ia*, 332–333. Archivum Romanum Societatis Iesu (ARSI).

Black, J. (1973). *Galapagos, Archipiélago de Colón*. Quito: Fundación Charles Darwin.

Cuvi, N., Sevilla, E., et al. (2014). La circulación del darwinismo en el Ecuador (1870–1874). *Procesos, Revista ecuatoriana de historia, 39*, 115–144.

Cuvi, N., Sevilla, A., et al. (2015). *Entre Darwin y Dios: las primeras clases universitarias sobre el origen de las especies dictadas en el Ecuador (1871). "YAMMERSCHUNER". Darwin y la darwinización en Europa y América Latina. F. O. Miguel Ángel Puig-Samper, Rosaura Ruiz y J. Alfredo Uribe*. Madrid: Ediciones Doce Calles.

Darwin, C. (1839). *Journal of researches into the geology and natural history of the various countries visited by H.M.S. Beagle*. London: Henry Colburn.

Demelas, M. D., & Saint-Geours, Y. (1988). *Jerusalém y Babilonia: Religión y política en el Ecuador, 1780–1880*. Quito: Corporación Editora Nacional.

Donohue, K. (2011). *Darwin's finches: Readings in the evolution of a scientific paradigm*. Chicago: University of Chicago Press.

Escuela Politécnica, Q. (1871). *Programa de las materias que se enseñan en la Escuela Politécnica establecida en Quito el 3 de Octubre de 1870 y aplicación de las mismas a las distintas carreras profesionales, bajo la dirección de los padres de la Compañía de Jesús*. Quito: Imprenta Nacional, Biblioteca Escuela Politécnica Nacional: I-II.

Escuela Politécnica, Q. (1872). *Programa de las materias que se enseñan en la Escuela Politécnica establecida en Quito el 3 de Octubre de 1870 y aplicación de las mismas a las distintas carreras profesionales, bajo la dirección de los padres de la Compañía de Jesús*. Quito: Imprenta Nacional, Biblioteca Escuela Politécnica Nacional: I-II.

Fernós, R. (2005). En busca del Fénix, la ciencia y su historia en América Latina.

Foucault, M., & Miskowiec, J. (1986). Of other spaces. *Diacritics, 16*(1), 22–27.

Glick, T. (2010). The comparative reception of Darwinism: A brief history. *Science & Education, 19*(6), 693–703.

Glick, T., Puig-Samper, M. A., & Ruiz, R. (2001). *The reception of Darwinism on the Iberian World*. Dordrecht: Kluwer Academic Publisher.

Larrea, C. M. (1952). *Bibliografía científica del Ecuador*. Madrid: Ediciones Cultura Hispánica. Not cited in the chapter above.

Larson, E. (2001). *Evolution's workshop. God and science on the Galapagos islands*. London: Penguin Press.

Latour, B. (1987). *Science in action: How to follow scientists and engineers through society*. Cambridge: Harvard University Press.

Maiguashca, J. (1994). El proceso de integración nacional en el Ecuador: el rol del poder central 1830–1895. In J. Maiguashca (Ed.), *Historia y región en el Ecuador: 1830–1930* (pp. 355–420). Ecuador: Proyecto FLACSO—CERLAC IV Corporación editora nacional.

Martínez, A. N. (1994). *Setenta años de recuerdos: el Dr. Teodoro Wolf* (Contribuciones para el conocimiento geológico de la región volcánica del Ecuador: Pioneros y precursores del Andinismo Ecuatoriano, Vol. 3, pp. 255–279). Quito: Ediciones Abya Yala y Agrupación de Excursionistas "Nuevos Horizontes" (Original work published 1934).

McEwen, A. (1988). The English place-names of the Galápagos. *The Geographical Journal, 154*(2), 234–242.

Menten, J. B. (1872). Discurso sobre la enseñanza. In *Programa de las lecciones que se darán en la Escuela Politécnica de Quito en el año escolar 1872 a 1873* (pp. 1–18). Quito: Imprenta Nacional.

Miranda, F. (1972). *La primera escuela politécnica del Ecuador: estudio histórico e interpretación*. Quito: FESO Fundacion Ecuatoriana de Estudios Sociales. Movimiento Desarrollo y Paz.

Raj, K. (2013). Beyond postcolonialism … postpositivism: Circulation and the global history of science. *Isis, 104*(2), 337–347.

Salvin, O. (1876). On the avifauna of the Galapagos Archipelago. Trans. Zool. Soc. London, 9, 447–510.

Sevilla, A. (2013). *El Ecuador en sus mapas: Estado y nación desde una perspectiva espacial*. Ecuador: FLACSO.

Sevilla Perez, A. (2013). La incompleta nacionalización de la amazonía ecuatoriana en el siglo XIX vista desde el mapa de Theodor Wolf (1892). *Apuntes. Revista de estudios sobre patrimonio cultural, 26*(1), 102–113.

Sulloway, F. (1982). Darwin's conversion: The Beagle voyage and its aftermath. *Journal of the History of Biology, 15*, 325–396.

Villavicencio, M. (1958). Cartas del Dr. Manuel Villavicencio al Sr. Presidente de la República don Vicente Ramón Roca. In *Homenaje al señor doctor don Manuel Villavicencio en el centenario de la publicación de su "Geografía de la República del Ecuador"* (pp. 31–40). Cuenca: Casa de la cultura Ecuatoriana, Núcleo Azuay (Original work published 1847).

Wolf, T. (1871, 17 enero). Carta a jesuitas en Alemania. Carta del Padre Theodor Wolf a fray Hermes en Bonn. *Colección de noticias*. Traducción del alemán por Sylvia van der Made, Archivo Padre Piñas: 21 páginas.

Wolf, T. (1879a). Apuntes sobre el clima de las Islas Galápagos, según las observaciones hechas durante un viaje, en los meses de agosto a noviembre de 1875. *Boletín del Observatorio Astronómico de Quito, 1*(3), 49–59.

Wolf, T. (1879b). Ein Besuch der Galápagos-Inseln. *Sammlung von Vorträgen für das deutsche Volk, 1*(9/10), 257–300.

Wolf, T. (1879c). Bemerkungen über die Galapagos Inseln, ihr Klima und ihre Vegetation, nach Beobachtungen in den Monaten August bis November 1875. *Verhandlungen der berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte, 6*, 245–256.

Wolf, T. (1879d). Una visita a las islas Galápagos, traducción Sylvia van der Made. Colección de conferencias para el pueblo alemán, 1(9/10), 257–300.

Wolf, T. (1887). *Memorias sobre las islas Galápagos. Imprenta del Gobierno*. Quito: Aurelio Espinosa Polit.

Wolf, T. (1892). Carta Geografica del Ecuador por Dr. Teodoro Wolf, publicada por orden del Supremo Gobierno de la Republica y Trabajada Bajo las Presidencias de los EE. Senores Dr. D. J. M. Placido Caamano y Dr. D. Antonio Flores. Leipzig: Instituto geográfico de H. Wagner & F. Debes.

Wolf, T. (1892b). *Geografía y Geología del Ecuador publicada por orden del Supremo Gobierno de la República por Teodoro Wolf, Dr. Phil, antiguo profesor de la Escuela Politécnica de Quito y geólogo del Estado*. Leipzig: Tipografía de F. A. Brockhaus.

Wolf, T. (1895a). Die Galapagos Inselen. *Verhandlungen der Gesellshaft für Erdkunde zu Berlin. Transacciones de la Sociedad para el eje de la Geografía a Berlín, XXII*, 246–265.

Wolf, T. (1895b). The Galapagos islands. *Geographical Journal London Royal Geographical Society, 4*(6), 560–564.

Wolf, T. (1904–1911). Cartas a Hans Meyer. *Hans Meyer collection*. Leibniz Institute for Regional Geography. Archive for Geography 179/367-374, 16 páginas.

Wolf, T. (1975). *Geografía y Geología del Ecuador por Teodoro Wolf*. Quito: Editorial Casa de la Cultura (Original work published 1892).

Chapter 4
Darwinians, Anti-Darwinians, and the Galapagos (1835–1935)

Elisa Sevilla

Introduction: Galapagos as *Classic Ground* for Evolutionary Studies

Explorations of the Galapagos after the *Beagle*'s voyage, and especially after the publication of *On the Origin of Species* in 1859, were made by scientists and collectors associated with natural history museums, universities, and private collectors like Baron Walter S. Rothschild. Also, several of the collections and observations were appointed to navy ship officers from Great Britain, Italy, France, Sweden, and the United States (Williams 1911: 291–292; Stewart 1911: 291–292) (see Table 4.1).

Galapagos became a "classic ground" for explorers and scientists interested in "investigating the complicated problems involved in the doctrine of the derivative origin of species" (Salvin 1875: 462). For Theodor Wolf, who visited the Galapagos twice during the 1870s, the Galapagos Islands were a privileged place for science. Mainly, he pointed out to "several circumstances that make them a very exceptional world, especially its isolation, its geological youth, besides the great amount of endemic species of plants and animals, limited to greatly reduced regions". He concluded that there "is no other place on earth with a similar size, with a creation so particular and isolated, none in which geographical botany and zoology raise the same amount of interesting questions" (Wolf 1895: 248). Even the wife of the skeptic Louis Agassiz thought of the Galapagos as a great place to solve the puzzle of the origin of species: "The archipelago offers at present a fine opportunity for a naturalist, who desires to make a residence here for several years, and thoroughly explore their structure and their productions, to throw a strong light upon the great modern question of the origin of species and the doctrines of evolution" (Agassiz 1871–1872).

E. Sevilla (✉)
Departamento de historia, Pontificia Universidad Católica del Ecuador, Quito, Ecuador
e-mail: esevilla099@puce.edu.ec

D. Quiroga, A. Sevilla (eds.), *Darwin, Darwinism and Conservation in the Galapagos Islands*, Social and Ecological Interactions in the Galapagos Islands,
DOI 10.1007/978-3-319-34052-4_4

Table 4.1 Chronology of expeditions to the Galapagos

Year of visit	Vessel name	Lead explorer	Institution
1838	La Vénus	Vice Admiral Abel Aubert Du Petit Thouars	French Navy
1852	Eugenie	Kinberg	Swedish Navy
		Andersson	
1868–1869	Mr. Rubira's orchilla fleet	Simeon Habel	Independent
1871	Hassler	Louis Agassiz	Harvard Comparative Zoology Museum, National Survey
1875 and 1878	Local vessels	Theodor Wolf	Independent and as Ecuador's state geologist
1875	Peterel	Commander Cookson	British Navy
	Challenger		
1884		Lieutenants Chierca and Marcacci	Italy
1888	Albatross	Lee	United States Fish Commission
		Tanner	
1891	Albatross	Agassiz, Alexander	United States Fish Commission
1891	Local vessels	George Baur	Independent
		C. F. Adams	
1897	Lila and Mattie	C. M. Harris, Rollo Beck	Walter Rothschild, Frank B. Webster
		F. P. Drowne	
		G. D. Hull	
1898–1899	Julia E. Whalen	Snodgrass, Heller	Hopkins-Stanford Expedition
1905–1906	Academy	Rollo H. Beck, Alban Stewart, W. H. Oschner, E. W. Gifford, J. S. Hunter, J. R. Slevin	California Academy of Science
1906–1907	Local vessels	Nicolás Martínez	Private with support of M. Cobos
1923	Noma	William Beebe	New York Zoological Society, Harrison Williams
		W. Morton Williams	
1924	Monsunen	Wollebæk	Norwegian Zoological Expedition
1924	St. George	J. Hornell	British Navy
1925	Arcturus	W. Beebe	New York Zoological Society
1927	Oaxaca	G. Allan Hancock	California Academy of Science
		Joseph Slevin	
1929	Mary Pinchot	Pilsbry, Fisher, and Wetmore	Gifford Pinchot
1929	Illyria	Schmidt	Chicago Field Museum of Natural History

(continued)

Table 4.1 (continued)

Year of visit	Vessel name	Lead explorer	Institution
1930	Nourmahal	Several scientists	Vincent Astor
1932–1934	Velero III	G. Allan Hancock	San Diego Zoo, California Academy of Sciences Steinhart Aquarium
1932	Zaca	Templeton Crocker, Harry S. Swarth, J. T. Howell	California Academy of Science
1936	Chiva	Ripley	Philadelphia Academy of Natural Sciences—Dennison Crockett
1937	Cressida	Vanderbilt, Gray, Smith	Philadelphia Academy of Natural Sciences—George Vanderbilt
1937	Cotopaxi	Acosta Solís and others from the Universidad Central del Ecuador	Universidad Central del Ecuador, Ecuadorian government

Sources: Oxford and Watkins (2009), Larson (2001), Donohue (2011), Acosta (1937), Martínez (1934)

After the 1932 Templeton Crocker expedition, Howell stated, "It would appear that there are few places in the world where [evolutionary] problems can be studied under such favorable and unusual conditions—a fact which has led me to call the archipelago Evolution's workshop and showcase" (quoted in Larson 2001: 166). This idea has lingered in the motivations of scientists interested in the Galapagos. The prominent Ecuadorian botanist Misael Acosta Solís argued in the late 1970s that Galapagos is "the most important national park in the World" because of its contribution to the study of the evolution of Earth's crust and life (Acosta Solís 1979: 51).

Galapagos was central to discussions about the theory of evolution mainly because of two reasons. First, its geology hinted that it was a new world, and thus, there was a question of the origin of its plants and animals. Second, most of these inhabitants were only found in the Galapagos but were similar to the ones in Central and South America. Darwin (1859), Hooker (1851), and Wallace (1892) all agreed that these creatures descended from American ancestors that had been accidentally carried into the archipelago through wind, currents, and birds. The question of how these variants came about was an unresolved topic until David Lack's work on what he called "Darwin's finches" (Lack 1947).

Despite this common interest in studying the Galapagos as an "evolutionary workshop" (Howell cited in Larson 2001), these islands were seen, appreciated, and understood in an array of circumstances and under a great deal of theories and paradigms, many times contradicting each other (Larson 2001). This tendency manifests itself greatly between Darwinians and non-Darwinians, both groups using the archipelago as a source of invaluable data to confirm their theories. The case of the debates

between the Swiss naturalist in Harvard, Louis Agassiz, and Charles Darwin is a clear example of this tendency (Lurie 1959, 1960; Winsor 1991; Mayr 1959; Morris 1997).

This leads us to the question raised by Ronald L. Numbers (1998: 27): "what did it mean to be a Darwinist, or, for that matter, an anti-Darwinist? ([…] these are not easy questions to answer, in part because of the complex and changing views of Charles Darwin himself." The two main goals of Darwin's theory were to demonstrate transmutation and to explain it mainly through natural selection, even though he pointed out to other mechanisms of change. This is one of the reasons why scientists that adhered to the idea of transmutation of species sometimes called themselves Darwinists even if they did not agree with the concept of natural selection. As Bowler (1988: 6) has pointed out, the term Darwinism has been extensively used as a synonym of evolutionism, producing confusion for those who study the history of these ideas.

Ruiz and Ayala (1999) identified the same problem. They describe the "hard core" of Darwinism to differentiate what should be studied as Darwinism and what should be called something else. Esparza (2014) has recently put forward the concept of "evolutionary thinking" to enclose all variants of theories that try to explain the diversity of life as related to the idea of change. Esparza and Bowler have shown how the variation of interpretations of biological diversity and change cannot be readily dismissed, as Ruiz and Ayala do, because it tells the story about the debates, paradigms, and different positions held by a large segment of the scientific community at the time (Esparza 2014; Bowler 1983, 1988).

At the end of the nineteenth century, there was a vast scientific field of research and theories inspired by non-Darwinian evolution, especially theories marked by the ideal of progress like orthogenesis (progressive evolutionism) or saltationism (Bowler 2005). Bowler's arguments challenge the view of former historians of Darwinism that saw continuity between Charles Darwin and the Darwinian synthesis. His main argument is that the idea of progress and several theological elements remained in many evolutionary thinkers of the turn of the twentieth century (Bowler 1983, 1988). Bowler proposes several positions among scientists working at the end of the fourteenth century, spanning from biblical theological creationists to true natural selection Darwinians. In the middle, there is an array of positions, like naturalists that agreed with the transmutation of species, but were more Lamarckian in their explanations of change, or those who believed in an inner progressive force of evolution.

In this chapter, we will discuss the arguments of the different scientists that dealt with Galapagos geology and life within the evolutionary framework. What debates motivated the many explorations of the Galapagos archipelago up to 1935, and what arguments flourished from these new visits to the islands? First of all, we will explore the different views regarding the geological origin of the islands. This will lead us to the question of how the Galapagos were perceived as remnants of old lands or as new volcanic islands. Then, we will compare the diversity of explanations of the ways in which evolution took place in the Galapagos. Finally, we will discuss the political motivations regarding the exploration of the Galapagos.

Debates Around the Geological Origin of the Galapagos

The geology and life of the Galapagos struck its visitors as primitive, as remnants of another time. Several scientists and explorers saw the islands as an ancient place frozen in time or as geologically new and thus an example of how a new world developed. Some of these views fueled theories of the geological origin of the islands and related it to its biological colonization.

Most explorers who visited the Galapagos describe them as relatively new volcanic islands (Darwin 1839; Du Petit Thouars 1859; Wolf 1892). Those who supported Darwin's ideas followed this explanation (Wallace 1892). For some scientists that did not see the islands, and to Georges Baur, the only theory that could accommodate such primitive-looking life was a sinking of a continental land, isolating ancient animals and plants. We will first focus on how the islands were described as primitive, and later we will tackle the problem of their geological origin.

Wolf said that the marine iguana was so interesting, because it's "like the last of those gigantic saurians that in our world's primitive times played such an important role" (Wolf 1892: 487). This idea of a new and thus primitive world—in the evolutionary and progress paradigm—is described in Wolf's general description of the islands:

> Some places are seeded with the later [secondary craters] like the skin of someone who had smallpox, and give the most singular and grotesque picture that fantasy can imagine: hundreds of cyclopean forges built from enormous pieces of the roughest and blackest lava; between the burnt rocks some corpulent trunk of a cereus or prickly pear cactus; over here a galapago monster, that moves its deformed limbs with an admirable phlegm, over there a group of ugly and strange marine iguanas that are sunbathing. All this nature is extravagant and strange, but the organic and inorganic parts of the picture are in perfect harmony between them, and sometimes remind vividly the antediluvian landscapes that the geologist tend to paint in their fossil descriptions. (Wolf 1892: 472)

Theodor Wolf and Charles Darwin had both an interest in geology and saw the Galapagos archipelago geologically and biologically similar to the times of the dinosaurs. Darwin (1839: 456), when telling about his first encounter with Galapagos tortoises among black lava and large cacti, wrote that they "appeared to my fancy like some antediluvian animals." Later, he stated that the sea iguanas are the only "existing" saurian to be "a maritime animal" and concluded, "If, however, we refer to epochs long past, we shall find such habits common to several gigantic animals of the Saurian race" (Darwin 1839: 472).

Also, Darwin pointed out to the predominance of reptiles and the absence of mammals in the islands, since, like no other place on Earth, "this order replaces the herbivorous mammalia in so extraordinary manner," and the geologist would "probably refer back in his mind to the secondary periods, when the Saurian were developed with dimensions" (Darwin 1839: 473).

When Darwin and Wolf recalled the secondary periods when describing the Galapagos, they both were thinking of the youth of the islands. The French vice admiral Du Petit Thouars (1859: 144) also saw the Galapagos as new volcanic lands and was puzzled by how plants and animals colonized these islands.

However, others saw these prehistoric-looking animals and landscape as remnants of other times. The taxonomist from the British Museum Albert Günther (1875) studied the specimens of giant tortoises brought from the Galapagos to the museum and through comparative anatomy concluded that they were taxonomically closer to extinct species collected in the Mauritius, than to the extant Aldabra tortoise. Even nowadays, it is remarkable to note that, during the Pleistocene, giant tortoises existed in every continent except Australia and Antarctica; however, in modern times, these types of tortoises only exist in oceanic islands in the tropics (Caccone et al. 1999). These facts had led several men of science to the subsidence theory that will be discussed later.

Wallace, who was a promoter of the idea that the Galapagos are new volcanic islands, had a problem with the Galapagos tortoise and had to explain it as a remnant of prehistoric species that once were widespread around the globe:

> (…) the antiquity of the genus Testudo, which dates back to at least the Eocene formation (in North America) with very little change of form. These sluggish reptiles, so long-lived and so tenacious of life, may have remained unchanged, while every higher animal type around he has become extinct and been replaced by very different forms; as is the case of the living *Emys tectum*,[1] which is the sole survivor of the strange Siwalik fauna of the Miocene epoch. (Wallace 1876: 289)

In his first edition of *Island Life*, Wallace (1880: 268) cited Günther's comparative work of the Mascarene and Galapagos tortoises as an argument of the migration of these reptiles from the American continent (Günther 1877). However, Günther argued that there was no comparative zoology proof of "direct genetic relationship" between continental and island tortoises. Albert Günther did find reasonable a subsidence theory of the Mascarene and Galapagos Islands and of a former land connection between Africa and America. Only the tortoises that were separated from the continents survived the advent of man and carnivorous mammals. Actually, Albert Günther (1895 cited in Baur 1897) later supported the subsidence theory of Baur and agreed that this event occurred in the Miocene period. Larson (2001: 105) argues that this herpetologist was indifferent toward Darwinism, especially to avoid any confrontation with the head of the British Museum, the anti-Darwinian Osborn. However, I have found that he did deal with the question of the origin of species both in his 1871 and 1877 papers. When comparing distant lungfish and tortoises with paleontological related species, he was concerned with forming evolutionary series, even if he was skeptical about a clear line from simple to complex forms (Günther 1871: 560). Especially in his 1877 treaty on giant tortoises, Günther seems to be against Darwinism and more inclined toward an idea of extinction of some species, but not finding evidence for transmutation, that is, species developing from other species.

Those who studied the tortoises usually saw them as remnant of antique species and thus thought of the Galapagos as remnants of old lands. These reptiles were thought to be related to paleontological giant tortoises that were once widespread around the globe[2] (Baur 1891b; Wallace 1876; Günther 1877 and 1895 cited in Baur 1897).

[1] "Indian roofed turtle," today classified as *Pangshura tecta* according to Gray, 1831.

[2] Recently, it has been shown through genetic analysis that the closest relative to the Galapagos tortoise are the much smaller species of *Geochelone chilensis*, or Chaco tortoise from Paraguay,

Subsidence Versus Volcanic Origin

Georges Baur was one of those naturalists that focused on the Galapagos tortoise to explain the archipelago's particular life-forms. He was interested in explaining the same phenomena observed by Darwin: each island has a slightly different variety or species from the same animals and plants, and the majority of living beings are related to American types. He stated that oceanic islands should have inharmonic flora and fauna, while harmonic[3] flora and fauna characterize continental islands.

Baur acknowledged that the vast majority of scientists who studied the Galapagos saw the islands as of new volcanic origin, including Darwin, Hooker, Salvin, Grisebach, Engler, Moritz Wagner, Wallace, and Peschel. The only previous opinion of a continental origin, according to Baur (1891b: 307), came from the French naturalist Henri Milne-Edwards who coedited the second edition of Lamarck's work and who later timidly supported Darwin in the difficult French natural history scientific community (Stebbins 1988: 133–134). In his *Remarques sur la fauna des îles Galapagos* (1859), Milne-Edwards commented on the issue raised by the account of the exploration of the islands by the vice admiral Abel Aubert Du Petit Thouars during his voyage around the globe in 1838. The French vice admiral raised the question about the origin of the fauna and flora of the Galapagos and of the coral islands in the Pacific, since he observed almost no similarity between the life-forms found there and those from the coast of South American and other Pacific islands like Hawaii, Marquesas, and Sandwich Islands. Even though Du Petit Thouars (1859: 144) described the volcanic and recent origin of the archipelago, Milne-Edwards had to resort to the subsidence of an ancient continent where vestiges of prehistoric life remained to account for the endemic plants and animals of the Galapagos. He argued that the same geological theory could explain the unique flora and fauna of New Zealand and the eastern islands of Madagascar (Milne-Edwards 1859: 148). The concern of Du Petit Thouars echoed those of other travelers to the islands, if these islands were new volcanic lands, and little by little, water eroded its tops to create lime soil, where did the first seeds come from? He ventured to say that marine birds and winds could carry them from the American continent, since the winds blow westward, but he could not explain the differences from the continental species. Milne-Edwards did not take into consideration this hypothesis from his source.

Bolivia, and Argentina, one of the largest in South America (Caccone et al. 1999, 2002). The hypothesis is that both *Geochelone* species derived from a giant South American ancestor now extinct (Parent et al. 2008).

[3] What did harmonic mean for Baur? He did not give a definition, but we can interpret that he was talking about the harmony between the animals, the plants, and the natural conditions. For Baur, following Darwin, it takes time for species to accommodate to new natural conditions; this means that the species that came later to the archipelago would still be in a process of "plastic" adaptation. Wolf also mentioned that the "the very scarce and singular vegetation of the islands, with which the no less singular animals are in harmony" (Wolf 1879: 49).

Coming back to Baur's theory, when he examined the common hypothesis that all living organisms came to Galapagos through the currents, he makes the same objection that some transformists made to the idea of successive creations: "To explain this we would have to invoke a thousand accidents" (Baur 1891b: 308). Since this repetition of accidents is improbable, according to Baur, the only explanation for the harmonic life on the Galapagos is that the islands originated from a subsidence of a continent that was attached to the American continent, and then, by isolation, the different species diverged from island to island. Baur used Theodor Wolf's observations to support his theory. He cited Wolf's appreciation that "the flora of the Galapagos at elevations of about 900 ft is typically that of the Andes at an elevation of 9000 ft. How could this alpine flora be explained by the theory of elevation; what is the reason that plants characteristic of an elevation 9000 ft are found at an elevation of 900 ft?" (Baur 1891b: 309). The former Jesuit Theodor Wolf, geologist and geographer, but also interested in Darwinism (Cuvi et al. 2014), lived and explored Ecuadorian highlands and coastal area, first as professor of the state-promoted and Jesuit-run *Escuela Politécnica* and then as state geologist until 1892 when he returned to Germany. When visiting the Galapagos in 1875 and 1878, he commented, "Anyone who is acquainted with the Ecuadorian flora, will notice the analogy that this vegetation presents with the forests in the moors (páramos)" (Wolf 1879: 55).

However, Wolf explained this fact by the cool climate produced by the effect on these isolated oceanic islands of the cold Antarctic Humboldt Current that sweeps across the Pacific coast of South America, from Chile to Cabo Pasado, near Guayaquil, and then redirects itself to the Galapagos (Wolf 1879: 51). Nonetheless, he left the matter open when he stated, "This particularity (the absence of beautiful 'tropical' flowering species) are not sufficiently explained by the climate alone, especially, if we take into consideration, that the majority of phanerogam plants are endemic." Wolf came to the conclusion that "¡These are the whims of nature, or, better still, the mysteries of creation!" (Wolf 1879: 56).

To prove the plausibility of his subsidence theory, Baur took into consideration the measurements made by the "Albatross" on his first trip to Galapagos and concluded that "We need only an elevation of about 10,000 ft to connect the Galapagos with America. This would give the highest mountain on the Galapagos an elevation of 14,700 ft. This height is reached by many mountains and very often surpassed" (Baur 1891b: 309).

Another argument for Baur's theory is that the Galapagos tortoise is related to the Miocene fossils. He stated that during the Eocene and even later, the Galapagos archipelago must have been connected to the American continent. He compared languages to species to explain the conservation of antique types by an isolation factor alone: "I believe, therefore, that the peculiar genera we find today on the Galapagos have not originated there, but have been preserved in their old condition" (Baur 1891b: 309).

Theodor Wolf's analysis of the geology of the Galapagos was absolutely contrary to that of Baur, since he concluded, "we face one of the best examples of a [geological] formation exclusively volcanic of the islands by accumulation of eruptive materials."

He pointed out the difference in geological composition of the Galapagos Islands made mainly on basalt rocks versus the Andes composed of andesite and trachyte rocks. To be clear on his position about the subsidence theory, he stated that "These islands haven't formed from detachment of the South American Continent (like some have dreamt), nor by uplifting of the ocean floor, but simply by successive accumulation of eruptive material, i.e., by volcanic eruptions that at the beginning they took place underwater, and later, over the level of the sea. Nowhere are there any vestiges of uplifted land, nor arguments for subsidence or uprisings" (Wolf 1887: 22).

Elizabeth Agassiz, wife of Louis Agassiz, saw the Galapagos as very new volcanic land. She stated that "Narborough and Albemarle have so fresh a look that you could easily believe that there had been extensive eruptions there within the present century" (Agassiz 1871–1872). Louis Agassiz (1872) stated in a letter to Peirce after his visit to the Galapagos that they are "of MOST RECENT ORIGIN, inhabited by creatures so different from any known in other parts of the world."

Hartert and Rothschild evaluated Baur's theory and argued that it has no scientific ground since there is no geological evidence (the geology of the Galapagos differs from that of the American continent) and the soundings made by the Albatross in 1891 showed that the ocean is deeper closer to the American coast. Although they were cautious in their conclusions, in their argumentation they favored Darwin and Wallace's theory of a recent volcanic origin and colonization of the islands from the American continent (Rothschild and Hartert 1899: 137–140).

Even though many scientists like Theodor Wolf, Alexander Agassiz, Rothschild, and Hartret gave sound geological arguments against Baur's theory, the debate continued into the twentieth century. Among the scientists of the vast collecting expedition sent in 1905 by the California Academy of Sciences, there were diverse views regarding the origin of the islands and its life. Williams (1911: 290), for example, began his article on butterflies and hawk moths stating that there is an open debate regarding the origin of the Galapagos:

> I have considered the Galapagos as oceanic in regards to their natural history; whether they issued in the first place from the bed of the ocean, or whether they were once completely submerged, or all living organisms thereon otherwise totally destroyed simultaneously by volcanic activity, as the flora and fauna would still be oceanic in character, i.e., transported across water to the islands, a condition that the writer believes has happened.

Williams believed that there was good evidence to show that the Galapagos archipelago was once one large island, which, by subsidence, had formed the many smaller islands. This theory, close to Baur's, helped him explain the existence on all or most of the islands of closely allied species or varieties.

On the other hand, John Van Denburgh (1912a: 331), curator of the department of herpetology, was also ambiguous to the relationship between the snakes and the origin of the archipelago:

> (…) the snakes of these localities must have had a common origin. Either the West Indian and Galapagos snakes have been derived from South America, or else all must be descendants of species which, in a former geological period, occupied a great central land-mass which has sunk below the level of the sea, leaving mere remnants in Central America, northern South America, the Antilles, and the Galapagos.

Van Denburgh considered that much could be said in favor of these theories and that the data were not yet at hand for making a decision between them. Nevertheless, either view, according to the herpetologist of the California Academy of Sciences, implied a former land connection and a continental origin of the Galapagos ophidian fauna. As Baur decades before, Van Denburgh explicitly disagreed with the opinion that the fauna of the Galapagos had reached these islands by the "more or less accidental agency of the winds and ocean currents" (Van Denburgh 1912a: 334). He considered that the various species must have spread slowly over some "continental mass with which the Galapagos were connected or of which they formed a part." Furthermore, Van Denburgh claimed that when the Galapagos finally "became separated from the rest of the world, it is probable that most or all of the present islands remained for a time united" (Van Denburgh 1912a: 334).

Van Denburgh developed his argument even further on another paper addressing the geckos of the Galapagos Islands (Van Denburgh 1912b). As with the snakes, the herpetologist sought to trace the history of these islands from the evidence afforded by a specific group of inhabitants. Van Denburgh's opinion on the origin of the Galapagos Islands discarded two hypotheses. In fact, when he found the same species of geckos (*Phyllodactylus bauri*) inhabiting both Charles and Hood islands, he discarded the possibility of this species having independently evolved in two separate islands. He also abandoned the hypotheses of these inhabitants being carried across the water from one island to the next. This line of argumentation forced him to conclude that Charles and Hood islands were connected "and formed parts of a single large southern island" (Van Denburgh 1912b: 408).

Stewart, the botanist in the expedition, insisted on the improbability of such a connection put forward by Baur in 1891. According to him, the great difference between the floras of Cocos and the Galapagos strongly opposed Baur's view. In fact, Stewart claimed that if there "has ever been a land-mass connecting the Galapagos Islands with the mainland of North America, it must evidently have included Cocos Island region" and this connection between the two groups of islands "should have left a much larger number of species common to the two than is actually found" (Stewart 1912a: 382–383). Stewart finally concluded that the flora of Cocos, like that of the Galapagos Islands, "is distinctly that of an oceanic island." Many facts lent support to this view. Stewart mentioned the relatively large number of ferns, the much smaller number of species in the remaining families, and the total number of species found on the islands.

In 1937, Misael Acosta Solís visited the archipelago with the Ecuadorian National Scientific Commission to celebrate Darwin's centenary in the Galapagos. He published a study of the islands centered in its vegetation and economical importance (Acosta Solís 1937). When describing the theory of subsidence put forward by Baur, he recognized that "this hypothesis has had many followers (…), the author was also an adept before knowing the Archipelago; but since then I know and have studied better, more carefully, I cannot be with (the position) of G. Baur, and in this matter I am now with Wolf" (Acosta Solís 1937: 437). On the other hand, another visitor to the Galapagos to celebrate the 100 years of Darwin's landing in the archipelago, Victor Von Hagen, wrote that Baur's land bridge theory was attractive, but

that the geological and oceanographic evidence of Darwin, Wolf, and Agassiz pointed out to a recent volcanic origin (Von Hagen 1936: 589).

Although all geological descriptions and studies of the Galapagos concluded that they emerged from underwater volcanoes and that they were new land masses, some skeptics of accidental migrations avoided all the evidence of this new volcanic origin and had to resort to a theory of a continental connection and submergence of a bigger land mass, leaving the mountaintops as islands. Darwinism was difficult to grasp, especially the idea of accidental migrations and random variation.

Biodistribution, "Harmony," and Evolution

Between the publication of the *Journal*'s first edition in 1839 and its second edition in 1845, Darwin pressed for results from the analysis of his botanical collections. Unlike the birds he collected, he had labeled his plants according to their respective islands, and he wanted to know about the patterns of distribution of these specimens and whether or not they reflected similarity to American plants. In his field book, he recorded: "I certainly recognize S America in Ornithology, would a botanist?" (Darwin 1835: 30). Of the plant specimens collected during the *Beagle* voyage, 211 stem from the Galapagos Islands (Porter 1980). Darwin's collection covered about 24 % of the flora of the archipelago known today, and it became the basis for the later description of the vegetation of the Galapagos (Stöcklin 2009). On his return to England, Darwin gave the collection to John Henslow (1796–1861), hoping that he would examine them, but he did not fulfill the task. Darwin transferred the specimens to the more approachable Joseph Hooker in 1843.

Darwin's letter of reaction to Hooker's results written in 1845 is a wonderful gateway both to Darwin's intellectual and emotional moments: a baby is born; "may he turn out a naturalist." Instead of blessing the baby, his father's wish is that he may turn out a naturalist (Darwin 1845).

Wallace's synthesis on the relationship between biogeography and evolution appeared in his *Geographical Distribution of Animals* (1876) and more specifically concerning the Galapagos, in his *Island Life* (1892). In his second edition, Wallace concluded that

> all these phenomena are strictly consistent with the theory of the peopling of the islands by accidental migrations, if we only allow them to have existed for a sufficiently long period; and the fact that volcanic action has ceased on many of the islands, as well as their great extent, would certainly indicate a considerable antiquity. (Wallace 1892: 283–284)

As well as Darwin, Wolf observed island-specific speciation but continued to be ambivalent about its origin when regarding plants but less so when talking about the land birds:

> The non-endemic plants have evidently immigrated from the continent, since they can also be found in the coasts of Colombia and Ecuador, from Panama to Guayaquil. The endemic plants have their origin in the islands themselves, be it that they were especially created for

> them, be it that they were born from a slow and successive transformation from species and genera immigrated in time immemorial from the continent. (Wolf 1887: 14)
>
> They [the land birds] cannot hide their analogy with those from the coasts of the continent, from which they probably derive through a successive transformation and accommodation. (Wolf 1887: 17 and Wolf 1892: 484–485)

Baur tackled the question on the origin of the different variations in the organic forms on the different islands. As well as for Wolf, the characters of the fauna and flora of the Galapagos were due to the differences in physical conditions of the islands. Variation aroused due to the pressure made by these changing conditions. Baur's hypothesis was that the archipelago was once a big island that subsided and was divided into different islands. He imagined a moist island, with a single species of each genus. Then, gradually the species found themselves in drier country, which "affected the flora and fauna; and the flora again the fauna" (Baur 1891b: 312). When trying to understand what Baur meant by harmony and disharmony, it seems that he saw evolution as a processes that was not continuous but instead there were periods when animals and plants were imperfectly adapted to their environment and that is when Baur would see disharmony. After adaptation took place, the species would become harmonious. In Baur's arguments, you cannot find a single example of a true oceanic island with inharmonious life. Instead, many oceanic islands, like Revillagigedos and even Sandwich, seem to be wrongly categorized by Wallace, according to Baur (1891b: 310).

The Galapagos finches were one of the puzzles that attracted much attention from scientists and explorers. The collections made by Habel in 1868 were studied by Salvin and Slater and compared with the specimens from Darwin's collection. In 1863, Salvin wanted to travel to Galapagos with encouragement from Joseph Dalton Hooker and Charles Darwin; however, he never got there (Grant and Estes 2009: 241–242). His work *On the Avifauna of the Galapagos Archipelago* was published in 1875 and endorsed the Darwinian transmutation theory, even though, as Larson (2001) points out, he could not explain how the Galapagos birds were modified from the continental immigrant ancestors "by different circumstances with which they became surrounded" (Salvin 1875: 509). He did, however, point to several interesting issues: first, the species of land birds were not island specific, but several species could coexist in the same island, although it seemed to him from Dr. Habel's collection that some species prevail in every island. Second, he tried to resolve the problem that certain species were difficult to separate. He said that the beak size seemed to be the only aspect that was less gradual, compared to coloring, general size, and locality. He mentioned, in particular, the relationship between the black plumage of male *Geospiza* and sexual selection. Salvin noted that, to establish clearer species boundaries, it would be very helpful to study the birds' behavior in field observations to see if there is sexual selection regarding the black plumage of the cock birds. Salvin thought that the plumage had no important role in selection because only a few individuals showed this color, since it takes 3 years to develop. Although Dr. Habel described the food inside each specimen, Salvin did not take this data into consideration. His conclusion was that "the members of this genus present a field where natural selection has acted with far less rigidity than is usually observable" (Salvin 1875: 470).

Darwin read Salvin's work and was surprised and interested in the fact that "the birds from the different islands prove so similar." He insisted that the study and comparison of the habits, nests, and eggs of the commonest species of each island would throw a "flood of light" on variation (Darwin 1875 published in Donahue 2011: 55).

On the other hand, Salvin and Darwin were both interested on how species migrated to oceanic islands. On 1868, Salvin communicated to Darwin that he saw a bivalve freshwater shell clasped into the foot of a sandpiper that he collected in Norway (Salvin 1868).

Different Proposed Mechanisms of Evolution

Louis Agassiz (1807–1873) belonged to the generation of naturalists who followed the steps of Cuvier. Following French empiricists, he was weary of both speculative philosophy (including *Naturphilosophie*) and religious dogma (Winsor 1979; Numbers 1998).

For Agassiz, real science was based on the accumulation of facts. This is mainly the reason why the Swiss naturalist dismissed Darwinism as "an ingenious but fanciful theory" (Agassiz in Numbers 1998: 31). Agassiz' (1857) own theory was elaborated and published in 1857. He saw in nature a correspondence between living beings and environment as harmonious and as evidence of a Creator who planned nature. He also argued that there was no evidence in contemporary nature or in the paleontological record of gradual change. His main arguments used the example of some advanced animals, like the shark, that had remained unchanged through very long periods of time (Numbers 1998).

In 1871, Louis Agassiz sailed on the vessel of the US Coast Survey fleet, *Hassler*; its itinerary included a visit to the Galapagos. Agassiz did not sail to the Pacific just to test evolution in abstract terms; his initial plan was to do deep-sea dredging of the ocean floor in search for fossils that will confirm his creationist assumptions. He, in fact, chose a specific route that would challenge Darwin in a direct way. However, as Gould (1983) has shown, Louis Agassiz didn't write anything to contribute to his debate against Darwinism. His wife's account of one of his lectures on the trip between Galapagos and Panama shows that what worried Agassiz the most is "[Darwin's] present influence on science very pernicious as favoring the habit of 'filling up the wide gaps of knowledge by inaccurate and superficial hypotheses'" (Agassiz 1871–1872). The conclusion made by his wife Elizabeth C. Agassiz (1871–1872) shows that they are skeptic of evolution although they share the same facts as Darwin, that is, that "the Galapagos have a fauna and a flora decidedly of an American type, yet decidedly peculiar to themselves," and that "the islands are to my eye much more recent in their formation than Juan Fernandez." She thought that the Galapagos was the perfect place for recovering data to solve the origin's question since she saw them as puzzles themselves: "younger than Juan Fernandez, purely volcanic, bringing no seeds from the bottom of the sea, not having had time to alter and amend species introduced from the mainland." His husband was more closed to the transformation hypothesis since in his letter to Peirce, the extreme

youth of the islands didn't give enough time for a transformation from continental species into the endemic Galapagos ones (Agassiz 1872). With the particular case of the Galapagos, according to the Agassiz, "the mystery of change (…) is only increased, and brought to a level with that of creation" (Agassiz 1872). For Louis Agassiz, science needed more facts, more knowledge for a "fair discussion of the origin of organized beings" (Agassiz 1872).

Another interesting case is that of the former Jesuit naturalist Theodor Wolf, who came to Ecuador as a university professor and later became state geologist. In Theodor Wolf's works, there is ambivalence in his opinion about the origin and evolution of the Galapagos life. At the same time that he employed the term "creation" to refer to living organisms, he stated that introduced species are "perfectly adapted" or that the small vegetative organs in the plants are explained by its "provident accommodation to arid climate" (Wolf 1892: 487, 388 and 480). Does he adhere to the idea of several creations or to the transmutation of species? Another observation about adaptation made by Theodor Wolf regarded the tameness of the land animals in contrast to the sea animals, especially birds. He said that in the islands more visited by man, Floreana and Chatham (San Cristóbal), birds were surlier than those from the least visited, like Albemarle (Isabela). He concluded that "it seems that birds get used with difficulty and very slowly to fear and flee man by instinct; but once this instinct is acquired, it stays hereditary and they keep it for many generations" (Wolf 1892: 485). The other way round, he observed that the aquatic birds, which to him emigrated from the continent many generations ago, are still cautious toward man. Does this mean that Wolf saw land animals as originated in the islands and aquatic animals as immigrants from the continent?

Baur not only theorized about the geological origin of the Galapagos but also ventured in a theory of variation. His view is fundamentally neo-Lamarckian. He started by stressing that the environment can modify biological organisms. Actually, he closed the first part of the article on the subject of the origin of the Galapagos with a quote from Darwin in a letter to Wagner[4]: "In my opinion, the greatest error which I have committed has been not allowing sufficient weight to the direct action of the environment, i.e., food, climate, etc., independently of natural selection" (Baur 1891a: 319).

Baur had a clear neo-Lamarckian explanation of variation, stating that different environmental conditions produced changes in the most "plastic" younger individuals of the population. Gradually, the older nonplastic individuals died, and the transformed ones took over. His concern with harmony appeared again in this explanation of transmutation since he considered this process to occur until "harmony is reached

[4]This letter is not yet identified in the Darwin Correspondence Project. Moritz Wagner (1813–1887) was a German explorer and naturalist, professor at Munich University, who developed the migration theory of fauna and flora in 1868 with great weight given to geographical isolation in speciation. Darwin corresponded with Wagner and in the 5th edition of the *Origin*, he cited Wagner's article stressing that although geographical isolation was important for preventing crosses between new varieties, it was not necessary for the formation of new species (Darwin Correspondence Project, Baur cited Wagner, Moritz. Die Enstehung der Artendurch Frdumliche Son-derung. Basel, 1889).

again between the individuals and the conditions" (Baur 1891b: 313). This process was exacerbated by the effect of isolation, concluded Baur, taking into consideration the work of Vladimir Schmankewitsch on *Artemia salina* and *A. A. mnuhzauisenii*. This neo-Lamarckian mechanism is divided into two processes, first "a new species on the same spot through the change of conditions; in the second a portion of the individuals becoming isolated from the original stock develop into a new form" (Baur 1891b: 314). Baur (1891b: 315) baptized his theory "the process of harmonic growth, founded on the plasticity of the younger individuals."

Darwin and Galapagos: Beyond Scientific Debates

In this section, we will discuss how the image of Darwin and Galapagos science were used in Ecuadorian politics and policy at the end of the nineteenth century and around the centennial of Darwin's voyage.

Ecuador took possession of the Galapagos two years before Darwin's visit through the efforts of Villamil. During the nineteenth century, there were poor attempts of colonization from Ecuador and rumors of selling or alienation of the archipelago from countries like Peru, France, and the United States. This was due to the belief that there was guano in the islands at first and then as a strategic and coal deposit in the Pacific, especially in anticipation to the opening of the Panama Canal (Larrea 1960; Latorre 1999; Luna Tobar 1997).

In both these strategies, scientists played an important role. I will focus on how the Ecuadorian state used science to take and show possession of the islands.

As Ana Sevilla has described in Chapter 3 of this volume, Theodor Wolf made two trips to the Galapagos from Guayaquil, the latter commanded by the government of Ecuador as state geologist. Wolf worked the geology and climate of the islands and also the economic possibilities of colonization and its natural resources. He was personally inspired by Darwin's work and had planned to explore the Galapagos years before, while being a professor for the Jesuit-run, state-owned polytechnic school. He finally made the trip on his own for the first time in 1875 and then was sponsored by the government's interest in surveying natural resources and making a map and geological description of the Republic, including the Galapagos. This work aimed at the final product, the *Geography and Geology of Ecuador* and its accompanying map, both published in 1892. These different interests, both scientific and practical, can be seen in the articles published by Wolf in Ecuador concerning the Galapagos. The same can be said of Misael Acosta Solís, who visited the islands with a National Scientific Commission sponsored by the Ecuadorian government and university in 1937. In his article, Acosta Solís (1937) also mixed scientific observation with practical recommendations regarding tourism, fishing resources, and agricultural potential of the islands.

In 1936, the Ecuadorian government declared the Galapagos a natural reserve. Before this, in 1934, a decree was issued protecting the fauna of the islands. Acosta Solís (1979: 52) argued that this regulation came from "hints from a group of professors of the Universidad Central del Ecuador, Nature lovers, especially Professor

Jonás Guerrero, my Sciences teacher." However, Barrow (2009) and Hennessy (2015) argue that the draft came from the American naturalists Moore and Coolidge who collaborated with V. M. Egas, former Ecuadorian consul in Los Angeles, to propose a draft of legislation to protect the fauna of the Galapagos; Acosta Solís said that the decree project was written by Professor Guerrero and that it was typewritten by himself (1979: 29). Acosta Solís might be confusing the 1934 decree with the one of 1936, since he recalls giving the decree proposal to President Federico Páez, who was in office from the September 26, 1935, to October 22, 1937 (Acosta Solís 1979: 52).

Misael Acosta Solís recalled that ever since getting to know the "magnificent explanation of the origin of the species and its adaptations to the local environment, from the great naturalist Charles Darwin" in 1933, he was interested in protecting the Galapagos (1979: 59). In 1936, he prepared a paper on Darwinism that was published in the *Anales de la Universidad Central* (Acosta Solís 1936). In 1937, he was part of a National Scientific Commission for Galapagos prepared by the university and supported by the Ecuadorian government. The Commission visited the islands during 18 days only and came back and prepared an exposition and a report for the government urging for the conservation and scientific exploration of the islands. Acosta Solís published in the local press and in an academic article that appeared in the *Anales*, where he insisted on the necessity of protecting the islands and creating a scientific research station (Acosta Solís 1937). In the 100-year celebration of the visit of Darwin to the Galapagos, there were three parties involved: (1) Von Hagen and the Darwin celebration expedition that promoted local support through meetings with influential people, the promotion of a "Corporación Científica Nacional para el Estudio y Protección de las Riquezas Naturales del Archipiélago de Colón" (Scientific Corporation for the Study and Protection of the Natural Riches of the Colon Archipelago), with academic members from Quito and Guayaquil universities (among them Dr. Teodoro Maldonado Carbo, eminent surgeon and Dean of the Universidad de Guayaquil) (Von Hagen 1935 and Baquerizo Maldonado 2011), (2) Misael Acosta Solís and other professors from the Universidad Central del Ecuador from the Corporación Científica Nacional, and (3) Ecuadorian consul Egas together with the American scientists Moore and Coolidge (Corley Smith 1990: 6).

Von Hagen sought local support by giving medals with the portrait of Darwin to government dignitaries and two busts of the British naturalist to the universities in Quito and Guayaquil to be unveiled on September 17, 1935, besides the one erected in San Cristóbal (Chatham) on the place where Darwin first set foot on the archipelago (Von Hagen 1935, 1940, 1978) (see Fig. 4.1). These busts were cast in Quito by the sculptor and Director of the Escuela de Bellas Artes, Luis Mideros, from a plaster cast made from a Darwin sculpture at the American Museum of Natural History. The inscription on the monument was written by Major Leonard Darwin, the last surviving son of the great naturalist (Von Hagen 1940). Today, the bust of the Universidad Central del Ecuador in Quito is displayed in the Historical Area of the new Library (see Fig. 4.2), and in the Universidad de Guayaquil, it stands next to the Casona Universitaria; it had been "restored" by Alfredo Palacio (Guerrero 2013). The text of the accompanying plate is in English in Guayaquil and in San

Fig. 4.1 Bust of Charles Darwin erected by Von Hagen in San Cristóbal (Chatham). The monument has been moved to the Naval Station. Source: (Guerrero 2013)

Cristóbal, but it was translated into Spanish in the one displayed in Quito. We do not know who was in charge of the translation, which includes a change of meaning because, in the original plates from Guayaquil and San Cristóbal, it says:

> Charles Darwin landed on the Galapagos Islands in 1835 and his studies of the distribution of animals and plants thereon led him for the first time to consider the problem of organic evolution. Thus was started the revolution in thought on this subject which has since taken place.

And in the Quito Spanish version, the idea of "studies of the distribution of animals and plants" is replaced by "his studies on the classification of animals and plants."

It is important to note that this bust with its inscription, both in English and in Spanish, sets Darwin's landing in the Galapagos as the first step toward the "Darwinian revolution," collaborating in the construction of the Darwin-Galapagos legend studied by Sulloway (1984).

Another difference is that the ones in Guayaquil and San Cristóbal are mounted outside, on top of a stone pyramidal base, and the inscription is accompanied by a high relief sculpture of young Darwin's bust, also by Luis Mideros, while the bust in Quito is set inside the university's library, on a wooden base, and the inscription does not have the sculpture of young Darwin (see Fig. 4.1 and Fig. 4.2).

Fig. 4.2 Bust of Charles Darwin donated by Von Hagen to the Universidad Central del Ecuador, Quito. Source: Elisa Sevilla

The celebrations in the Universidad Central del Ecuador included a conference by Dr. Jorge Andrade Marín (1936) where he described evolution and concluded that it should be taught in schools and universities to transit into the "why" questions of biology instead of staying in the "what" questions of descriptive and classificatory biology. The Ministry of Education published the chapter of the *Journal of Researches* concerning the visit to the Galapagos in commemoration of Darwin's exploration of the islands 100 years before. However, the document doesn't go into Darwin's theory of transmutation by natural selection (Torres 1935).

The celebrations were also present in Guayaquil. The Colegio Nacional Rocafuerte of Guayaquil donated a plate commemorating the centennial of Darwin's visit to the Galapagos that today is displayed in the naval base at Chatham next to Von Hagen's Darwin bust (Guerrero 2013) (see Fig. 4.1).

Nicolás Cuvi (2005) rescues the figure of Acosta Solís as an active and early promoter of the protection of the archipelago from a conservation and scientific point of view. He was the only Ecuadorian scientist in the Charles Darwin Research Station inaugural cruise and symposium held in the *Golden Bear* vessel. He promoted the cause inside and outside Ecuador. In those early years of his career, he promoted nature conservation with the goal of economic and rational use of the resources (Cuvi 2005).

Fig. 4.3 Ecuadorian stamps in commemoration of the visit to the Galapagos by Charles Darwin. Source: http://www.paleophilatelie.eu/images/sets/ecuador_1936_darwin.jpg

It is interesting to note that conservation efforts go hand in hand with an interest in commemorating Darwin. In 1936, a set of stamps were issued from the Ecuadorian government to commemorate the centennial of Darwin in Galapagos. These stamps represented Colombus (after whom the archipelago was renamed in 1892), a map of the islands with its Ecuadorian names remembering Columbus' "discovery" of America, a landscape with palm trees that do not correspond to the typical image of the Galapagos reminding us of the introduction of species to the islands, the characteristic reptiles (land iguana and Galapagos tortoise), and the picture of old Darwin and the *Beagle*. These stamps were meant to finance the Galapagos Research Station in the scheme conceived by Von Hagen. However, as he recalled in a letter to G. T. Corley Smith in 1978, this plan did not turn out because the Ecuadorian "President was deposed" (Von Hagen 1978). President Velasco Ibarra was turned over by a military coup on the August 21, 1935. The stamps were finally printed the next year, in 1936 (see Fig. 4.3).

Hennessy (2014) argues that Von Hagen did not succeed in his commemoration plan because he was not recognized as a member of the scientific community; instead, he was seen as a promoter. It is interesting to note that Acosta Solís (1979) does not mention Von Hagen's efforts to promote the conservation and establishment of a research station in the Galapagos. It seems that the Ecuadorian conservationist did not approve of his personality or methods either.

The results around the centennial of Darwin's visit summed up to the Executive Decree 607 issued in 1934 for protecting key species, regulating scientific

collections, and controlling visiting yachts and the Supreme Decree 31 of 1936, declaring the Galapagos Islands as a national reserve and establishing a National Scientific Commission to propose strategies for the conservation of the archipelago (Oxford and Watkins 2009).

Conclusions: Galapagos, a Place of Dispute

In this chapter, we have seen how the Galapagos peculiar geology and life have been explained by a diversity of theories. To some like Darwin and Wolf, the primitive volcanic appearance of the islands pointed out to a new world where species of animals and plants had to be recent and derived from ancestors from the American continent. To others, this seemed like science fiction, too many accidents, and thus, many saw the prehistoric landscape and inhabitants of the Galapagos to be remnants of life from another era that survived without the depredation of carnivorous animals, especially man. These theories usually came from those scientists studying reptiles, in particular, giant tortoises. Those who focused on birds were less inclined to resort to the subsidence theory. Another conclusion is that there is a very tight relationship between geological explanations and the theories about biodistribution concerning the Galapagos.

The proposed mechanisms of transmutation were also varied. Some followed Darwin and Wallace's idea of natural selection, while others talked more of plasticity of the young; somewhat like Lamarck. And there were those to whom the Galapagos prehistoric-looking saurians were proof that species didn't vary over time.

Finally, Darwin was not only an inspiration for further scientific explorations of the Galapagos. Some international scientists and the Ecuadorian government and universities were also involved in exploring the islands in commemoration of the centennial of Darwin's visit to the Galapagos.

References

Acosta Solís, M. (1936). *Filosofía biológica a través de los tiempos: Darwin, darwinismo, evolucionismo*. Quito: Imprenta de la Universidad Central.

Acosta Solís, M. (1937). Galápagos observado fitológicamente. *Anales de La Universidad Central del Ecuador, LIX*(302), 427–504.

Acosta Solís, M. (1979). *Galápagos y su naturaleza*. Quito: IPGH.

Agassiz, L. (1857). *Essay on classification* (Contributions to the Natural History of the United States of America, pp. 3–234). Boston: Little, Brown.

Agassiz, E.C. (1871–1872). *Narrative of the voyage of the Hassler in the form of letters written on board by Mrs. Agassiz and published in the Boston Transcript and the New York Tribune, 1871–1872*. Spec. Coll. MCZ 023. Ernst Mayr Library, Museum of Comparative Zoology, Harvard University, Cambridge, Mass. Retrieved August 1, 2015, from http://pds.lib.harvard.edu/pds/view/11908084.

Agassiz, L. (1872). Letter from Louis Agassiz to Benjamin Peirce, July 29, 1872. reprinted in Agassiz, E.C.C. (Ed.). 1885. *Louis Agassiz: his life and correspondence*. Houghton, Mifflin and company. Retrieved from August 1, 2015, from http://www.encyclopaedia.com/pdfs/4/655.pdf.

Andrade Marín, J. (1936). El evolucionismo. *Anales de La Universidad Central del Ecuador, 56*(295), 249–273.
Baquerizo Maldonado, J. (2011). Teodoro Maldonado Carbo. In *El Universo, 6 June 2011*. Retrieved, April 22, 2015, from http://www.eluniverso.com/2011/06/06/1/1363/teodoro-maldonado-carbo.html.
Barrow, M. V. (2009). *Nature's ghosts: Confronting extinction from the age of Jefferson to the age of ecology*. Chicago: University of Chicago Press.
Baur, G. (1891a). On the origin of the Galapagos islands. *The American Naturalist, 25*(291), 217–229.
Baur, G. (1891b). On the origin of the Galapagos islands (continued). *The American Naturalist, 25*(292), 307–326.
Baur, G. (1897). New observations on the origin of the Galapagos islands, with remarks on the geological age of the Pacific Ocean. Part 1. *The American Naturalist, 31*(370), 864–896.
Bowler, P. J. (1983). *The eclipse of Darwinism: Anti-Darwinian evolution theories in the decades around 1900*. Baltimore: John Hopkins University Press.
Bowler, P. J. (1988). *The non-Darwinian revolution: Reinterpreting a historical myth*. Baltimore: Johns Hopkins University Press.
Bowler, P. J. (2005). Revisiting the eclipse of Darwinism. *Journal of the History of Biology, 38*(1), 19–32.
Caccone, A., Gentile, G., Gibbs, J. P., Fritts, T. H., Snell, H. L., Betts, J., et al. (2002). Phylogeography and history of giant Galápagos tortoises. *Evolution, 56*(10), 2052–2066.
Caccone, A., Gibbs, J. P., Ketmaier, V., Suatoni, E., & Powell, J. R. (1999). Origin and evolutionary relationships of giant Galápagos tortoises. *Proceedings of the National Academy of Sciences, 96*(23), 13223–13228. doi:10.1073/pnas.96.23.13223.
Corley Smith, H.E. (1990) Early attempts at Galapagos conservation. *Noticias de Galápagos* no.49 (June). Retrieved from http://www.darwinfoundation.org/articles/.
Cuvi, N. (2005). Misael Acosta Solís y el conservacionismo en el Ecuador, 1936–1953. *Geo Crítica/Scripta Nova. Revista Electrónica de Geografía Y Ciencias Sociales, 9*(191).
Cuvi, N., Sevilla, E., Sevilla, A., & Piñas, F. (2014). La circulación del darwinismo en el Ecuador (1870–1874). *Procesos: Revista Ecuatoriana de Historia, 39*, 115–142.
Darwin, C. (1835). Galapagos. Otaheite Lima. *Beagle field note book*. EH 1.17. Retrieved from http://darwin-online.org.uk/content/frameset?itemID=EH1.17&viewtype=text&pageseq=1
Darwin, C. (1839). *Journal of researches*. London: Henry Colburn.
Darwin, C. (1845). Darwin letter to Hooker, 11–12 July, 1845. Retrieved from http://www.darwin-project.ac.uk/entry-889.
Darwin, C. (1859). *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*. London: John Murray.
Darwin, C. (1875). Darwin letter to Osbert Salvin, 22 Aug, 1875, published in Donahue, K. 2011. *Darwin's Finches: Readings in the Evolution of a Scientific Paradigm* (p. 50). Chicago: University of Chicago Press.
Donahue, K. (2011). *Darwin's finches: Readings in the evolution of a scientific paradigm*. Chicago: University of Chicago Press.
Du Petit Thouars, A. A. (1859). Observations faites aux îles Galapagos. *Comptes Rendus Hebdomadaires Des Séances de l'Académie Des Sciences, 48*, 144–147.
Esparza, M. S. (2014). *La cultura científica en México: Imágenes del pensamiento evolutivo en el periodo porfiriano* (Unpublished doctoral dissertation). Universidad Autónoma de México, Mexico.
Gould, S. J. (1983). *Agassiz in the Galapagos* (Hen's Teeth and Horse's Toes: Further Reflections in Natural History, pp. 107–119). New York: Norton.
Grant, K. T., & Estes, G. B. (2009). *Darwin in Galápagos: Footsteps to a New World*. Princeton, NJ: Princeton University Press.
Guerrero, A.M. (2013). "Los bustos de Charles Darwin erigidos en 1935 en las ciudades de Puerto Baquerizo Moreno, Quito y Guayaquil." *Ecuador: personajes y especies (Galápagos y Continente)*. Retrieved May 26, from http://pinzonesygorriones.blogspot.com/2013/05/los-bustos-de-charles-darwin-erigidos.html.

Günther, A. (1871). Description of Ceratodus, a genus of Ganoid fishes, recently discovered in rivers of Queensland, Australia. *Philosophical Transactions of the Royal Society of London, 161*, 511–571.

Günther, A. (1875). Description of the living and extinct races of gigantic land-tortoises. Parts I. & II. Introduction, and the tortoises of the Galapagos islands. *Philosophical Transactions of the Royal Society of London, 165*, 251–284.

Günther, A. (1877). *The gigantic land-tortoises (living and extinct) in the collection of the British Museum*. London: British Museum.

Hennessy, E. (2014). *On the backs of tortoises: conserving evolution in the Galápagos islands* (Unpublished doctoral dissertation). University of North Carolina at Chapel Hill, Chapel Hill.

Hennessy, E. (2015). The molecular turn in conservation: Genetics, pristine nature, and the rediscovery of an extinct species of Galapagos giant tortoise. *Annals of the Association of American Geographers, 105*(1), 87–104.

Hooker, J. D. (1851). On the vegetation of the Galapagos archipelago, as compared with that of some other tropical islands and of the continent of America. *Transactions of the Linnean Society of London, 20*(2), 235–262.

Lack, D. (1947). *Darwin's finches*. Cambridge: Cambridge University Press.

Larrea, C. M. (1960). *El Archipiélago de Colón: (Galápagos)*. Quito: Casa de la Cultura Ecuatoriana.

Larson, E. (2001). *Evolution's workshop. God and science on the Galapagos islands*. London: Penguin Press.

Latorre, O. (1999). *El hombre en las islas encantadas: La historia humana de Galápagos*. Quito: FUNDACYT.

Luna Tobar, A. (1997). *Historia política internacional de la Islas Galápagos*. Ecuador: Editorial Abya Yala.

Lurie, E. (1959). Louis Agassiz and the idea of evolution. *Victorian Studies, 3*(1), 87–108.

Lurie, E. (1960). *Louis Agassiz: A life in science*. Chicago: University of Chicago Press.

Martínez, N. (1934). *Impresiones de un viaje a Galápagos*. Quito: Talleres Gráficos Nacionales, Observatorio de Quito.

Mayr, E. (1959). Agassiz, Darwin, and evolution. *Harvard Library Bulletin, 13*, 165–194.

Milne-Edwards, H. (1859). Remarques sur la fauna des îles Galapagos. *Comptes Rendus Hebdomadaires Des Séances de l'Académie Des Sciences, 48*, 147–148.

Morris, P. J. (1997). Louis Agassiz's arguments against Darwinism in his additions to the French translation of the essay on classification. *Journal of the History of Biology, 30*(1), 121–134.

Numbers, R. L. (1998). *Darwinism comes to America*. Cambridge, MA: Harvard University Press.

Oxford, P., & Watkins, G. (2009). *Galapagos: Both sides of the coin*. Morgansville: Imagine.

Parent, C. E., Caccone, A., & Petren, K. (2008). Colonization and diversification of Galapagos terrestrial fauna: A phylogenetic and biogeographical synthesis. *Philosophical Transactions of the Royal Society of London, 363*, 3347–3361. doi:10.1098/rstb.2008.0118.

Porter, D. M. (1980). Charles Darwin's plant collections from the voyage of the Beagle. *Journal of the Society for the Bibliography of Natural History, 9*(4), 515–525.

Rothschild, W., & Hartert, E. (1899). A review of the ornithology of the Galapagos islands, with notes on the Webster-Harris expedition. *Novitates Zoologicae, 6*(2), 85–202.

Ruiz, R., & Ayala, F. J. (1999). El núcleo duro del darwinismo. In T. F. Glick, R. Ruiz, & M. A. Puig-Samper (Eds.), *El darwinismo en España e Iberoamérica* (pp. 299–324). Madrid: Universidad Nacional Autónoma de México, Consejo Superior de Investigaciones Científicas, Doce Calles.

Salvin, O. (1868). Enclosure in Salvin's letter to Darwin, 20 June 1868, Darwin Manuscript Collection, Cambridge University Library, available in Darwin Correspondence Project at http://www.darwinproject.ac.uk/letter/entry-6253.

Salvin, O. (1875). On the avifauna of the Galapagos archipelago. *Transactions of the Zoological Society of London, 9*, 447–510.

Stebbins, R. E. (1988). France. In T. F. Glick (Ed.), *The comparative reception of Darwinism*. Chicago: University of Chicago Press.

Stewart, A. (1911). A botanical survey of the Galapagos islands. Expedition of the California Academy of Sciences to the Galapagos islands 1905–1906. *Proceedings of the California Academy of Sciences, 1*(2), 7–288.

Stewart, A. (1912). Notes on the botany of Cocos islands. Expedition of the California Academy of Sciences to the Galapagos islands 1905–1906. *Proceedings of the California Academy of Sciences, 1*(5), 375–404.

Stöcklin, J. (2009). Darwin and the plants of the Galápagos-islands. *Bauhinia, 21*, 33–48.

Sulloway, F. J. (1984). Darwin and the Galapagos. *Biological Journal of the Linnean Society, 21*(1–2), 29–59.

Torres, L. F. (1935). *Darwin en el archipiélago de Colón (Galápagos): Celebración de su centenario*. Quito: Ministerio de Educación.

Van Denburgh, J. (1912a). The snakes of the Galapagos islands. Expedition of the California Academy of Sciences to the Galapagos islands 1905–1906. *Proceedings of the California Academy of Sciences, 1*(4), 323–374.

Van Denburgh, J. (1912b). The geckos of the Galapagos archipelago. Expedition of the California Academy of Sciences to the Galapagos islands 1905–1906. *Proceedings of the California Academy of Sciences, 4*(2), 405–430.

Von Hagen, V. 1935. Letter of Von Hagen to Pedro Pinto Guzman, Dean of the Universidad Central del Ecuador, Guayaquil, September 2nd, 1935. Printed in *Crónicas de la Universidad*. Anales de la Universidad Central LV, 293–298.

Von Hagen, V. 1936. Contribution to the Biology of the Galapago of the Archipelago de Colon (Testudo sps). Anales de la Universidad Central LV2, 296, 579–596.

Von Hagen, V. (1940). *Ecuador the unknown*. New York: Oxford University Press.

Von Hagen, V. 1978. Letter to Mr. G.T. Corley Smith, Rome, June 13, 1978. Retrieved April 10, 2015, from http://www.galapagos.to/TEXTS/VONHAGEN78.HTM.

Wallace, A. R. (1876). *The geographical distribution of animals*. New York: Harper.

Wallace, A. R. (1880). *Island life, or, the phenomena and causes of insular faunas and floras: Including a revision and attempted solution of the problem of geological climates*. London: Macmillan.

Wallace, A. R. (1892). *Island life, or, the phenomena and causes of insular faunas and floras: Including a revision and attempted solution of the problem of geological climates* (2nd and revised ed.). London: Macmillan.

Williams, F. (1911). The butterflies and hawk-moths of the Galapagos islands. Expedition of the California Academy of Sciences to the Galapagos islands 1905–1906. *Proceedings of the California Academy of Sciences, 1*(3), 289–322.

Winsor, M. P. (1979). Louis Agassiz and the species question. *Studies in History of Biology, 3*, 89–117.

Winsor, M. P. (1991). *Reading the shape of nature: Comparative zoology at the Agassiz museum*. Chicago: Chicago University Press.

Wolf, T. (1879). Apuntes sobre el clima de las Islas Galápagos, según las observaciones hechas durante un viaje, en los meses de agosto a noviembre de 1875. *Boletín del Observatorio Astronómico de Quito, 1*(3), 49–59.

Wolf, T. (1887). *Memorias sobre las islas Galápagos*. Quito: Imprenta del Gobierno.

Wolf, T. (1892). *Geografía y geología del Ecuador*. Tipografía de FA Brockhaus.

Wolf, T. (1895). Die Galapagos Inseln. *Verhandlungen der Gesellschaft für Erdkunde zu Berlin, 22*, 246–265.

Chapter 5
Mythologizing Darwin's Islands

Elizabeth Hennessy

> [In the Galápagos] both in space and time, we seem to be brought somewhat near to that great fact—that mystery of mysteries—the first appearance of new beings on this earth.
>
> —Charles Darwin [1845], p. 359

> The Galápagos Archipelago is historically of great scientific importance, since it was its fauna and flora which more than anything else convinced Charles Darwin of the fact of evolution. It provides indeed one of Nature's most clear-cut experiments in evolution, and for this reason, and as a memorial to Darwin's great achievement, its flora and fauna should be studied, preserved and safeguarded.
>
> —Julian Huxley,
> quoted in Eibl-Eibesfeldt (1958a, b)

Other than Down House, no single place is more associated with Charles Darwin today than the Galápagos Islands. Darwin reflected in his published account of the *Beagle* voyage that the islands seemed to hold the key to the "mystery of mysteries—the first appearance of new beings on this earth" ([1845], p. 359). As such, the islands are commonly thought to hold the key to the origins of Darwin's theory of evolution. Nearly a century after the publication of *On the Origin of Species*, Julian Huxley, an evolutionary biologist, the first Director General of UNESCO, and the grandson of Darwin's confidant and "bulldog" advocate T.H. Huxley, wrote that it was the curious plants and animals in the archipelago "which more than anything else convinced Charles Darwin of the fact of evolution" (quoted in Eibl-Eibesfeldt 1958a, b). This quote reflects a popular idea that Darwin discovered evolution in the Galápagos. This discovery narrative is reiterated today by Galápagos travel writing, nature documentaries, and tourism advertising that repeatedly quote Darwin as saying the Galápagos were the "origin…of all my views" (Darwin 1959, p. 7; Stewart 2009).

E. Hennessy (✉)
History Department, Nelson Institute for Environmental Studies,
University of Wisconsin-Madison, Madison, WI 53706, USA
e-mail: elizabeth.hennessy@wisc.edu

D. Quiroga, A. Sevilla (eds.), *Darwin, Darwinism and Conservation in the Galapagos Islands*, Social and Ecological Interactions in the Galapagos Islands,
DOI 10.1007/978-3-319-34052-4_5

This is an appealing story, but a misleading one. Darwin did not discover evolution in the Galápagos Islands. Historians of science have roundly refuted that idea, instead showing that Darwin was only convinced of evolution after he returned from the *Beagle* voyage. They have demonstrated that it was through reflection on his experiences and specimens once back in Britain, as well as his experiments at Down House, that Darwin became convinced of the transmutation of species (Sulloway 1982b, 1984, 2009; Browne 1995, 2002).

If he did not discover evolution in the islands, then why do we associate Darwin with the Galápagos so strongly today? How was this myth created? This chapter argues that what historian Frank Sulloway has called the "Darwin-Galápagos legend" (1984, 2009) emerged in the mid-twentieth century. Although Darwin was certainly influenced by the islands' flora and fauna, the myth that Darwin discovered evolution in the Galápagos is the product of efforts to protect the islands that began in the 1930s and continued through the 1950s. It was in this period, as the centenary of the publication of the *Origin* neared, that US and European naturalists campaigned to establish a research station and national park in the Galápagos. In this chapter, I show how they used Darwin's link to the islands to make their case, arguing that a park would not only memorialize Darwin, but would also protect this "natural laboratory of evolution" for future research.

The chapter demonstrates how the myth was established by detailing the process through which naturalists negotiated the authority to manage the islands in Darwin's name. The evidence presented is drawn mainly from mid-century correspondence among scientists, officials of UNESCO and the International Union for the Conservation of Nature (IUCN), and Ecuadorian diplomats as well as publications concerning conservation efforts in the Galápagos. It shows that the modern association of Darwin with the Galápagos is not the result of an act of scientific discovery in the islands, but the product of a process of rhetorical framing and political negotiations among Western scientists, emerging transnational environmental organizations, and the Ecuadorian government that occurred more than a hundred years after Darwin visited the islands. Thus rather than read Huxley's quote above as a statement of fact, we must read it as emerging from a particular historical context and doing particular political work. Understandings of the Galápagos as Darwin's islands emerged in the context of a resurgence of Darwinian theory with the Modern Synthesis of the 1930s, a rise in field-based ecological research in the early twentieth century, and a turn following the world wars to new forms of transnational governance based on scientific management of natural resources. Investigating the establishment of the Charles Darwin Research Station (CDRS) provides a case study that illuminates the political maneuvering through which this new form of governance was negotiated.

To situate this historical moment, the chapter first reviews work that refutes the Darwin-Galápagos legend, instead tracing Darwin's conversion to evolution to the years after his *Beagle* voyage. It then turns to the Galápagos a century after Darwin's 1835 visit to give a baseline for understanding the reinvention of popular understandings of the islands in the mid-twentieth century. During this period, the Galápagos were on the fringe of the Ecuadorian nation-state and were more widely known as a colony of convicts and political exiles than a "natural laboratory." The scientific

understanding emerged in the 1930s as naturalists used the islands' Darwinian history to advocate for conservation. The chapter details protectionist campaigns in the 1930s, which succeeded in securing legislation but failed to archive a permanent research base, before turning to campaigns following World War II when naturalists succeeded in establishing the Charles Darwin Research Station and Galápagos National Park in 1959.

The founding of the research station and national park is an important historical moment because it was at this point that a shift in the dominant way the islands were understood and managed became institutionalized. Previous to this moment, the Galápagos were not known as a paradise of pristine nature as they are widely portrayed today, but as a cursed, inhospitable landscape. Through their campaigns, naturalists asserted an understanding of Galápagos nature as scientifically valuable and worthy of protection. Foreign scientists aligned the value of scientific research with Ecuadorian desire to consolidate its sovereignty over the islands and make them a productive part of the state. Naturalists framed the new nature reserve as a potential nature tourism destination—and thus as a source of revenue for state economic development. This mid-century shift in the construction of Galápagos nature has subsequently shaped the islands not only through the production of scientific knowledge and conservation work, but also through the development of the tourism industry. Tracing the negotiations through which this occurred illuminates the process through which scientific, cultural, and economic valuations of the islands first cohered in celebrations of the Galápagos as "Darwin's islands."

On the Origin of Darwin's Views

Precisely when, and why, Darwin came to believe in the "transmutation," or evolution, of species has long been a question of popular and scholarly interest. The now-common assertion that Darwin discovered evolution in the Galápagos appears to be supported by a quote from a journal he kept while writing his famous "Transmutation" notebook, which historians pinpoint as where he first recorded evolutionary ideas. In the journal, Darwin wrote that he "Had been greatly struck from about month of previous March on character of S. American fossils — & species on Galápagos Archipelago. — These facts origin (especially latter) of all my views."[1] This quote appears to be a straightforward reflection that locates the inspiration for Darwin's theory of evolution by natural selection in the Galápagos. But historians tell a more complicated story about the origin of Darwin's views.

The Darwin-Galápagos legend turns on the notion that the diversification of species across isolated islands became clear as Darwin observed two key species—the finches and the giant tortoises. But historians have shown that Darwin did not "convert" to evolution upon inspecting the flora and fauna of the Galápagos. Instead,

[1] Journal July 1837, 13 recto. Accessed through Darwin Online project, February 28, 2015: http://darwin-online.org.uk/content/frameset?viewtype=side&itemID=CUL-DAR158.1-76&pageseq=3

detailed examination of his notebooks indicates that he developed the theory of natural selection slowly as he discussed his *Beagle* specimens with taxonomists and naturalists back in England (Sulloway 1982a, b, 1984, 2009; Browne 1995). Indeed, in the short five weeks Darwin spent in the Galápagos during the five-year *Beagle* voyage, he did not make the collections one would expect from someone who was trying to prove a theory about the divergence of species. He stored Galápagos birds from different islands in the same bag, not realizing that the location of each finch and mockingbird would be important, although he did recognize that the mockingbirds differed by island (Browne 2006). This jumble of specimens left something of a mess for ornithologist John Gould to sort out when Darwin returned to England (Sulloway 1982a). It was not until March 1837—about six months after the *Beagle* returned to the UK—that Gould told Darwin that the Galápagos birds could represent distinct types. This was the key meeting that spurred Darwin to realize the evolutionary implications of his Galápagos specimens (Sulloway 1982a, b). But even then, Darwin did not discuss the finches as evidence in the *Origin*, and only added statements about their significance to the second edition of his *Beagle* narrative, the *Journal of Researches*, published in 1845 (Sulloway 1982a). Although today the Galápagos finches are widely known as "Darwin's finches," this phrase was only first published by ornithologist Percy Lowe in 1936 and became widely known when ornithologist David Lack used it as the title of his 1947 book. The retrospective association of Darwin and the Galápagos finches is an example of the mid-twentieth century refiguring of the islands as a Darwinian landscape.

Darwin did not discover evolution in the beaks of finches, nor on the backs of giant tortoises. He did not even make collections of tortoises in the Galápagos, thinking them to have been introduced by sailors. The tortoises the *Beagle* crew did collect they ate, throwing the carapaces overboard (Sulloway 2009).[2] They only brought home four young animals as pets—not sufficient evidence for taxonomist Thomas Bell to make an assessment about whether they were different species, although he did believe them to be native to the islands (Desmond and Moore 1991, p. 220). Darwin had not recognized the full significance of what Galápagos Vice Governor Nicholas Lawson and other "Spaniards" living on the islands told him, which was that the form of the tortoises differed by island. In retrospect as he wrote his *Beagle* narrative, Darwin noted this was likely the product of species divergence due to the isolation of populations on different islands (Sulloway 2009). But he had not collected the necessary evidence from the Galápagos to make his case.

Thus while reflecting on Galápagos specimens was clearly an important source of inspiration for Darwin, his experiences in the islands did not provide a sudden flash of inspiration. The Galápagos specimens were not the singular key to his theory of evolution such as they are often popularly presented today. The origin of Darwin's views on evolution cannot be traced to any single place. Other places and species were also important influences on his thinking—including, as he noted in the introduction to the *Origin*, the distribution of South American rheas and

[2] They likely believed the tortoises to be species introduced to the islands by sailors rather than a native species (Sulloway 1984; Chambers 2006).

Patagonian fossils of extinct mammals (Browne 2006). Historian John van Wyhe traces Darwin's questions about the fixity of species to comparisons of fossilized and living mammals on the South American mainland.[3] Decades of experimentation at Down House and research on domesticated species in Britain provided the bulk of the evidence for the *Origin* (Browne 1995). The first chapter of *Origin* details Darwin's experiments with pigeon breeding to illustrate processes of artificial selection through domestication. It was these experiments and research on domesticated breeding in the UK, rather than his experiences aboard the *Beagle*, from which Darwin pulled the central metaphor of *Origin*—natural selection (Feeley-Harnik 2007). His "conversion" was not made in a shock of discovery, but rather through a process of reflection on firsthand observations, consultations with other naturalists, and experiments at Down House.

If the Galápagos were not the key to Darwin's theory of evolution, then why has the archipelago been singled out as a place particularly associated with him? Other influential locations Darwin described in the *Journal of Researches*, such as Patagonia, are not similarly associated with Darwin today. To answer this question, it is first necessary to review the islands' history following Darwin's visit. Doing so provides a baseline for understanding the shift in popular cultural perceptions of the islands that took place in the mid-twentieth century.

The Origins of Galápagos Conservation

Today, the Galápagos are often framed as a land of "pristine" nature, a place with little history other than Darwin's visit and the exploits of a few early settlers. But while the islands had no indigenous human population, they were not pristine landscapes even when Darwin visited.[4] Instead, this understanding of the islands is a product of the mid-twentieth century campaigns detailed here (see also Hennessy and McCleary 2011). The century between Darwin's visit in 1835 and the founding of the national park and research station in 1959 saw a marked shift in dominant perceptions of the islands—from a cursed landscape to one that holds the secrets of life on Earth. But the interceding period witnessed a variety of different interpretations and uses of the islands. Exploring what today are alternate, ultimately nonhegemonic, understandings of the islands is important to understand the scope of the rhetorical shift conservationists achieved in the mid-twentieth century.

[3] Darwin-Online Project, accessed February 28, 2015: http://darwin-online.org.uk/EditorialIntroductions/Chancellor_fieldNotebooks1.17.html.

[4] Although Darwin noted that island creatures seemed "antediluvian," he neither experienced nor understood the islands as "pristine" wilderness. Darwin relied considerably on local residents during his travels—even noting that it was the Galápagos vice governor and other "Spaniards" who told him that different tortoises could be identified as belonging to different islands based on their morphology. It was through mid-twentieth conservation efforts that the islands were first understood place of "pristine" nature as discourse about the islands as a "natural laboratory" merged with pristine understandings of nature central to histories of American environmentalism.

Before the Galápagos were an endangered landscape, they were known mainly for their harsh, dry landscapes and as a source of tortoises, a popular food source for sailors. After Herman Melville visited in 1842, he reiterated earlier sailors' dark narratives about "*Las Encantadas*" as evilly enchanted isles that seemed to drift in the fog, a curse to becalmed sailors (2002/1854). Even Darwin apparently agreed, noting in his *Journal of Researches*, that "nothing could be less inviting than the first appearance" (Darwin n.d./1845, p. 354). The islands' remote location and little fresh water deterred settlers for centuries. It was not until the islands became an Ecuadorian territory in 1832 that the first semipermanent colony of 200–300 people was established. Geographer Teodoro Wolf, who surveyed the islands on behalf of the state in 1875 and 1878 (see Chap. 3), suggested the islands could support a regular population living off agriculture, coastal fishing, raising livestock, and collecting natural resources including orchilla (a lichen used to make dye) and tortoise oil (1887). Over the next 100 years, such small settler colonies ebbed and flowed, encouraged by the Ecuadorian state as a means of securing its sovereignty in the archipelago. These included Ecuadorian penal colonies, a sugarcane plantation, European exiles who fled the world wars, and efforts to can tuna, tortoise oil, and sea turtles. None of these efforts was particularly successful or resulted in stable industries, yet by the mid-1950s, about 2,000 people lived in the islands.

At the turn of the twentieth century, some of the naturalists who visited the islands in Darwin's wake grew concerned about the impact of settler colonies and feral species on the islands' flora and fauna. Goats deposited on the islands by sailors, for example, competed with tortoises and other native species for sparse vegetation. When US paleontologist Georg Baur returned from the archipelago in 1891, he stressed the urgency of scientific research in the islands: "Such work ought to be done *before it is too late*. I repeat, before it is too late! Or it may happen that the natural history of the Galápagos may be lost, lost forever, irreparably!" (Baur 1891, p. 318 [emphasis in original]).

Naturalists' concerns about native Galápagos species grew along with broader realization of species extinctions in the early twentieth century (Barrow 2009). Both the California Academy of Sciences and Lord Walter Rothschild sponsored major expeditions to the Galápagos to make collections for museums. They thought the tortoises in particular were in danger of extirpation because visitors and settlers relied on them as a primary source of meat and fat to use as cooking oil. At this time, the best way to protect the species for scientific study was to collect specimens to store in metropole museums. Rothschild, convinced that the tortoises would soon vanish, directed his collectors to bring home every tortoise they could find, alive or dead, to "save them for science" (quoted in Rothschild 2008/1983, p. 197).

During the 1920s, as travel to the islands became easier after the opening of the Panama Canal, more field biologists and gentleman naturalists visited the islands for research and pleasure. Their trip narratives, often published in popular and scientific journals, popularized the islands' unique species. Famous New York naturalist William Beebe's 1924 book *Galápagos*: *World's End*, which told a lively narrative of scientific discovery, was perhaps the most widely read of these accounts. The Darwin discovery narrative begins to take shape in Beebe's writing. He notes

that Darwin spent more than a month in the islands and that "from observations on the varying forms of bird life he derived perhaps the first inspiration for his *Origin of Species*. From that day to this, the islands remained almost unchanged…for month after month, and year after year, on most of the islands the reptiles and birds and sea lions knew only each other's forms and alone watched the sun rise and set. Generations of these creatures came and went without ever seeing a human being" (Beebe 1924, p. 60). Beebe frames the islands as scientifically valuable because of their Darwinian history and mostly untouched nature—a rhetorical trope common to later conservationist discourse.

In the late 1920s and early 1930s, naturalists took up the cause of conserving the native species Beebe celebrated. They were alarmed that it was increasingly difficult to find giant tortoises where they once had been abundant. In 1928, the director of the New York Aquarium, Charles Townsend was pessimistic about the fate of tortoises in their homeland. He tried to establish giant tortoise breeding colonies across the southern United States. The effort brought giant tortoises to US zoos, but the animals did not reproduce quickly as Townsend hoped they would. By the early 1930s, naturalists began advocating for in situ protections in the islands. After a century of collecting specimens to be studied in natural history museums, a new generation of field biologists were interested in understanding the biological processes of living animals—which meant studying them in their natural habitats rather than preserved on museum shelves (Kohler 2002).

This shift toward in situ protection meant naturalists would need to contend more directly with other uses of the landscapes they valued as natural habitats for unusual wildlife. But at the time, both in Ecuador and abroad, the archipelago was valued principally for its geopolitical position and the extraction potential of its natural resources. In 1887, Teodoro Wolf had anticipated the completion of the Panama Canal as an opportunity for Ecuador to develop a profitable naval station in the archipelago. The strategic position was not lost on the United States. A 1917 California magazine article put the geopolitical issue starkly: "Whose hands should hold the key to our Canal's western gateway and what are we going to do about it?"[5] A 1929 *San Francisco Chronicle* story reported on a US businessmen's attempts to acquire land rights in the islands because of their proximity to the Panama Canal.[6] Concern about the Panama Canal was not the first cause for US business interest in the islands. During the guano boom of the late nineteenth century, the US government and businesses had attempted to acquire the islands, based on incorrect belief that they could be profitably mined. Such intimations of US might threatened Ecuadorian sovereignty and thus encouraged the government's support of island settler colonies. In the 1930s, the US press was more captivated by tales of eccentric Galápagos settlers than by conservation. A 1937 headline in the *San Francisco Chronicle* extolled "Thrilling

[5] Hodges, G.C. 1917. The Pacific's Key to Panama. *Sunset*: *The Pacific Monthly*, Vol. 39, p. 36. CAS Slevin Files, Box 2, Folder 8.

[6] Trent, E. April 21, 1929. Bay Group Seeks Galápagos Rights. San Francisco Chronicle. CAS. Slevin Files, Box 3.

Discoveries of Strange Animals and Human Exiles" in the islands.[7] The report narrates an ostensibly scientific cruise aboard the *Velero III*, helmed by California oilman G. Allan Hancock, but spends fewer column inches on the endemic species than on the sordid account of a murder mystery surrounding the self-proclaimed German "Empress of Galápagos" and her two male companions. Naturalists who wanted to conserve the islands would have to change the perception of their value.

In the 1930s, field biologists began asserting the scientific value of the Galápagos as justification for their protection to counter what they saw as degrading uses of the islands. They framed the islands as a "natural laboratory" that should be preserved for the study of biology. After a 1932 expedition, an American botanist stressed the archipelago's scientific value, telling an audience "It would appear that there are few places in the world where [evolutionary] problems can be studied under such favourable and unusual conditions—a fact which has led me to call the archipelago Evolution's workshop and showcase" (quoted in Larson 2001, p. 166).[8] Another member of the same expedition called for Ecuador to create a wildlife sanctuary in the islands that would serve as an "outdoor biological laboratory" in what he said were "one of the most amazing natural laboratories of evolutionary processes on earth" (quoted in Barrow 2009, p. 176).[9] This appeal was reiterated in the UK by an ornithologist for whom the Galápagos finches "presented a 'biological problem of first class importance, and that this problem alone would justify the establishment of biological reserves on one or more of the islands" (quoted in Larson 2001, p. 166).[10]

In a scientific world dominated by laboratory-based biological research, field scientists used the *natural* laboratory metaphor to assert the validity of place-based research. This generation of field biologists venerated Charles Darwin as a pioneering field naturalist and sought to emulate his field observations and experiments (Kohler 2002). What better place to do this than in the islands Darwin himself realized only too late were ideal for studying processes of evolutionary adaptation? The idea of a "natural laboratory" reflects the simplified, stripped-down ecology of remote archipelagos, which often have starker environments and many fewer species than comparable continental landscapes. As one naturalist later explained,

> Owing to the remoteness of the archipelago, the number of ancestors is of course very limited. Hence a simplification in the fauna which makes the laws of evolution much easier to distinguish than in the rest of the world, where the complexity of natural phenomena and the multiplicity of ancestors complicate inextricably the tracing of relationships. The Galápagos Islands thus stand out as Nature's experimental station (Dorst 1961, p. 30)[11]

---

[7] Burton, MJ. Capt. Hancock's Thrilling Discoveries of Strange Animals and Human Exiles. *San Francisco Chronicle*, April 11, 1937. CAS Archives, Slevin Papers, Box 3.

[8] J.T. Howell, of the California Academy of Sciences (CAS), following the Templeton Crocker expedition in 1932.

[9] Harry Swarth, CAS Curator of Birds.

[10] P.R. Lowe, British Museum (Natural History).

[11] Jean Dorst was the second president of the Charles Darwin Foundation and later Director of the Paris Natural History Museum. The quote appears in a *UNESCO Courier* article promoting Galápagos conservation efforts.

For these biologists, the island archipelago was an ideal place to understand the role of isolation in the production of variation among species. Yet these same features that made the Galápagos an ideal laboratory—their isolation and relatively low rates of what is now called biodiversity—also made the islands' flora and fauna more vulnerable to change, particularly to competition for resources with introduced species such as goats and pigs. As Darwin had noted in the *Origin*, many "naturalized" or introduced plants and animals had nearly exterminated native species on St. Helena Island (1988, p. 542; also Grove 1995). Because the laboratory metaphor emphasized the stark simplicity of island landscapes, it underscored what is now commonly called the fragility of island ecosystems, contributing to a sense of urgency among naturalists that something would have to be done to ensure the continued survival of Galápagos species for future research (also Barrow 2009).

By casting the archipelago as a natural laboratory, naturalists reframed the value of the islands as a place in which to study *the* central question of biology—as Darwin had put it, the "mystery of mysteries," the origins of new forms of life on earth. Rather than see the islands as an evilly enchanted hell on earth, as Melville had, these naturalists saw stark island environments as a scientific asset. In the mid-twentieth century, their framing of the islands as a natural laboratory emerged as the dominant narrative about the islands. But it was not only with rhetorical flourish that naturalists succeeded in seeing their vision of the islands as a laboratory come to fruition. As the following sections detail, gaining authority to manage the islands as a biological station and nature reserve required years of political negotiations. Through their advocacy, which was motivated by desire to protect the species they wanted to study, these naturalists emerged as the first generation of Galápagos conservationists.

Protecting a Living Laboratory

Calls to protect the islands in Darwin's name first became concrete in 1935 when a US naturalist installed the archipelago's first Darwin statue. A century after the *Beagle*'s arrival in the Galápagos "precisely to the day, month, and year—on September 21, 1935," Victor Wolfgang von Hagen erected a monument to Charles Darwin at the bay where he had first landed on the islands (Von Hagen 1949, p. 215).[12] An avid traveler and naturalist von Hagen was determined to protect the archipelago in Darwin's name. But, as he wrote, "raising the monument was more than an act of biological piety. It was the beginning of a campaign to bring to the attention of naturalists all over the world, and to the attention of the Republic of Ecuador, to which the Galápagos Islands belong, the need for conserving the irreplaceable natural phenomena of the archipelago, and to save from extinction this living laboratory for the study of evolutionary processes" (Von Hagen 1940, p. 96). von Hagen had the support of the American Museum of Natural History and

[12] Von Hagen erected the Darwin bust at Wreck Bay on San Cristobal Island although the *Beagle* first anchored nearby at Cerro Tijertas.

Darwin's only surviving son, Leonard, but had financed the bust himself.[13] It was only a shadow of the Darwin Memorial Expedition von Hagen had proposed, but failed to finance, which would have tracked the *Beagle*'s course along the entire South American coast (Barrow 2009). Instead, von Hagen and his wife spent 6 months surveying the islands, an experience that left him unsatisfied with weak protections for wildlife. He mounted what would be ultimately an unsuccessful 2-year effort to start a biological station in the islands that would have served as a base from which to study and protect them.

Von Hagen was not the first to campaign to protect the islands. By the time he arrived in Ecuador, the government had just put in place the first decree protecting the islands, the result of an effort led by American naturalists and an Ecuadorian diplomat in Los Angeles. In 1934, Ecuadorian President Abelardo Montalvo issued an executive decree calling for the protection of species most threatened by over-collection and industry—including sea lions, fur seals, tortoises, penguins, flightless cormorants, albatrosses, and flamingos—as well as the setting aside of several islands as "inviolate refuges for all forms of zoological life." [14] The decree also called for the establishment of a Darwin Memorial Zoological Laboratory and support for park wardens (Barrow 2009, p. 178). The decree was drafted by American ornithologist Robert T. Moore, who had recently returned from a researching trip to Ecuador, and V.M. Egas, the former Ecuadorian consul in Los Angeles. They recruited well-connected naturalists on the American Committee for International Wild Life Protection, including Harold Coolidge, a Harvard primatologist and stalwart of American conservation.[15] These calls for Galápagos conservation in the 1930s were the first to tie together celebration of Darwin with assertions that the islands remained scientifically valuable as a "living laboratory."

The process of securing approval for these early protection plans reflects the political stakes involved in asserting a scientific vision for managing the archipelago. After the American Committee passed a resolution approving the "Scientific Station at the Galápagos Islands Act," Egas sent the decree on to the Ecuadorian government for approval. Recalling the crafting of this legislation later in life, Coolidge wrote about the negotiation involved with the Ecuadorian government:

> This text was discussed with Dr. V.M. Egas and we decided that the hope of having it adopted by the government depended upon their feeling that he was the person who had conceived the idea and prepared the draft of the document. For this reason, both Bob's

[13] von Hagen to O.J.R. Howarth, nd., BMNH, DF206/159 British Association Galápagos Islands Committee: letters of O.J.R. Howarth, Secretary 1935–1937.

[14] After reviewing the Moore/Egas decree, von Hagen pointed out two problems with it—that it practically precluded commercial activity in all the islands and obligated the foreign contracting party supporting the research station and warden to spend $20,000 by 1941 as well as all the expenses of potential guards. "This statement is so general and so dangerous" von Hagen wrote, "that it would cause the almost definite continuance of deplorable incidents." V. W. von Hagen to H. Swarth, June 27, 1935, DF206/158 British Association Galápagos Islands Committee: minutes and circular letters 1935–1937.

[15] Coolidge directed the Museum of Comparative Zoology and was later founding director of the IUCN and the World Wildlife Fund.

> [Moore's] and my names were carefully excluded, and strong credit must be given to Dr. Egas and his friends in the government who put through the executive decree for protecting endangered species.[16]

Their plan worked. The only major change Montalvo made was to limit foreign cooperation in the establishment of a biological laboratory—a revision that reflects Ecuadorian concern about ceding some of the state's sovereign control over the islands.

A year later, after erecting his Darwin monument, von Hagen began campaigning to strengthen the 1934 legislation and start a research station. The political stakes of the project soon became apparent to him as well. von Hagen "spent … 3 months writing the legislation, conferring with officials, giving teas and cocktail parties in an endeavor to make matters progress the more quickly."[17] He reported that "It is, indeed, a very ticklish political question in Ecuador. My path was full of…diplomatic pitfalls, which I have so far avoided."[18] His aim was to allow foreign intervention in the research station, but following decades of Monroe Doctrine expansionism, including Theodore Roosevelt's seizure of the Panama Canal zone, intimations of American desire for Latin territory were not a hollow threat. Installing a foreign scientific presence on the islands with the authority to enforce conservationist measures was a matter of geopolitics.

von Hagen worked directly from Ecuador to secure local support. He pulled together a group of Ecuadorian professors in a Darwin Memorial Association and a "Corporación Científica Nacional para el Estudio y Protección de las Riquezas Naturales del Archipelago de Colon," (Scientific Corporation for the Study and Protection of the Natural Riches of the Colon Archipelago). He used the cover of both organizations to lobby the state, later explaining that he thought it important for international scientists to have a local board with which to confer about Galápagos matters. While he hoped the group would assuage fears of foreign meddling in internal Ecuadorian affairs, he also acknowledged that the boards were an instrument to solidify his position in Ecuador while opening the door to foreign intervention.[19] Displaying a condescending attitude toward his local counterparts, von Hagen wrote to a foreign naturalist that "there would be no fear of disturbance of the plans of the International Wild Life Association, for these people will soon lose interest and the whole thing will eventually be worked and operated by outside interests."[20] von

---

[16] H. Coolidge to R. Bowman, August 26, 1978, CAS Bowman Papers, Box 6.

[17] To O. J. R. Howarth, Secretary of the British Association for the Advancement of Science. von Hagen to O. J. R. Howarth, nd., BMNH, DF206/159 British Association Galápagos Islands Committee: Letters of O. J. R. Howarth, Secretary, 1935–1937.

[18] Ibid.

[19] von Hagen to H. Swarth, June 27, 1935, DF206/158 British Association Galápagos Islands Committee: minutes and circular letters 1935–1937; also Barrow 2009, p. 179.

[20] Ibid. According to the British consul in Quito, the corporation was little more than a front for von Hagen and did not operate. Mr. Stafford London reported: "I hear … that the Corporation met once with a majority of members, but that at the second meeting only Dr. von Hagen and Dr. Maldonado Carbo, the President, were present. The former tells me the Corporation is completely inactive and that nothing is likely to be heard of it until his return to Ecuador." (Stephen Gaselee (Foreign Office) to Tate Regan, FRS August 20, 1936. BMNH DF1004/361 Expeditions: Galápagos Islands 1935–1960).

Hagen's efforts thus laid the groundwork for foreign scientists—rather than Ecuadorian naturalists—to manage the islands as a "natural laboratory."

von Hagen's lobbying paid off—on May 14, 1936, Chief Executive of the Republic Federico Páez signed another decree that declared most of the major islands national reserve parks and established a provisional committee of directors to be named by the government to supervise the protection of wildlife.[21] The law, von Hagen wrote, "was passed in a last desperate attempt to guard the pitiful remaining fauna of the islands. It permits the cooperation of foreign scientific institutions in making this conservation as effective as possible."[22] It was a "triumph of enthusiasm" and a "modus operandi" for scientific interests in the islands that would facilitate future research. von Hagen later wrote that with this legislation, "for the first time in Ecuador's history, 'foreign intervention' was allowed in the person of qualified naturalists, who would, under a society created for the purpose, erect and maintain a research station on the Galápagos" (Von Hagen 1949, p. 215).

An opening thus secured, von Hagen set to work recruiting foreign naturalists in the United States and the United Kingdom to back his plans for a biological station. While surveying the islands, he had scouted a working farm on Santa Cruz Island that could serve as a station base, but he needed funding and scientific support to build the station. He reached out to leading conservationists, including Hal Coolidge and Julian Huxley (then Secretary of the Zoological Society of London). But his own lack of scientific credibility kept him an outsider to these networks. The well-established naturalists were supportive of plans for a biological station, but did not trust von Hagen's methods or motivations (Barrow 2009). Stafford London, British consul in Quito, reported home to the Foreign Office that "it is difficult to make out whom he represents or why he is so interested in the Galápagos Islands."[23] In the United States, Kingsley Nobel, Curator of Herpetology at the American Museum of Natural History, told Huxley that von Hagen, "is, as you suspect, a promoter rather than a scientist. There are so many things we do not understand about his arrangements that the Museum has been very cautious in backing up his various schemes…"[24] Nobel denied him the status of a scientist, differentiating between the professional status of a qualified biologist and that of an amateur naturalist "promoter."[25]

---

[21] von Hagen to O.J.R. Howarth, nd., BMNH, DF206/159 British Association Galápagos Islands Committee: letters of O.J.R. Howarth, Secretary 1935–1937.

[22] von Hagen to J. Huxley, February 20, 1937. BMNH DF206/160 British Association Galápagos Islands Committee: correspondence with J S Huxley 1935–1937.

[23] H. Coolidge to J. Huxley, September 12, 1935; BMNH DF206/160 British Association Galápagos Islands Committee: correspondence with J S Huxley 1935–1937.

[24] K. Nobel to J. Huxley Jan 23, 1937; BMNH DF206/160 British Association Galápagos Islands Committee: correspondence with J S Huxley 1935–1937.

[25] von Hagen was reportedly educated in Europe (Barrow 2009), but I have been unable to find any mention of specific degrees or institutional affiliations. In 1949, he donated his collected papers to the Yale University archive, which accepted them, although he was not a Yale graduate and the university now has no record of why they were selected as a depository. Following his Galápagos efforts, von Hagen later became a prolific nature and travel writer, publishing 48 books, primarily focusing on Latin America.

von Hagen extended his self-appointed role as Galápagos diplomat, inviting Huxley, and Darwin's grandson, Charles Galton Darwin, to take permanent seats on the governing board of a sanctuary, although it is not clear he had the authority to do this. Both Huxley and Darwin were hesitant to accept. Darwin wrote to Huxley asking him to look into the plan because his previous experience with von Hagen left him distrustful: "as I expect you know, H. has been acting as rather a blight on my family for years now, but his last move looks to be sounder than most he has done… But I cannot see how anything can come of it without a lot of money spent in providing wardens, etc., and also probably bribing people at Quito, and where would it come from?"[26] Huxley concurred, responding that he did not want to commit to a board because the Americans had strongly advised against dealing with von Hagen. Huxley dodged von Hagen's invitation, but did set up a Galápagos Committee through the British Association for the Advancement of Science to investigate the idea of a station.

von Hagen further sullied his reputation when he tried to position himself as a key point of entry for future Galápagos research. He told Smithsonian curators in 1937 that, with the new Ecuadorian decree, they would need a permit from him before conducting research in the Galápagos—a claim that prompted the Ecuadorian Government, the British Committee, and the American Committee to investigate him (Barrow 2009, p. 181). They found that he had faced arrest in Mexico after allegedly forging an official's signature on a research permit to help finance a collecting trip, and that the Better Business Bureau had cited him for bouncing bad checks and failing to return rented equipment (ibid).

von Hagen was effectively closed out of the project he had led as the British committee members discussed plans for managing a biological station. The committee members were concerned about increasing human traffic on the islands and saw the potential station von Hagen proposed as a small undertaking for one man and a couple assistants, not a full-scale scientific laboratory.[27] They were convinced that the warden should be a "qualified biologist" who would not only report

[26] Ibid. [No mention is made in the letter of what von Hagen and Darwin's previous interactions had been.]

[27] While the committee voiced support for a research station, members were skeptical about its operation and the adverse affect a permanent institution might have on the islands. Coordinating British and American approaches, Huxley had written to Moore in 1936 that "We here, by the way, feel that it is not very desirable to have a large biological laboratory on the islands, as this might in many cases lead to destruction of fauna rather than their preservation. The important thing in our view is that there should be an efficient Warden with a scientific training, who would be able to make scientific studies on the natural history and ecology of the islands as well as preventing depredations of the fauna." The memorandum, drafted by H.W. Parker (of the British Museum Natural History), reflected Huxley's concern: "The establishment of a permanent research station of any magnitude would be impracticable on the grounds of finance and might involve an undesirable measure of destruction." J. Huxley to R. Moore, April 7, 1936, BMNH DF206/160 British Association Galápagos Islands Committee: correspondence with J S Huxley 1935–1937; BMNH DF206/158 British Association Galápagos Islands Committee: minutes and circular letters 1935–1937.

offenses, but would also be capable of conducting his own research, issuing research permissions, and making recommendations to the government based on such research. At the AMNH, Kingsley wrote to Huxley of von Hagen's inappropriateness for the role:

> von Hagen claims to have some knowledge of insects but I know for a fact that he has been bluffing considerably in this field. This may be excused on the assumption that von Hagen is a promoter and not a biologist, but how can a non-scientist direct a biological station? It all seems very strange and peculiar to me and also to many others who have made contact with this individual[28]

von Hagen's lack of credibility undermined the effort he put into building a station. The case was further sealed when the Ecuadorian government put an end to von Hagen's diplomatic posturing. It "emphatically disauthorized" him as an official representative because he had overstepped his role by positioning himself as a key member of the sanctuary governing board. von Hagen despaired to Huxley, who had been most sympathetic to the cause, that,

> recent conferences with Museums and individuals who should have toward the Islands a *noblesse oblige*, (for they have sacked the islands of the species), allow me to understand, that any assistance at this time is impossible…I cannot make people understand that it is not years, but months, days, when some yachtsmen shall remove, or some inhabitant kill the remaining species of a rare tortoise or bird.[29]

Despite his mournful rhetoric and reproach for scientific institutions to make amends for their own contributions to declining wildlife populations, von Hagen could not gather enough support for his cause. Ultimately, he left the islands, moving on to a research trip to the Ecuadorian Amazon.

The outbreak of World War II soon overshadowed the station campaign. In 1942, just 5 days after the Japanese attack on Pearl Harbor, the US Military occupied Baltra Island in the archipelago with the "grudging consent of the Ecuadorian government" (Larson 2001, p. 175), and built an air force base from which to defend the Panama Canal. The Smithsonian and American Galápagos Committee attempted to align their desire for a research station as a complement to military endeavors. President Roosevelt supported the effort with a memorandum to his secretary of state, "… I would die happy if the State Department could accomplish something" to protect the Galápagos (quoted in Larson 2001, p. 176), but their efforts were unsuccessful. Following the war, the Americans tried to gain control of the decommissioned air base. At the 1946 meeting of the Pacific Science Conference of the National Research Council, Harold Coolidge and S. Dillon Ripley, then directing Yale's Peabody Museum (and later Secretary of the Smithsonian), led the passage of a resolution recommending the establishment of a base research station in the

[28] K. Nobel to J. Huxley Jan 23, 1937; BMNH DF206/160 British Association Galápagos Islands Committee: correspondence with J S Huxley 1935–1937.

[29] von Hagen to J. Huxley, February 20, 1937 BMNH DF206/158 British Association Galápagos Islands Committee: minutes and circular letters 1935–1937.

islands. But their efforts were trumped by Ecuadorian sovereignty when the state denied a US request for a 99-year lease that would have effectively ceded Ecuadorian sovereignty of the archipelago.[30]

A Darwin Research Station

In the 1930s, von Hagen's campaign and public writing helped to frame the Galápagos as "the islands that inspired Darwin's mutation theory."[31] After World War II, a new generation of young biologists working in the islands picked up the cause of Galápagos conservation. As they worked through leading conservation organizations to protect the islands, their efforts solidified the "Darwin-Galápagos legend" by founding an island research station in the great naturalist's name. In the 1950s, well-connected scientific groups articulated a vision for managing the Galápagos that combined the islands' scientific, cultural, and economic values with conservation goals. Public rhetoric casting the Galápagos as a Darwinian landscape full of unusual and endangered species was central to this success. But as it had been in the 1930s, the process depended not only on rhetoric, but was rife with political negotiations—between international conservation groups and the Ecuadorian government as well as among the naturalists themselves.

These renewed efforts began with two young scientists—Austrian Irenäus Eibl-Eibesfeldt, who visited the islands on a marine biology expedition in the early 1950s, and Canadian–American Robert Bowman, who had done his dissertation research on the evolution of song among Galápagos finches in 1952–1953. Following their trips, both Eibl-Eibesfeldt and Bowman wrote to the International Union for the Conservation of Nature (IUCN) in 1955 to voice concern about extirpation of native species and to push for a research station. This time, naturalists' efforts would succeed.

Bowman's and Eibl-Eibesfeldt's letters reached a receptive audience at the IUCN, a recent spin-off of UNESCO. UNESCO and the IUCN emerged as institutions that exemplified a changing climate following the wars, reflecting both faith in scientific progress and peaceful intervention designed to save the world from the ravages of war and poverty. Julian Huxley, Director General of UNESCO in the late 1940s, remained supportive of Galápagos conservation efforts. The research station fit his vision for UNESCO's mission to achieve progress through scientific enlightenment. An advocate of what he called "evolutionary humanism," Huxley outlined a philosophy for UNESCO based on "a scientific world humanism, global in extent and evolutionary in background" (quoted in Larson 2001, p. 180). He believed UNESCO should "relate its ethical values to the discernible direction of evolution, using the fact of biological progress as their foundation" (ibid). For Huxley, the Galápagos

[30] Manuel María Borrero, Informe de la Comision de Relaciones Exteriores, 18 December 1944, *Documentos de la Occupación del Archipelago de Galápagos*, *1940 a 1944*, *Tomo I*, G.3.4.1, Archivo del Ministerio de Relaciones Exteriores, Quito, Ecuador, 33pp.

[31] von Hagen, V.W. Auckland Star. November 21, 1936. Islands that Inspired Darwin's Mutation Theory: Mysteries of the Galápagos Group. CAS, Slevin Papers, Box 2.

project would protect wildlife, encourage study of evolution, and educate the public about both, fulfilling a scientific, conservationist, and cultural purpose.

In 1956, the IUCN secured an invitation from the Ecuadorian government for an exploratory mission to Galápagos. For the government, the mission was a well-timed opportunity to back its claims to the islands with scientific authority. That year, a film about Norwegian explorer Thor Heyerdahl's recent archeological expedition to the Galápagos was screening in European cities. The film buttressed Heyerdahl's theory that the Polynesian Islands were originally populated by migrants from South America. In the Galápagos, Heyerdahl's team found pottery shards that Peruvian scientists matched to similar artifacts of the Chimú people of coastal Peru. Ecuadorian diplomats saw the film—which made no reference to the islands as an Ecuadorian territory—as a Peruvian attempt to use modern science to make a historical claim to the archipelago, which was then particularly desirable for its lucrative fisheries.[32] After this episode, the government welcomed the IUCN's recognition of its sovereignty among the international scientific community.

With the government's support, UNESCO arranged to send Eibl-Eibesfeldt on a "first mission of reconnaissance" to investigate the feasibility of establishing a research station (Bowman 1960a, p.8). American conservationists pulled together funding to send Bowman along as well. Well aware of the value of publicity for their cause, they also sent a photographer and illustrator for *Life* magazine.[33] Arriving in July 1957, the four men spent four months "on the trail of Darwin," as one newspaper report put it, surveying the islands with the help of local guides and an Ecuadorian navy boat (Behrman 1957, p. 6). They visited every major island and several small islands—16 in all. By the end of the trip, Bowman and Eibl-Eibesfeldt had located the "ideal spot" for a biological station at Tortuga Bay on Santa Cruz Island in the center of the archipelago: "a bay about three-quarters of a mile wide, a most beautiful spot which provides a number of interesting biotopes. There are mangrove swamps and sand beaches, surf-beaten rocks, lagoons with flamingoes and a luxuriant untouched cactus forest beyond" (Eibl-Eibesfeldt 1960, p. 27).[34]

The magnificently illustrated *Life* story that followed the mission was full of allusions to the islands as a "Darwinian treasure."[35] Indeed, it was the second part of a yearlong series of stories on Darwin and evolution. One headline declared that the "Land of mystery gave Darwin a living theater of evolution" (Barnett 1958, p. 57). The story narrated—incorrectly—Darwin's mind-set as the *Beagle* approached the islands: "He was convinced of the *fact* of evolution, but had not yet deduced its processes. On the remote Galápagos archipelago he was to find the clue" (Barnett 1958, p. 68). Although the article later clarifies that Darwin "enjoyed no lightening flashes

[32] *Estudios Sobre Galápagos*, *April 1956–January 1957*. Archivo Reservado, Departamento de Fronteras, G.3.4.4, Ministerio de Relaciones Exteriores, Quito, Ecuador.

[33] These men were nature photographer Alfred Eisenstaedt and illustrator Rudolf Freund.

[34] The planned site at Tortuga Bay proved inaccessible—the thick underbrush made it impossible to clear a road with available tools—so the station was later relocated to a plot along the beach on the eastern edge of the settlement at Puerto Ayora.

[35] Barnett, L. Sept. 8, 1958 "The Fantastic Galápagos: Darwin's Treasure of Wildlife" *Life*. Chicago.

of revelation," the rhetoric in this popular American magazine helped to establish the discovery narrative that establishes the Galápagos as the key to Darwin's theory. The story goes on to explain that "It was through his observations in the Galápagos…that Darwin could see evolution at work not in the antique fossil past, but in the living present." From this conclusion, the author moves directly into a plea for conservation, briefly discussing the reconnaissance mission to the islands and clearly linking the islands' Darwinian value with modern science and the need for protection.

The reports Bowman and Eibl-Eibesfeldt submitted to the IUCN were more somber if no less dedicated to the need for conservation. Each outlined its author's concerns and suggested plans, reiterating earlier pleas for protection and advocating a research station as the best means to ensure conservation. The bulk of both reports discussed evidence for concerns—biological intelligence Eibl-Eibesfeldt and Bowman gathered about the status of native fauna and the threats that endangered them, from foreign fisheries to settler colonies and their introduced goats, pigs, and dogs. Eibl-Eibesfeldt stressed the need for a permanent presence in the islands, positioning a biological station as a center of conservation enforcement and research, as had his predecessors in the 1930s:

> Everywhere in the world laws alone have proved to be insufficient to protect animal and plant life; control of the area and enforcement of the law are always necessary. If control is to be effective in the Galápagos throughout the year, a base is required and the most urgent step is the establishment of a biological station. The fauna can then be surveyed periodically and every decrease and increase of the animal population noted (Eibl-Eibesfeldt 1960, p. 25).

As primary justifications for a research station, Bowman listed the importance of the archipelago to Darwin's work on evolution, the destruction of unique life forms, the threats posed by settlers and tourists, and the "impediment to scientific study… due to lack of basic facilities on the islands" (Bowman 1960a, p. 36). In his view, a research station would serve four functions: (1) assist in the protection of the Galápagos biota; (2) serve as a center for biological and other scientific research; (3) commemorate the visit of Charles Darwin to the Galápagos Islands; and (4) serve as an example of international cooperation in the preservation of the natural resources (ibid). For these scientists, a research station would help ensure wildlife protection and facilitate their own access to do research in the Galápagos—making difficult field conditions on the islands more livable. Creating a station in Darwin's name would also firmly place modern research in his legacy.

Bowman's and Eibl-Eibesfeldt's reports were published by UNESCO and formally presented to the International Congress of Zoology in 1958. Although it was an unorthodox situation, the Congress adopted a resolution on their behalf and created a Galápagos committee to see that the suggestions were carried through.[36]

[36] Hal Coolidge later recounted to Bowman the politicking that went into this resolution: "I also recall the preparation of the resolution at the International Zoological Congress in London where Van Straelen and Ripley played a strong role in getting the resolution about the Station adopted. It was not customary for Zoological Congresses to adopt resolutions and it took a great deal of lobbying effort to get this resolution put through. There was no question about enthusiastic support for it, but we had to overcome some stubborn bureaucratic and procedural objections." H. Coolidge to R. Bowman, August 26, 1978, CAS Bowman Papers, Box 6.

This international committee included several prominently placed scientific environmentalists, chief among them Julian Huxley, who acted as chairman, but primarily lent his name for stature and publicity. Luis Jaramillo, Ecuador's permanent delegate to UNESCO, represented the state and was a key figure in securing government support. Belgian Victor Van Straelen, a former vice president of the IUCN, served as president.[37]

In Ecuador, the national commission for the International Geophysical Year presented a project to reform the 1936 law to the National Congress after a 1958 trip to the islands. This effort was led by Cristobal Bonifaz Jijón, who would become Ecuadorian ambassador to France in 1961 and, with Jaramillo, the only other Ecuadorian on the original board of the Charles Darwin Foundation. In Paris, Bonifaz stressed the international scientific value of the islands during a UNESCO meeting, saying that their privileged position at the junction of El Niño and Humboldt currents would allow scientists to better understand the history of the formation of the islands and their surrounding oceans.[38]

Despite celebrations of international collaboration on the station project, geopolitical issues surfaced again as IUCN officials set to work on the logistics of foreign presence in the islands. They secured an official Ecuadorian request for technical assistance and applied for capital funds to begin construction. But the chief issue would be getting land rights.[39] Even with the credible backing of elite transnational scientific institutions, securing official authority in the Galápagos was a political challenge. As Bowman explained, it would be

> a delicate diplomatic project which must not be forced, since in effect it means that an outside agency (albeit international in membership) wants to have authority to regulate some of the "internal" affairs of Ecuador. It is as if the [committee] wanted the United States Government to turn over authority to prohibit dams, etc., in our National Parks.[40]

While the islands had never been central to state politics or development strategies, the Ecuadorian state was interested in maintaining its sovereign control and sensitive to foreign, particularly American, interest in the Galápagos. As one committee member explained,

> One of the difficulties in all of this is the attitude of the Ecuadorians themselves. People in Europe have gathered that the Ecuadorians are extremely reluctant to commit themselves to the project and that this reluctance is based on politics in Ecuador and the control of the

[37] Also involved were Jean Dorst, director of the French Natural History Museum, Hal Coolidge, Sir Peter Scott (who later lead the WWF), S. Dillon Ripley, and Jean-Georges Baer, then president of the IUCN. Bowman was also on the committee, serving as Secretary for the Americas.

[38] Embajador Ecuatoriano en París expuso en UNESCO importancia de Galápagos. *Diario del Ecuador*, 29 October 1961, p. 6.

[39] Jorge Espinosa (Government of Ecuador Ministry of Foreign Affairs) to Luther Evans (Director General of UNESCO), February 19, 1958; A. Balinski (Ecuador Permanent Representative to UNESCO) to R. Galindo (Chief, UNESCO Bureau of Relations with Member States), May 30, 1958; R. Galindo to J. Dorst, November 12, 1958, UNESCO Archives, 551.46 A5/01 (866) AMS/TA Marine Sciences—Research Station, Part II: from 1.6.57, Galápagos Isles, Ecuador, Part.Prog. & TA.

[40] R. Bowman to N. Rothman, November 21, 1960, CAS Bowman Papers, Box 8.

> military who view the islands in terms of strategy of their own. There is also, of course, the usual tendency of South Americans to resentment of 'Norte Americanos.'[41]

To allay charges of American monopoly, the appearance of an international effort to protect the Galápagos was necessary. Bowman explained this in a letter to a supporter, Norma Rothman, of the Philadelphia Herpetological Society (PHS). When Rothman approached Bowman about an outreach campaign in support of a potential research station, he hesitated to accept, explaining that,

> One thing is certain, if the Ecuadorians think for a moment that the Americans are monopolizing the [committee] or in any way trying to pressure the Government unduly, the whole affair will backfire. This is why I fear that many of the members of the Executive Council of the [Galápagos Committee] will wish not to associate with the PHS resolution, *unless* there are similar popular movements in several foreign countries. Otherwise the Ecuadorians will conclude that the [committee] is really a pressure group from the US using the [Galápagos committee] as a pseudo-international front. Our goals are too important for us to risk the whole project at this point, no matter how sincere the PHS may be…[42]

Because of the "many foolish and ill-advised [American] schemes proposed for Galápagos," Bowman felt that the United States could not "take over the driver's seat."[43] While committee members agreed that American involvement in the administration of a research station would be essential for funding purposes—to make the station eligible for US government grants—they recognized the need for an international appeal and Ecuadorian political support. To guard against interpretations of the Darwin Foundation as a "pseudo-international front" required the umbrella of the IUCN and UNESCO to provide legitimacy as an undertaking of transnational governance in service of the state rather than an institutionalization of American power over the eastern Pacific.

But geopolitics were not the only problem—maintaining the international consortium also was a struggle. Despite concerns about monopoly, the Americans strove to assert their role in the project. Bowman in particular felt sidelined by Europeans in the IUCN, complaining to Coolidge in 1959 that "intrigue" in the organization "may ultimately lead to the downfall of the whole project if something isn't done immediately to get the situation cleared up":

> Correspondence between Prof. Heim [Head of IUCN], and various other European collaborators lead me to believe that the Americans are going to be kept rather removed from the planning and developing of the Galápagos Station. The basis of this deeply rooted feeling against the Americans is unknown to me…I fear that the tremendous enthusiasm which I have seen throughout the U.S., and particularly in California, for the Darwin Station is being misinterpreted abroad in some quarters, as an attempt to monopolize the project. Since the U.S. is geographically so close to Galápagos, since many of the tuna boats regularly fish Galápagos waters, and since most of the scientific collections from Galápagos are in American institutions, particularly Californian, it would be unwise diplomatically as well as administratively, to ignore the American group.[44]

---

[41] S.D. Ripley to R. Bowman, November 4, 1958, CAS Bowman Papers, Box 8.

[42] R. Bowman to A. Eglis, November 26, 1960, CAS Bowman Papers, Box 8.

[43] R. Bowman to N. Rothman, November 21, 1960, CAS Bowman Papers, Box 8.

[44] B. Bowman to H. Coolidge, October 31, 1959, CAS Bowman Papers, Box 6.

While Bowman felt sidelined by European–US politicking, his own attitude toward Ecuadorians also became an issue. In a joust of bickering, Eibl-Eibesfeldt accused Bowman of having "a quite arrogant attitude toward the Ecuadorians"—"I think he did not realize yet that *Ecuador* is going to build a station on Galápagos with international help."[45] In 1960, Hal Coolidge was forced to ask Bowman frankly whether he had ever published anything that might be read as disturbing to Ecuadorian authorities and jeopardize his ability to return to the islands.[46] Although Bowman denied to Coolidge publishing "un facheux article" (as Heim had put it), he did acknowledge in a letter to Rothman that his initial letter to the IUCN in 1955 "was much criticized for its frankness." He noted, however, that "as it turned out, my comments about Ecuador (given in confidence) turned out to be true."[47] Bowman's condescension, while not uncommon, betrays an attitude of superiority that was central to scientists' assertions that they knew best how to manage the islands and justifications for intervening in what they perceived as Ecuadorian mismanagement of this treasured Darwinian landscape. Despite Eibl-Eibesfeldt's reproach that it would be Ecuador that built the station with international help, correspondence among US and European naturalists makes clear that the station project was their undertaking for which they needed to secure Ecuadorian approval—hence why they considered Bowman's condescending attitude a potential threat to good relations.

---

[45] I. Eibl-Eibesfeldt to T. Grivet 12-1-1958. UNESCO Archives. 557.46 (866) AMS/ Galápagos. Bowman may have been particularly sensitive to US–European politics because of his strained relationship with Eibl-Eibesfeldt. Following their joint reconnaissance mission, relations between the two soured. Their plans to write a joint report to UNESCO fell apart after Eibl-Eibesfeldt reprimanded Bowman for his condescending attitude toward their Ecuadorian government hosts—Bowman wanted to request a formal apology from Ecuador when arrangements for their return flight to Ecuador from the Galápagos were postponed for several weeks. Eibl-Eibesfeldt took his concern that this diplomatic misstep could cost the project to officials at UNESCO, reporting that,

"…I wrote him that he should not ask for an official apology as a member of the UNESCO mission… I feared the Ecuadorian government to get annoyed and uninterested in the station project." (I. Eibl-Eibesfeldt to T. Grivet 12-1-1958. UNESCO Archives. 557.46 (866) AMS/ Galápagos).

Eibl-Eibesfeldt's UNESCO contact concurred that Bowman had never been an official representative and was certainly not authorized to demand an apology in the organization's name. (Ibid., Eibl-Eibesfeldt and Grivet correspondence.) After agreeing to write individual reports, Bowman accused Eibl-Eibesfeldt of plagiarizing his report and criticized him for taking full credit for the station plan, virtually erasing Bowman's role in the reconnaissance mission. (In letters, Bowman and Rothman discussed a book Eibl-Eibesfeldt published on Galápagos and the mission in which he positioned himself as a nearly solitary explorer and the mastermind of plans for a research station. Bowman surmised, "Eibl is mainly concerned in promoting Eibl and using the Galápagos as his front." [Bowman to Rothman, March 29, 1961 CAS Bowman Papers, Box 8]) The conflict between them lasted for years—even to the extent that the two were never concurrently on the CDF board—demonstrating the difficulty of organizing international collaboration.

[46] Coolidge to Bowman, Feb 6, 1960. This was a potentially serious threat considering that Bowman's research focused on Galápagos finches.

[47] R. Bowman to H. Coolidge, February 11, 1960, CAS Bowman Papers, Box 6; R. Bowman to N. Rothman May 1, 1961, CAS Bowman Papers, Box 8.

Despite the trials of holding the network together, the committee succeeded in winning Ecuadorian support for a research station during a 1958 follow-up mission. But the situation was complicated when UNESCO's legal department stipulated that it would be inappropriate for either the organization or the lead envoy Jean Dorst, as a private citizen, to sign agreements with the Ecuadorian state. To solve this bureaucratic problem, committee president Victor Van Straelen organized an official entity, the nongovernmental Charles Darwin Foundation (CDF), under Belgian law to act as signatory and collect funds for the station project. The Galápagos Committee established at the International Zoological Congress became the founding board of the CDF.

On July 4, 1959, the Ecuadorian government issued an executive decree establishing an emergency law that declared the Galápagos to be "zones of reserve and National Parks." The decree officially recognized the Charles Darwin Research Station, to be administered by the CDF, and empowered it with the authority to determine what zones would be deemed reserves as well as which species needed protection, and which needed to be controlled. It also prohibited new colonization in areas determined by the CDRS.[48] With this decree, the committee secured scientific management of the islands with the cooperation of Ecuadorian military and civil authorities.

Over the next few years, Van Straelen and the committee worked to cement the achievement, pulling together funds from various scientific entities to send down a director and begin construction of the station.[49] Five years later, in 1964, the station was officially dedicated in a ceremony that brought together many of the Americans, Europeans and Ecuadorians who had worked to make the Charles Darwin Research Station a reality. At the ceremony, representatives of the military "junta" then governing the state awarded Van Straelen, Bowman, and other scientists medals of

[48] The decree read, "CDRS is hereby empowered to determine the zones of reserve of national monuments, without restriction of area, on the following islands: Santa Cruz, Isabela, Espanola, Santa Fe, and others…

… to determine the species of the fauna and flora that must have priority in protection and which are at present in danger of extinction

…authorized to take all steps considered appropriate, with the support of the Military and Civil authorities, for the control and extermination of animals, either native or introduced that have become a menace and are altering the environmental conditions required for the conservation and perpetuation of the insular fauna and flora

Any type of spontaneous colonization of the islands for the purpose of farming, burning or exploitation of the trees for lumber and charcoal is hereinafter prohibited on those areas so determined by the CDRS." (1959 Decree: Junta Militar de Gobierno, Executive Decree No. 523. CAS Bowman Papers, Box 3.)

[49] To make the station a physical as well as legal reality, UNESCO funded building equipment as well as the salaries of station directors through direct technical assistance. The Ecuadorian Government and various scientific and conservationists organizations in the USA and Europe, including the WWF and NYZS, were also major supporters. Eventually, the foundation settled on a plan to raise capital by leasing research tables at the station to organizations that would sponsor science in Galápagos—Max Plank, the Royal Society of London, the Smithsonian, and the Belgian Ministry of National Education—an arrangement that lasted for nearly 20 years. Although it took time for these funds to be established, the money eventually allowed the foundation to complete plans that had been in the making for decades.

honor for their efforts (Larson 2001). The government signed an agreement with the Charles Darwin Foundation to serve as the official scientific advisor to the state for Galápagos for the next 25 years, effectively securing the naturalists' ability to manage the majority of the islands.

Profiting from "Darwin's Galápagos"

Securing authority from the state to manage the archipelago was not purely a matter of convincing authorities of the value of scientific knowledge to be produced there or the cultural importance of commemorating Darwin. Naturalists offered the state a new way to benefit from the archipelago economically. As Bonifaz wrote in 1963, "Economically, we have the right to think that today's studies, in many cases, will be sources of wealth in the future." He suspected this wealth would come in the form of development of the archipelago's fisheries, where "scientific work will have immediate industrial use."[50] An editorial in *El Comercio*, one of the state's leading newspapers, in 1961 supported the research station project because of the recognition it would bring to the state:

> The Galápagos marine biology station will elevate the name of our country in all latitudes and environments. In the shadow of this scientific work can be developed a form of organized and controlled tourism that looks and collaborates, but does not destroy, the rare examples of marine and terrestrial life here safeguarded by an exceptional conjuncture of circumstances not found anywhere else on the planet.[51]

Foreign naturalists focused more on state interest in tourism than fisheries development to convince the government of the profitability of conservation. Bowman, for example, wrote to Rothman, explaining that the "greatest hopes" of Ecuadorian minister in charge of island colonization

> [were] in tourism, once a first-class hotel is built. Unfortunately, these people do not realize that the main reason people come to Galápagos is to see the giant cacti, the unusual reptiles, tropical penguins, etc., not because of the cultural attributes of the people, institutions, etc. It (the islands) are classical ground because of Darwin's visit. Ruin the biota, and there is nothing left. Iguanas, tortoises, etc. *are* Galápagos. We need to make this point, I think, in the resolution. Present policy on Galápagos is to pay little attention to the natural elements, which will in future attract tourists.[52] [emphasis in original text]

As Bowman articulated, the key for the network would be to make the Galápagos synonymous with its fantastically unusual creatures. In this quote, he translates the archipelago's scientific value based on a Darwinian imaginary of Galápagos nature into an economic value through tourism. This strategy fit well with Huxley's mission for the national park as a place to educate world publics about evolution.

---

[50] Cristobal Bonifaz, "El Ecuador y Las Islas Galápagos" *Noticias de Galápagos*, UNESCO and Charles Darwin Foundation, No. 1, July 1963, p. 3.

[51] "En las Islas Galápagos," *El Comercio*, October 16, 1961, p. 4.

[52] R. Bowman to N. Rothman, November 21, 1960, CAS Bowman Papers, Box 8.

The CDF naturalists were not the only ones to recognize the appeal of tourism revenue. A member of the PHS involved in the outreach campaign wrote to Bowman with a strategy for convincing the government:

> My personal feeling in this matter is that we can expect little action from the Ecuadorians on the basis of an "Ecuador Should Save its Tortoises as Europe Saved Its Cathedrals" type of appeal. We should persuade the Ecuadorian government that colonization of the archipelago won't pay off in the long run, that there is something in it for Ecuador to have a strictly supervised system of wildlife refuges… Improving air transportation should be held out as an aspect that will make a sort of "controlled tourism" of Colon Territory feasible in the future. Strictly guided by rangers, tourism could be undertaken on the four large Western islands…We simply must make this look economically advantageous to the Ecuadorians or they won't heed our proposals.[53]

Bowman replied that he "could not agree more fully," stressing again that the islands should be valued for their nature:

> That the colonization of Galápagos will not succeed financially, should be the key issue. All attempts in the past (with the notable exception of the U.S. military base of WWII) have failed, and every new scheme results in more and more destruction of the very things that make Galápagos an attractive site for tourists. Galápagos *means* marine iguanas, giant tortoises, tree-like cacti, flightless birds, lava and firey volcanoes, among other things. To destroy these is to destroy Galápagos, for then there is no reason for anyone to go to Galápagos, except to witness what ill-advised projects can do to destroy a jewel once world renowned.[54] [emphasis in original text]

To Bowman's mind, they needed to convince the government that extractive settler colonies would not succeed and that the islands should be valued for what they *really* were—synonymous with their endemic species and the stark landscapes that produced them. In his report to UNESCO following the reconnaissance mission, Eibl-Eibesfeldt had questioned human settlement in the islands: "On the whole colonization conflicts with nature protection. How can both interests be reconciled and what are the prospects?" (1960, p. 22). As he predicted, ecotourism provided a solution (Larson 2001). It would not only provide a source of revenue, but would also reinforce a Darwinian understanding of the islands as tourists came to see the species said to have inspired.

The potential for Galápagos tourism was first officially acknowledged in the 1964 decree signed with the dedication of the CDRS. Selling the islands as a Darwinian landscape was central to marketing strategy. A 1967 brochure from what today remains one of the leading Galápagos tour companies, Linblad Expeditions, advertised trips as an opportunity to experience "Darwin's Galápagos."[55] The first commercial cruises offered in the islands began in 1969.[56] The naturalists had successfully converted the Ecuadorian state to their goal of

[53] A. Eglis to R. Bowman, November 13, 1960, CAS Bowman Papers, Box 8.

[54] R. Bowman to A. Eglis, November 26, 1960, CAS Bowman Papers, Box 8.

[55] CAS Galápagos Boxes News clippings.

[56] Indeed, ecotourism scholar Martha Honey cites the Galápagos as the first modern ecotourism destination (1999). Although this might have ushered in a new era of tourism, it was in many ways a continuation of early twentieth century luxury yachting trips to the archipelago.

conserving this "natural laboratory" by making the islands economically valuable only if they were protected. In this conservationist model of commodification, nature was simultaneously made valuable to capital and science.

In the 1960s—a period with little island infrastructure and no regular flights to the islands—it is unlikely that naturalists could have foreseen how successful Galápagos tourism would become. They could not have imagined that 50 years in the future more than 200,000 tourists a year would stroll down Darwin Avenue to visit the research station they had only just begun constructing. But the growth of the tourism industry is an important legacy of this period of protectionist advocacy. Conservation and tourism development, which are now often framed as contradictory forces in the Galápagos, emerged from the same historical moment as naturalists campaigned to manage the islands as a Darwinian landscape that should be protected.

Conclusion

By the mid-1960s, rhetoric locating Darwin's discovery of evolution in the Galápagos had become increasingly common. In a quote that clearly illustrates the "Darwin-Galápagos legend," Julian Huxley celebrated a 1966 collection of Galápagos research papers by asserting that "It was on the Galápagos…that Darwin took the first step out of the fairyland of creationism into the coherent and comprehensible world of modern biology; for it was here that he became fully convinced that species are not immutable—in other words, that evolution is a fact" (Huxley 1966, p. 3). Reading quotes like these as emerging from a particular historical and political context sheds light on the process through which the myth that Darwin discovered evolution in the Galápagos was constructed. The point of unpacking the creation of the Darwin-Galápagos legend is not to assert that the islands were insignificant to Darwin nor that they should not be conserved. Instead, tracing the creation of this popular myth to the mid-twentieth century allows us to understand Galápagos conservation efforts in their broader geopolitical context. It allows us to see how the political work of naturalists shaped new forms of transnational environmental governance that emerged following the world wars.

Discourse like Huxley's quote above both reframed popular understandings of the islands as a scientifically important site and served to support naturalists' political efforts to found a research station in the islands. Naturalists' assertions that the islands should be conserved and studied in memorial to Charles Darwin drew from his quotes reflecting on the significance of his fieldwork in the islands as well as the lasting scientific value of the observations he made there. But it was the early twentieth century resurgence of Darwinian theory with the Modern Synthesis and the birth of the fields of ecology and later island biogeography that made the Galápagos a relevant scientific landscape for a new generation of scientists. For these naturalists, the Galápagos constituted a "natural laboratory" where the stark, isolated landscapes and limited species made processes of species diversification more readily

visible. To protect these fragile landscapes and secure their access to do research there, naturalists used Darwin's history in the islands to make their case for their continued scientific importance.

Recasting the islands as a Darwinian landscape was a feat not only of rhetoric, but also of political negotiations among naturalists, new transnational institutions, and the Ecuadorian state. Reframing the value of the islands from a cursed backwater, refuge for exiles, or locale of geopolitical significance to a site of primarily environmentalist and scientific value required decades of advocacy. It was through political negations that an understanding of the islands as scientifically, culturally, and economically valuable because of their link with Darwin congealed. Framing the islands as a Darwinian natural laboratory was a rhetorical strategy through which to articulate different visions of the islands as a scientifically significant site, a place to be conserved, a cultural memorial, a living museum, and a source for revenue generation through tourism.

Understandings of the Galápagos as a Darwinian landscape has shaped subsequent management of the islands over the past 50 years. The Charles Darwin Research Station and Galápagos National Park have facilitated decades of scientific research and conservation efforts and have regulated the growing tourism industry. Although today it seems counterintuitive, the evidence presented here demonstrates that conservation and tourism development—which today often are framed in popular writing as competing forces doing battle in the islands—both emerged from the same historical moment. The mid-twentieth century was a key turning point in which the archipelago was reinvented as "Darwin's islands"—an assertion that rests on a myth about scientific discovery, but which has had very real material consequences.

References

Barnett, L. (1958, September 8). The fantastic Galápagos: Darwin's treasure of wildlife. *Life,* 56–76.

Barrow, M. (2009). *Nature's ghosts: Confronting extinction from the age of Jefferson to the Age of ecology*. Chicago: University of Chicago Press.

Baur, G. (1891). On the origin of the Galápagos Islands. *American Naturalist, 25*(1), 307–319.

Beebe, W. (1924). *Galápagos: World's end*. New York: G.P. Putnam.

Behrman, D. (1957, July 29). On the trail of Darwin in the Galápagos. *UNESCO Futures 247*, 6–7.

Bowman, R. (1960a). *Report on a biological reconnaissance of the Galápagos Islands during 1957*. United Nations Educational, Scientific, and Cultural Organization, 65.

Browne, J. (1995). *Charles Darwin: Voyaging*. Princeton, NJ: Princeton University Press.

Browne, J. (2002). *Charles Darwin: The power of place*. Princeton, NJ: Princeton University Press.

Browne, J. (2006). *Darwin's origin of species: A biography*. New York: Atlantic Monthly.

Chambers, P. (2006). *A sheltered life: The unexpected history of the giant tortoise*. Oxford: Oxford University Press.

Darwin, C. (1959). Darwin's journal. In G. de Beer (Ed.), *Bulletin of the British Museum Natural History Historical Series* (Vol. 1).

Darwin, C. (n.d.). *Voyage of the Beagle round the world*. New York: Tess Press. (Original work published 1845)
Desmond, A., & Moore, J. (1991). *Darwin*. New York: Warner Books.
Dorst, J. (1961). Where time stood still: The Galápagos Islands their prehistoric creatures. *UNESCO Courier*, 28–32.
Eibl-Eibesfeldt, I. (1958, January). Galápagos: Wonders of a Noah's Ark off the coast of Ecuador. *UNESCO Courier*, 19–23.
Eibl-Eibesfeldt, I. (1958b). *Survey on the Galápagos Islands* (p. 46). Brussels: UNESCO/IUCN.
Eibl-Eibesfeldt, I. (1960). *Galápagos*. London: Macgibbon & Kee.
Feeley-Harnik, G. (2007). An experiment on a gigantic scale: Darwin and the domestication of pigeons. In R. Cassidy & M. Mullin (Eds.), *Where the wild things are now: Domestication reconsidered* (pp. 147–182). New York: Berg.
Grove, R. (1995). *Green imperialism: Colonial expansion, tropical island Edens and the origins of environmentalism, 1600–1860*. Cambridge: Cambridge University Press.
Hennessy, E., & McCleary, A. (2011). Nature's Eden? The production and effects of 'pristine' nature in the Galápagos Islands. *Island Studies Journal, 62*, 131–156.
Honey, M. (1999). *Ecotourism and sustainable development: Who owns paradise?* Washington, DC: Island Press.
Huxley, J. (1966). 'Charles Darwin: Galápagos and After' Chapter 1. In R. I. Bowman (Ed.), *The Galápagos*. Proceedings of the Galápagos International Scientific Project, Brussels, Charles Darwin Foundation, Palais des Academies, 3–9.
Kohler, R. (2002). *Landscapes and labscapes: Exploring the lab-field border in biology*. Chicago: University of Chicago Press.
Larson, E. (2001). *Evolution's workshop: God and science on the Galápagos Islands*. New York: Basic Books.
Melville, H. (2002). *The enchanted isles*. London: Hesperus Press Limited. (Original work published 1854)
Rothschild, M. (2008). *Dear Lord Rothschild: Birds, butterflies, and history*. London: Natural History Museum. (Original work published 1983)
Stewart, P. (2009). *Galápagos: The islands that changed the world*. New Haven: Yale University Press.
Sulloway, F. (1982a). Darwin and his finches: The evolution of a legend. *Journal of the History of Biology, 15*, 1–53.
Sulloway, F. (1982b). Darwin's conversion: The Beagle voyage and its aftermath. *Journal of the History of Biology, 15*, 325–396.
Sulloway, F. (1984). Darwin and the Galápagos. *Biological Journal of the Linnaean Society, 21*, 29–59.
Sulloway, F. (2009). Tantalizing tortoises and the Darwin-Galápagos legend. *Journal of the History of Biology, 42*(1), 3–31.
Von Hagen, V. W. (1940). *Ecuador the unknown; two and a half years' travels in the Republic of Ecuador and Galápagos Islands*. New York: Oxford University Press.
Von Hagen, V. W. (1949). *Ecuador and the Galápagos Islands*. Norman: University of Oklahoma Press.
Wolf, T. (1887). *Memoria Sobre las Islas de Galápagos*. Quito, Ecuador: Imprenta del Gobierno.

Chapter 6
Darwinism in Latin America: Reception and Introduction

Arturo Argueta Villamar

Presentation

In natural history, the paradigm of classification held a privileged place during the eighteenth century, briefly ceding to transmutation during the end of the eighteenth and the nineteenth centuries. The break between fixism and evolutionism provoked the substitution of natural history for biology. Of all the proposals regarding the origin of species, the most accepted theory at the end of the nineteenth century was the idea of evolution by natural selection. In this chapter, we will analyze the reception and introduction of Darwinian evolutionism in various Latin American countries between the late nineteenth and the beginning of the twentieth century.

An excellent demonstration of what has been known as the "Impact of crucial ideas in science" is the great diversity of responses to new scientific views. The debate around the concept of evolution generated a modification in the conception and practice of natural history, as well as of many other disciplines in this part of the western hemisphere. As we will see in the following chapter, the personalities and controversies of this period can be understood within a scientific context as well as a political and philosophical one. Both Comtian and Spencerian positivism were present in the permanent and decisive debates between liberalism and conservatism.

Thomas Glick writes that Darwinism was received in Latin America in association to positivism, whether explicit or not. This term was used by the social scientist Saint-Simon to refer to the use of the scientific method and its extension to philosophy, in which the scientific knowledge was reasoned as "positivism." He adds that positivism in its Comtian aspect was "social positivism" and its Spencerian aspect

A. Argueta Villamar (✉)
Regional Center of Multidisciplinary Research, National Autonomous University of Mexico, Mexico City, Mexico
e-mail: ayruroa@gmail.com

D. Quiroga, A. Sevilla (eds.), *Darwin, Darwinism and Conservation in the Galapagos Islands*, Social and Ecological Interactions in the Galapagos Islands,
DOI 10.1007/978-3-319-34052-4_6

was "evolutionist positivism." The former drove the idea of a more just society through the application of science. The latter used the term evolution as synonym of progress, and praised unilineal evolution and universal progress.

Social and Political Context of the Period

While these schools of thought were developing in Europe and spreading throughout the rest of the world, what was happening in the sociopolitical and economic landscape of Latin America during the six decades between 1860 and 1920? What was the contribution of the region in an international context? And, what plans did the imperialistic power have regarding the young republics?

In 1860 the majority of the countries in the region, with the exception of Brazil and Cuba, had started their long struggles for independence 50 years prior, which consumed both lives and resources. These young republics had unstable government structures, their limited infrastructure had been destroyed by the wars of independence, large masses of rural areas were impoverished and large territories were deserted. Some of the younger republics, like Ecuador and Panama, resulted from subdivision of Great Colombia.

The national states searched for a new production base and promoted modernization through the industrial revolution. Within this framework, new intellectual circles emerged, and although they were small, they were critical and spirited. Also, universities, scientific institutes, and cultural centers were renewed and reinvigorated. Modernization and the new industrial activities brought huge changes to the rural property, and though these changes were described as "wonderful progress" in numerous religious texts from the region, they resulted in the creation of large impoverished masses. These people, malnourished and living in poor health conditions, were restricted to extractive labors and exhausting farming.

In general terms, communications developed and urban centers grew. The expansion of manufacturing activities and commerce strengthened the configuration of new socioeconomic strata, putting the political power in the hands of large landowners, the military and the church. However, it was still a time of fragile democracies and the ungovernable nature of the region led to coup d'état and crises of power. Democracy was exercised by a restricted population, often man who's right to vote and run for office was determined by their ability to read and write, or because they owned "legally" acquired land. Thus, the huge majority of the population were only observers of the political process, witnessing decisions made in a world too "wide and foreign."

Old historic agreements between the national states and the rural populations were broken through the liquidation of ancient communitarian practices of landownership, and the opening of these lands to the market in order to transform them into individually owned property. However, in many instances, what really happened was that they reverted to large ownership like in postindependence times. The nineteenth-century destruction of the indigenous communities not only

followed the agenda of modernization, but also declared illegal, and whenever possible, the communitarian territories "privilege enclaves," which were considered vices of the colonial regime.

During the decades 1860s, 1870s and 1880s, there was a great expansion of the imperialist monopolies that hoped to install monarchies, reconquer territories or reconfigure enclaves. This was attempted using diverse strategies, such as those employed by the French "adventurer" Tounens in Chile in 1859, or the British threat to occupy the region of Canelos in Ecuador in 1860, the French invasion of Mexico in 1861, or the occupation of the Peruvian islands of guano by the Spanish marine in 1864. Furthermore, the European powers backed border wars between the new nations, such as the war against Paraguay by Argentina, Brazil, and Uruguay between 1865 and 1870, or the Pacific War between 1879 and 1884 that included the occupation of Lima by the Chilean military between 1881 and 1883, the occupation of the Bolivian and Peruvian territory by combined British and Chilean forces, as well as the territory of "El Acre" in Bolivia, carried out by Brazil in conjunction with British interests (Stanley & Stein, 1974).

Some historians have noted that compared to the first half century after the independence, the years after 1870 were characterized by political consensus. What has been summarized here definitely does not coincide with this vision. At the end of the century in Bolivia, the "Federal war" marked a return to conservatism, and conflicts continued in the area between the Pacific Ocean and the Acre. In Mexico, there was a long dictatorship that praised liberalism, but that moved toward an "administrative stability" that harshly prosecuted and punished dissent and internal complaints. In Chile, there was the military coup of the parliamentarian state followed by a long conservative decade. Therefore, the last third of the nineteenth century witnessed a great deal of conflict, in contrast to the superficial immobility during the years of the colonial regime, perhaps due to the repression of differences during colonial times.

In the historical context summarized above, it was simple and useful for the members of the political circles—as well as for many intellectuals—to utilize the ideas about the similarity between the organic evolution and the evolution of the societies in their political discourse; to pass from the individuals more apt for survival to the more apt nations; to talk about the natural diversity of species as justification of the "naturalness" of classes and social strata; and to argue that the multiple origins of the human being founded the reasoning behind the existence of the human races, racism, and pigmentocracy, amongst other ideas. It is now clear that there was a political use of ideas rooted in biology. Many politicians, and even some naturalists, assumed a Spencerian or Lamarckism focus, rather than a Darwinian one; however, the differences were only appreciated in rare instances.

In countries such as Argentina, Bolivia, and Brazil, the necessity to maintain the order imposed by the pigmentocracy, meaning the power of the creoles, the white population (or the whites that had recently arrived through immigrant selection programs), over the rest of the mestizos, Indians, and afros, made use of the Galtonian argument over the Eugenism which many—including Galton—linked to the Darwinian thesis on heredity and artificial selection, but applied to humanity rather than animals or plants.

Reception and Introduction

Now we turn to the processes of reception and introduction of Darwinism and other ideas in Latin American countries. We understand the term reception as the use of concepts such as evolutionism, natural selection, and adaptation by journalists politicians and ideologists. In terms of introduction, it is the use of those same terms by doctors, biologists, agronomists and other professionals that employ such concepts in their professional practice to better explain the processes that they study.

Geology and Paleontology in Argentina

In Argentina, Darwinism was well received as evidenced by the teaching of evolution in the Teacher's College, the homage made on the year of Darwin's death, and in a period of introduction fuelled by the works of the paleontologist Florentino Ameghino.

During the beginning of the nineteenth century, the doctor and paleontologist Francisco Javier Muñiz was one of the founders of the Argentinian paleontological research tradition. He discovered and analyzed numerous copies of paleontological fauna such as mastodons, toxodons, and glyptodons, thus gathering one of the most important collections of pampean fossils in the country (Onna 2000, p. 63). This constituted one of the most important links between the work of Darwin and that of Ameghino. Previous to the arrival of the Beagle, Darwin and Muñiz maintained a dialogue (some call him "Darwin's correspondent in Argentina"), particularly concerned with the matter of the *ñata* cow and the issue of crossing (Glick 1989, p. 34; Onna 2000). The *ñata* cow is a bovine breed that Darwin observed in the territory occupied by the *pampas* indigenous population (Darwin 2002).

In the 1882 Civic Funeral in Memory of Darwin hosted by the Argentinian medical circle in the National Theatre, Sarmiento (1900) notes "I would like to honor Darwin, our wise Burmeister, our astronomer Gould, and our Ameghino." Ameghino, young representative of the Argentinian paleontology, was 28 at that time and was already a recognized and esteemed scientist in the country. It is important to indicate that the Ameghino "case" would not have existed if Argentina had not produced a mature paleontological tradition, which, as Glick states, features "critical mass, an interconnected interdisciplinary group, with the control of one or two of high quality museums, the support of the Ministry of Instruction, and wide contacts with European researchers."

As a matter of fact, the most renowned of the whole group was Ameghino, who in 1882 gave the lecture "Un recuerdo a la memoria de Darwin: El transformismo considerado como ciencia exacta." This was published in the Boletín del Instituto Geográfico Argentino, and where "…does not expound upon the fundamentals of Darwinism, instead focusing on his own contributions from the field of paleontology, specifically on the evolutionary relationships that link the small modern armadillo with the Megatherium." Aside from paleontology, Ameghino specialized in

geology and anthropology. In 1884, he published one of his most important works, "Filogenia," which was very successful and widely disseminated. Here, he establishes the key moment of the introduction of Darwin's ideas in Argentina.

In this text, he develops his thesis on evolutionary classification based on natural laws and mathematical proportions. Subsequently he published *La antigüedad del hombre en La Plata*, where he expresses his support in favor of monogenism, thus constructing the hypothesis of the shared origin of mammals and humans, locating the Argentinian pampa as the place of origin for both. Even though these were original works, his hypothesis on the human origin and other unfortunate errors related to the dating of fossils resulted in the work of Ameghino being forgotten, perhaps unjustly.

The Survival of the Fittest and the Progressive Ideology of Argentina

It is likely that Darwin had not suspected, at least until the sixth edition of *The Origin of Species* (1877), that Spencer would become one of the biggest proponents of Darwinism. However, through this process he began to pass his own Spencerian ideas as Darwinian, and Spencerian positivism was coined "Social Darwinism," which contributed to justify some of the worst atrocities and social excesses in various countries.

As was suggested by Wallace, Darwin named the core of his theory "Natural selection or the survival of the fittest," and it appears in Chap. 4 of the *Origin of the Species* starting in the fifth edition. As it becomes clear from the aforementioned, even though Darwin took the Spencerian idea of the "survival of the fittest" to biology, he did not produce the idea of "Social Spencerism," which was later developed in many parts of the world, particularly in the USA and Germany. In Argentina, while Darwin's ideas were being introduced into paleontology through Ameghino, Spencer's interpretation of Darwinism would serve to scientifically legitimize a powerful social ideology: the ideology of progress (Montserrat 1999). This Spencerian positivism was the dominant tone in Argentina during 1870 and 1890, which played an important role in the political and educational activities of the country.

Montserrat (1999) notes that it was Spencer who took the notion of progress to the philosophical extreme of being an irresistible universal law. The idea of progress as a permanent and unavoidable destiny was shared by various social circles infected by Spencer's "optimism."

Conjoined with that progressive optimism, Spencer's explanation of the survival of the fittest was always present. As an expression of the ferocious individualist rivalry in human societies, Ricaurte Soler (1968, p. 6) states that: "Using evolutionary biology as a base, the 'conqueror bourgeoisie' of the 80s will replace Providence with an ideology legitimized by modern science." Spencer's Argentinian positivists, who identified completely with the liberal oligarchy mentality of the 1880s, faced a nation to be built and educated, a territory to be conquered and settled, and a new material and intellectual frontier to be defined. During and after his presidency, Sarmiento was one of the most enthusiastic Spencerists.

Embryology in Brazil

In terms of the development of Embryology, Brazil benefitted from Fritz Müller's presence, which developed one of the earliest and most important interpretations of evolutionism in Iberoamerica. Müller travelled to Brazil as a merchant, but had been a student of Johannes Müller in Germany, and as soon as he could he dedicated most of his time to research. He was well known internationally amongst the scientific circles in 1864 through the publication of a small book called *Für Darwin*. In this book, he used his embryological studies in crustaceans to demonstrate some of the elements of the evolutionist theory, that is to say, he indicated that the complicated development process among some crustaceans has the nature of a "historical document," anticipating with it the haeckelian recapitulation.

Moreover, he discovered the "nauplius" larva in the superior crustaceans or malacostráceos, which previously had only been found in the inferior crustaceans, the entomostráceos, "showing that during the embryological phases, the superior crustaceans would first go through the 'nauplius' larva phase. He also compared the appendices of the male and female crustaceans of the genus *Tanais*, showing its sexual dimorphism. He studied the aerial respiration of the crustaceans and compared the structure of the heart in the amphipods and isopods."

The impact of Müller's book in the German and British scientific circles was immediate. This resulted in Darwin suggesting its translation to English, which appeared in 1869. The two became friends and exchanged letters. Müller would send Darwin materials for his studies and they carried out work on different groups of animals and vegetables. However, all his work in Brazil, of great relevance to the world, was made without any dialogue with the rest of the Brazilian scientists and without impacting neither the institutions nor the disciplinary practices of Brazil. Müller published a great part of his work in international scientific journals and his observations were very specialized to the field of biology. Only after he gained international recognition, Müller started to have financial support in Brazil as he was hired as a naturalist traveller by the National Museum between 1876 and 1891. However, his job was restricted to sending collected materials to improve the museum's collections. Nevertheless of the importance of his scientific production, Fritz Müller not only did not have great impact or recognition in Brazil, but his advances were attributed to Haeckel who was more influential in Brazil and in Latin America (Bertol, H. y M. Romero, 1999).

Comparative Anatomy in Cuba and Venezuela

In the University of La Habana, Carlos de la Torre was part of the group of convinced evolutionists made up by Arístides Mestre, Juan Vilaró, Luis Montané, Tranquilino Sánchez, amongst other professors that received the teachings of Felipe Poey. They were present during the debate and the controversies about Darwinism in Cuba.

De la Torre was elected as member of the Academy of Sciences of La Habana in 1889, and his opening speech addressed the anatomy of "manjuari" (*Atractosteus tristoechus*), a relic species of a freshwater fish. This primitive representative of the

teleosteos belongs to a group that was widely distributed although now it is restricted to North America. The Cuban species lives only in a lagoon in the peninsula of Zapata in Central Cuba. In his speech, (De la Torre, 1889) notes that the so-called "cranial plaque" of this fish is not—as some eminent icitologos had thought—the frontal bone of the cranium, but only a series of modified scales. When responding to the speech of his disciple, Felipe Poey (1889) went further in order to imply (an obvious evolutionist conclusion) that the resulting structure was not but a residue of the external "armor" of the ancient and extinct placoderms fish.

Besides these efforts, Glick (1982a, b, c) notes that Carlos de la Torre directed a thesis about the variation in the number of human ribs under the Darwinian focus. It was produced by one of his students in order to gain his PhD in the Faculty of Sciences in La Habana. Furthermore, he insists on the importance that the anatomy class had in the Hispanic world, as well as the diffusion of Darwinism due to the fact that De la Torre, and later Luis Razetti, used these anatomy lectures in Caracas to disseminate the Darwinist perspective in the comparative anatomy.

With respect to Venezuela, Pablo Acosta introduced the study of contemporary anatomy based on the evolutionist views of Leo Testut in his anatomy class at the Academy of Medicine. This class was taken by Luis Razetti in 1896, who continues on the same bases training numerous generations of Venezuelan doctors with the fundamentals of evolutionism. Cappelletti (1994) tells us that Razetti occupied subsequently the lectures of external Pathology, Obstetrics, surgical medicine, descriptive Anatomy, and clinical surgery. Between 1890 and 1893 he was Consul of his country in Marseille France. This same author notes that Razetti was Rafael Villavicencio's student in his lecture on the Philosophy of History.

In 1906, Razetti acquired the support of the Venezuelan president to edit and disseminate his book titled *What is life*? which meant that there was wide governmental support for the exposure of Darwinian ideas. Glick (1982a, b, c) comments that the president at the time was "the dictator Cipriano Castro, who was ideologically a liberal and somewhat a positivist, who saw in Razetti an ideological support, since the traditionalist 'goths' were as opposed to the president as they were to Darwin." The aforementioned author wrote the *Code of medical morals*, sanctioned by the National Academy of Medicine in 1918. It took on varied topics of public hygiene and of eugenics.

Animal Breeding in Uruguay

Darwinism in Uruguay was received and used by means of a very interesting controversy between those in favor of selection and those in support of crossing. This was only an intellectual disguise of a bigger debate between two economic strategies for the future of the country. It is interesting to analyze this controversy because Darwin, although he had anticipated strong changes in terms of animal breeding, had never imagined that 40 years after the "descendants" of Don Juan Fuentes, the wealthy farmer/rancher he visited in the surroundings of Maldonado in July 1832, would become one of the leading persons in an interesting and unique debate on the implications of Darwinian evolutionism centered around the zootechnique of bovine and ovine cattle in Uruguay.

As Cheroni (1999) has rightfully pointed out, *The origin of the species* was read by cattle breeders and landowners of semicolonial Uruguay, as a technological component, primarily concerned with the improvement of cow and sheep in the national livestock.

The technical debate confronted two scientific-technical positions. The discussions revolved around the improvement of the Uruguayan cattle, the main productive activity of the country. The controversy also included an agitated discussion between those in favor of artificial selection and those in favor of crossing.

There was also a confrontation between two production and technological models. One of the models, the selectionist, was the expression of the conservative ranchers, known by Cheroni (1999) as precapitalists, who were dedicated to the extensive cattle industry that was settled in technological inertia based on a method of production good enough to satisfy the low demand of quality in the industry of processing leathers and meat for the production of *charque*. The other model, of crossing, was the alternative technological model driven by the capitalist investors in the fields, who demanded the introduction of the best scientific and technological advances in the cattle production process, which conducted to a radical change in the economic politics.

The model of production that was defined by Domingo Ordañana (1892) as "the agronomic cattle," allowed the entry of rural Uruguay into the capitalist world, which promoted a radical improvement in "the exploitation of water supply, artificial fields, forage, fertilizers, etc. This would allow a scientifically controlled blend, which was taken care of in stables and protected with vaccines and specific chemicals. Effectively they entered the period of scientific cattle industry, exploiting rational and corporately this new industry that will and should change into the modern farm."

In one of the paradoxes of the Uruguayan case, Ordañana who was completely progressive in the productive level took a leading role in anti based on two fixism positions and tried to dismantle Darwin's scientific contributions towards cattle improvement. They maintained that if it would be justified that it could be applied in other "kingdoms," its scientific approach and efficiency for its production was not valid as it was intended to be applied in the "cow kingdom." He concluded as follows: "If Dr. Darwin had been a cattle breeder, he would not have proposed half of the theories that infest his books, because all of them are contradictory to the facts that are observed in practice."

Glick notes that Ordoñana's attack is sustained by pointing out that Darwin confuses races with species, when arguing that both crossing as well as selection do not "lead to change" because the type is fixed, and we add here, to disqualify him "because half of his theories did not come from the practice"; "Naturally, Glick says that it was the other way around. The observations, on which Darwin had created his concept of artificial selection, and thus, natural selection, were gathered from the English breeders so well cited in the Journal (of the Rural Association)."

Another paradox consisted of the debate about Darwinism, which had an effect that gravitated negatively in the development of the science in Uruguay, thus solidifying somewhat of a rupture between productive and technical practice, and scientific knowledge. The process of confrontation between ranchers and academics had its origins in the attacks of some distinguished leaders of the Rural Association of Uruguay, who were opponents of Darwinism, directed against the core of the university intellectuals who defended Darwinism.

Despite the great efforts that Ordoñana and others in the RAU, in the world of production and in the scientific world, the Darwinisms favorable trends prevailed in Uruguay, as part of a social movement that struggled to industrialize the country and achieve economic independence, without necessarily including cows or sheep under the agroindustralization model. Cheroni notes the effective solidification of the industrial social sectors that in the following years would conclude in the first decades of the twenty first century with the establishment of a state capitalism in Uruguay directed by the national elites, but that anti-Darwin profile that was imposed during that time in the civil discourse was not buried, but rather reborn episodically in every zigzag of (the) contemporary history.

For Glick, the debate and the basis of the debate in Uruguay was a very complex matter. "Crossing was in vogue in the Anglophile countries, but the introduction of the European cattle in Uruguay and the successive efforts on crossing did not yield the expected results." For this author, the selectionists were right, since the improved cattle could not survive from the nutrient poor grasses of the Uruguayan pampas. Years later, this would translate to twentieth century Uruguay having to import zebu cattle from India, one which could optimally use the natural grass.

There are very few examples of this discussion to show all the angles of this complex controversy, where a scientific theory generates the lead in terms of scientific, technological, and political issues. There is nothing more logical than the discussion on animal breeding in which the cattle breeders and ranchers participated and not only the academics and politicians of Uruguay. Darwin did not doubt that his proposal on evolution would be a matter of controversy and debate amongst the "artificial selectionists," with whom he continued to exchange letters until his last years of life. However, he thought with certainty that this strong controversy such as the one in Uruguay, would first develop in England or in Germany, before it would in the "Banda Oriental", like is called Uruguay too.

Darwinism Against Ideas of Progress

Darwin's theory of evolution broke through the disciplinary barriers of natural history, medicine, and biology and was readily accepted in debates among social scientists, philosophers, and politicians, in some cases, even before it was accepted by biologists and natural scientists. In fact, in Latin America the social discussion predominated over the biologic discussion.

Darwin contributed to this process of reception of the theory within social sciences by adding to *On The Origin of Species*, concepts such as the "struggle for existence" and the "survival of the fittest," which were contributions of the economist, Thomas Malthus, and the sociologist, Herbert Spencer, respectively. It has been noted that both concepts preceded Darwin and are, in fact, examples of disciplinary "import" since they had been taken from economics and sociology to biology. It is also clear that within Darwinian evolutionism these concepts hold different meaning, that they are not entirely based on or are central to Darwinian Theory.

The Struggle for Existence in Mexico

The founding of the National Preparatory High School, in 1868, was a great educational platform for fostering the scholarship of Comtian Positivism. The Sociedad Metodófila, also founded in 1868, was a space for developing ideas where the debate in favor of or against Darwinism and Social Darwinism began. Moreno de los Arcos (1984) has noted the importance of the Sociedad Metodófila as a privileged and open space for discussing Darwinism. Gabino Barreda, founder and principal organizer of the society, argued against Darwinian Evolutionism. Meanwhile, a majority of the society's members—young students of various disciplines and worthy disciples of their teacher—argued reasonably in favor of Darwinism.

Mexico has been considered a country where the influence of Comtian Positivism was profound, but that by no means implies that the discussion around Malthusianism was absent when considering the future of the country. On the contrary, its presence in the debate was permanent. Gabino Barreda not only did not accept natural selection as an explanation for the process of the transformation of species, but also opposed the "Malthusian" component of Darwinism. Finally, he accused the evolutionists of taking Malthus' Law as given without having proved it.

Justo Sierra, who Moreno de los Arcos (1984) attributes as having driven Darwinist theories within the most diverse areas, takes an opposing view of the issue. He asserts, for example in sociology and geopolitics, that nations act as organisms. On the other hand, Manuel Ramos, who was at the core of the Sociedad Metodófila, points out that if one or more causes of destruction of weak individuals were suppressed, the number of weak individuals would increase, allowing for a weak posterity among them. He supports this discourse with the Malthusian theory of scarcity due to overpopulation, asserting that protecting the weak only results in the increase of the human population to a degree that is disproportionate to the means of viably obtaining subsistence.

Towards the mid-90s, Agustín Aragón (1895–1896) writes an anti-Darwinist article dedicated to his much loved and respected teacher Porfirio Parra (celebrated darwinist from the Sociedad Metodófila). He calls into question the so-called fourth law, relative to the struggle for existence, challenging Malthus. He ends his article practically condemning Darwin by using the authority of Spencer, who is—at least in Aragon's opinion—"The only evolutionist that has dealt with the problem of evolution in a scientific fashion."

Emilio Rabasa (1921) expresses a completely different opinion relative to the educational environment that indicates that the struggle for existence is a palpable reality, and that the most apt individuals obtain the best position in society and therefore should be protected by the state. Because of this, he postulates that the task of education should focus solely on this social sector, which he denominates the capable sector, as opposed to the incapable sector (including the indigenous population), which in reality should receive all of the effort and support (Ruiz, 1987).

Along different lines, Andres Molina Enríquez (1978) highlights the evolutionary potential of the indigenous and mestizo populations, and he even recognizes the indigenous peoples as the most evolved race (understanding this as the race most

phylogenetically removed from their ancestral primates). The European races, suggested Molina, have achieved their maximum potential, unlike the indigenous that have a bright future due to their biological potential: "…the white races can consider themselves superior to the indigenous because of their action, which is a logical consequence of their advanced *evolution*, and… the indigenous races can consider themselves superior to the whites due their superior resistance, which is a logical consequence of their advanced selection" (Argueta, 2009).

Facing positions like those put forth by Rabasa, that were full of racism against the indigenous, or those of Molina Enriquez, which sought to justify indigenous superiority and inverse racism, one must note that Darwin did not dedicate his theoretical efforts toward proving the superiority or inferiority of one human society over another, and less so with the indigenous populations. However, it is also true that he did briefly discuss the indigenous in both a positive and negative fashion in his effort to conceptualize the dichotomy between the savage and the civilized, which was a recurrent theme during his time.

The Pro- and Anti-Darwinists in Bolivia

In *History of Bolivian Science*, Ramiro Condarco (1978) notes that the first text on evolutionism in Bolivia was Dumont's book, *Haeckel and the theory of evolution in Germany*, which was translated and published in instalments beginning in 1877 in the city of La Paz. The controversy that followed this publication and the diffusion of evolutionism in general occurred with the distinguished participation of intellectuals, political groups, and institutions settled in Sucre, La Paz, and Santa Cruz.

Evolutionism in Bolivia, as well as in other countries of the region, was received by a group of anticlerical liberals that relied on it to discuss issues of education, religion, and progress. Later on, it was introduced by naturalists working in geography and medicine. As in other countries, some of Comte's positivists were bitter enemies of evolutionism, while the Spencer's positivist groups spread Darwinism before evolutionism was accepted in public curriculum.

The Darwinian works were introduced by Belisario Díaz-Romero, its most important diffuser. Amongst the receptors there were both pro-evolutionists and antievolutionists. However, there were also sectors that acted as mediators, eclectics, and dualist in Bolivia. Amongst the group of the social Darwinists pro-evolutionists there are two conspicuous Bolivian writers, both from Santa Cruz: Nicomedes Antelo and Gabriel Rene-Moreno. Among the antievolutionists were the bishop Jose de los Santos Taborga and the president of the republic Mariano Baptista.

Physician Diaz-Romero was also a writer who practiced several disciplines: physiology, psychology, and psychiatry; as well as the natural sciences, botany and biology; history, anthropology, and philosophy. Partially self-educated, he wrote a pioneering article on Darwinism (Díaz Romero, 1892).

In this extensive essay, he describes the origin of the American man and discusses whether humans originated in Europe or are native to the Americas. The preface of the first edition was written by Valentin Abecia, the second Vice President of the Republic Alvarado (1969).

For Diaz-Romero it was indubitable that the three cores of human evolution were Asia, Africa or Oceania, and Europe; however, he asks "Can we exclude America as a generating continent for the human species?" He answers positively, since "There is not the slightest remnants of a native race in America: the absence of monkey fossils of the catarrhini group, or the evident anthropine prototype, whose presence would be indispensable for giving rise to humans in that part of the globe." This discussion was of great interest and relevancy in America since Florentino Ameghino, in Argentina, had published two texts (1881, 1884), meanwhile the Bolivian Villamil de Rada had confirmed the origin of man in Sorata, Bolivia (1871, 1888) under the American monogenist perspective. Also, the Mexican Jose Ramirez argued on the origin of the American man in the Americanist Congress in Mexico of 1895.

He clearly highlights that the *Homo pampaeus*, the new human type discovered by Ameghino in Tertiary and Quaternary territory in the basin of the Plata and presented as the ancestors of the American and global races, does not have reliable data due to incorrect genealogical tables. He adds that many academic institutions and Europeans naturalist do not believe Ameghino's deductions. Interestingly, despite the American monogenism, at the time it was a well-received argument and had the support of many educated sectors as well as the governments of various countries in the region, because it leaned originality to the local cultures. Furthermore, as stated in another part of the book, there were American authors such as D'Orbigny, Agassiz, and Müller who also maintained the same thesis, and our author imposes the necessity to review all data and evidence and after doing so, he rejects all probability of native Americans and argues in favor of polygenist without the contribution of the New World.

Diaz-Romero publishes the book "Ecclesia versus Scientia," (1921) in which he was determined to battle what had been taught in Bolivian schools. He declares: "This work includes two components: first, we will prove the falseness of the religious teachings that proceed from the Biblical cosmogony, to which our adversaries try to give scientific value. Second, we will expose the absurdity of the Anthropogenic Genesis, the Judaic text that has served as the historic-natural teaching program of the priests with regards to the origin of living beings and especially of man."

According to Diaz-Romero, the main issue to be discussed during that time was evolutionism that pretends to address and explain the origin of the human species and for which he addresses four principle matters: harmonization, the recognition of evolutionary processes in plants and animals but not in man, limited evolution in comparison to universal evolution, and monogenism versus polygenism.

In regard to harmonization, he says that the Church moved from condemnation to the transformism that Pope Pio XI promoted, whose behavior towards new ideas was of intransigence and intolerance. With this he achieved "… the disdain of the scientist and the educated people of the world." The new attitude of Pope Leo XIII, who recommended in the new encyclical *Providentíssimus Deus*, that "it should be examined, profoundly studied, discussed, and clarified when possible, the great issues for which contemporary science has disputed the Catholic dogmas, and, if the scientific teachings are true in those particular points, they should be accepted, attempting to harmonize them when possible in the teachings of the Church." Under this perspec-

tive, Diaz-Romero shows and comments on the authors that were working on the proposal of harmonization: French Dominic Leroy, P. Vigil the French Guibert Gonzales de Arintero, the Jesuit Zahm, as well as Gardeil, Gaudry, Quatrefages, Mivart, and many others. Our author believes that the idea of harmonization is not but a strategy that creationism uses to survive the struggle of ideas. "There is a profound antagonism between what has been accepted by the Church and what has been accepted by Science. They are opposing doctrines, antithetic, and essentially opposite one from the other. If the Roman religion proclaims the *creation* of the Universe, the positive science proclaims the *evolution* of the same. If theology accepts creation, then science rejects it emphatically and categorically. Therefore, there is a complete disharmony between the two concepts."

In regard to the second nucleus of ideas, there is the tendency for some catholic naturalists to accept evolution in plants and animals, but not in man. P. Zahm, following the work of P. Wasmann, posed matters in the following way: "According to this theory, God created man's soul directly and his body indirectly by means of secondary causes," for which he comments that according to this idea "God has used *evolution* to create animals and plants, to create man he abandoned that precedent, and creates him in his divine image. In the same way that (…) animals were created by God by means of evolution and man by revolution."

In reference to the idea of limited evolution and universal evolution, Díaz-Romero says that P. Marabini argued on this topic in a rhetoric way, pointing out that there is a type of evolution, theoretically acceptable, that is visible in the gradual perfection that occurred not only in the universe as a whole, but also in particular beings bound to the laws imposed by God when creating them. Evolution is unique, it is a unique process of cosmic development, it does not have species of any gender, it is a universal law, without divisions, distinctions, nor exceptions. It is a law such as the law of universal gravitation. Will we admit, according to your misplaced criteria, species of gravity? Where have you gotten such scientific inspirations? "Daydreaming without a doubt."

In respect to the controversy between the monogenists, some of which are Buffon, Quatrefages, Moritz Wagner, W.S. Duncan, Wallace, Owen, Ameghino, Villamil de Rada, and the polygenists such as Agassiz, Desmoulins and Morton, Vogt, Pouchet, and Haeckel's followers like Diaz-Romero. However, Diaz-Romero was not an unconditional and uncritical follower of Haeckel, since in another part of his text, he criticizes his positions on the relationship between the Pitecantropo and the human species when he says: "In the ninth edition published in Germany, of his *History of natural creation*, Haeckel openly alleges that Pitecantropo was the non speaking monkey-man that had certainly preceded the speaking man." Both Diaz-Romero and Dubois point him out as the precursor and not as the ancestor of the human species. "Then, Haeckel's mistakes was presenting the pitecantropo as the immediate ancestor," with this, our Bolivian author elaborates his own conclusions based on the available information that he read in German, which was not common in Latin America, and without a doubt, he did not blindly follow Haeckel.

The reading on Diaz-Romero's materials allows us to see clear links with Darwin and with Haeckel regarding his ideas about the origin of man. Moreover, his ideas

about organic–inorganic and universal evolution puts him in a line of thought that is strongly inspired by Spencer. Precisely in relation to this point, he tells us that he is preparing a new text with great echo to Spencer, called *The cosmic organism*, in which he addresses the topic on intelligent matter from a physiological perspective.

Our character is a convinced evolutionist that writes the epitaph of creationism in Bolivia and declares his support to the scientific theory of evolution even though he acknowledges and foresees that without a doubt the theory will suffer changes and adjustments. He affirms that the creation theory has disappeared from the mind of the educated men of that time and that science, with a more noble and elevated understanding, has substituted it. And even though the new scientific discoveries clarify the evolutionist doctrines, it will remain as the sole rational, positive, and philosophical explanation of universal life.

Conclusion

Darwin predicted changes in the fields of geology and paleontology, in embryology, in taxonomy, and in animal and plant breeding, amongst other disciplines and practices. Darwin correctly predicted the great changes that would happen in natural history and in all its subdisciplines, but I must highlight that the change that he did not predict, the most crucial of all, was of the displacement of natural history by biology, which without a doubt evolutionism contributed to form and strengthen. Darwin's predictive efforts are very useful in order to establish an analysis of the early changes produced by the evolutionist ideas in several disciplinary practices.

Darwin's evolutionism impacted several disciplinary practices, but this also occurred due to other non-Darwinian interpretations of evolution. In this sense, it has been noted that the trajectory of the reception of Darwinism in Latin America was distinctly influenced by the preeminence of Haeckel's work and his emphasis on Lamarck's mechanisms and recapitulation, reinforced in several countries by the exposure to French transformism and, in others, by the delay on the Darwinian debate until the end of the century when natural selection had entered that period known as the eclipse.

When analyzing the changes introduced by Darwinian evolutionism in each of the subdisciplines of natural history, it could be noted that if considered in isolation, they would have little effect on its theories. However, when analyzing them as a group, the conclusion is that the effect of the sum of its parts was much greater. Natural history exerted a long control over the concepts, forms, and processes of thought and study of the living phenomena that prevailed from mid seventeenth century to mid nineteenth century. Darwin also predicted that a wide path would open a field of study, broad and barely studied, focused on the causes and laws of variation, the correlation, the effects of use and disuse, and the direct action of external conditions.

In relation to the translation of ideas from the social sciences to Darwinism, and later the ideas of Darwinism back to the social sciences, it is concluded that Spencer was a clever disseminator amongst his numerous readers, and that Darwinian

evolutionism was at the base of his declarations on "natural" inequalities, which were used to justify social injustice. With this he coined the concept of "Social Darwinism," one of the most penetrating thought systems in Latin American of the nineteenth century (together with positivism and marxism), which really should be called Spencerism (Palerm, Harris).

Today, some of Darwin's predictions might seem obvious, but during that time the "World change," in Kuhn's terminology, was announced. Without a doubt, evolutionism gave Biology the possibility to emerge as contemporary science and served to separate Botany and Zoology from the domain of natural sciences contained in natural history and establishes themselves in the core of the contemporary biological Sciences. Mineralogy, previously part of natural history, was regrouped with paleontology, geology, pedology, meteorology, volcanology, and speleology, among others, to constitute what today is known as Earth Sciences.

Glick notes that Darwinism was influential in the nineteenth century in all of Latin America with the exception of Paraguay. If we analyze the process in the whole region, we must add that we are lacking the historiography of some of the Caribbean, the Central American countries and the Guyanas, as well as a deeper understanding on the studies of Ecuador and Peru. Referring to what has been documented through the second decade of the twenty-first century, Glick in retrospect formulates the following great tendencies of the region: (a) The strong discussion on race and national identity in those countries where indigenous and black peoples were prevalent, using social Darwinism. (b) Where Comte's positivism opposed Darwinism, Spencer's positivism reinforced it. (c) The Catholic church's opposition to Darwinism managed to get some countries to follow Italy's reception pattern, where solid scientific institutions were muddled and disturbed in regard to Darwinism. (d) Medical and Law schools were the fortresses where reception and introduction of Darwinism was made. (e) Darwin's, Haeckel's, and Huxley's books were read in French, even though some libraries had the English editions. (f) Some foreign Darwinians (Goeldi in Brazil, Wolf in Ecuador, Arechavaleta and Suñer in Uruguay, and Ernst in Venezuela) had direct influence in several Latin American countries.

Acknowledgements To Ana Sevilla from the Universidad San Francisco de Quito, Ecuador for the invitation to participate in this volume and to the Regional Center of Multidisciplinary Research of the National Autonomous University of Mexico for allowing me the proper conditions to develop the research on reception and introduction of Darwinism in Latin America.

References

Alvarado, J. M. (1969). Belisario Díaz Romero, un filósofo olvidado, La Paz, Bolivia, Imprenta y Librería Renovación.

Argueta, A. (2009). El darwinismo en Iberoamérica. Bolivia y México. España, CSIC y Catarata.

Bertol, H. y M. Romero (1999). La introducción del darwinismo en Brasil: las controversias de su recepción, en Glick, Th., Ruiz, R. y Puig-Samper, M. A. (eds.), El darwinismo en España e Iberoamérica, Madrid. UNAM, CSIC y Ediciones Doce Calles.

Cappelletti, Á. (1994). *Positivismo y evolucionismo en Venezuela*. Caracas: Monte Ávila Editores.
Cheroni, A. (1999). Darwin en el reino de las vacas. In T. F. Glick, R. Ruiz, & M. A. Puig-Samper, (Eds.), *El darwinismo en España e Iberoamérica*. Madrid: unam-csic-Doce Calles Editores.
Condarco Morales, R. (1978). *Historia del Saber y la Ciencia en Bolivia* (p. 424). La Paz: Academia Nacional de Ciencias de Bolivia.
Darwin, C. (1872). *The origin of species by means of natural selection, or the preservation of favoured races in the struggle for life* (6th ed.). London: John Murray.
Darwin, C. (1894). *Journal of researches into the geology and natural history of the various countries visited by H: M. S. Beagle*. London: Ward, Lock and Bowden.
Darwin, C. (1958a). *El origen del Hombre y la selección en relación al sexo* (p. 707). México: Editorial Diana.
Darwin, C. (1958b). *Autobiography of Charles Darwin with original omissions restored* (p. 253). London: Collins. Edited with Appendix and Notes by his grand-daughter Nora Barlow.
Darwin, C. (1977/1837). Questions about the breeding of animals, London, Stewart and Murray. In R. B. Freeman (Eds.), *The works of Charles Darwin: An annotated bibliographical handlist* (2nd ed.). Folkstone: Dawson.
Darwin, C. (1980). In S. Herbert (Ed.), *The red notebook of Charles Darwin* (p. 160). British Museum/Cornell University.
Darwin, C. (1984a). *Autobiografía y cartas escogidas, selección de Francis Darwin, 2 v., traducción de A. Cohen y Ma. Teresa de la Torre, introducción de Luis García Balllester* (2a. ed., p.490). Madrid: Alianza Editorial.
Darwin, C. (1984b). *La expresión de las emociones en los animales y en el hombre, traducción y prólogo de Tomás Ramón Fernández Rodríguez*. Madrid: Alianza Editorial.
Darwin, C. (1987a). *Autobiografía, presentación de Pedro M. Pruna* (p. 188). Barcelona: Editorial Alta Fulla.
Darwin, C. (1987b). In P. H. Barret, et al. (Eds.), *Charles Darwin notebooks, 1836–1844* (p. 747). British Museum/Cornell University.
Darwin, C. (1988). *El origen de las especies por medio de la selección natural, traducción de Antonio de Zulueta, introducción de Jaume Josa i Llorca*. Madrid: Espasa Calpe.
Darwin, C. (1999). In F. Burkhardt (Ed.), *Cartas de Darwin (1825–1859)* (p. 255). Madrid: Cambridge University Press.
Darwin, C. (2002). *Voyage of the Beagle*. New York: Dover Publications.
Darwin, C. (2008/1839). *Insectivorous plants*. Londres: Murray, 1875. (La primera edición en español es reciente, Las Plantas Insectívoras, trad. e introd. Susana Pinar. Madrid, CSIC, AMC, UNAM, Los Libros de la Catarata, 371 pp.).
Darwin, F., & Seward, A. (Eds.). (1977). *More letters of Charles Darwin*. London: J. Murray and Sons.
De la Torre, C. (1889). Consideraciones anatómicas acerca de los manjuaríes. In *Anales de la Real Academia de Ciencias Médicas, Físicas y Naturales de La Habana* (Vol. 26, pp. 282–291).
Díaz-Romero, B. (1892). *La teoría de Darwin y su importancia científica en la actualidad*.
Díaz-Romero, B. (1905). *El dominio de la biología. Bosquejo para una síntesis filosófica*.
Díaz-Romero, B. (1906). *Estudio de Prehistoria Americana*. La Paz: Imprenta Artística.
Díaz-Romero, B. (1909). Antropología boliviana. In *Boletín de la Oficina Nacional de Estadística, núms* (pp. 49–51). La Paz.
Díaz-Romero, B. (1917). Disquisiciones biológicas, ¿Es un organismo la sociedad? In *Revista de la Asociación de Est. Med*. (núm. 1). La Paz.
Díaz-Romero, B. (1920). *Ensayo de Prehistoria Americana. Tiahuanacu y la América Primitiva* (p. 198). La Paz: Arnó Hermanos.
Díaz-Romero, B. (1921). *Ecclesia versus Scientia* (p. 268). La Paz: Casa Editora José L. Calderón y Talleres Gráficos La Prensa.
Dumont, L. A. (1877, junio 20). "Haeckel y la teoría de la evolución en Alemania", trad. Julio Méndez. In *Círculo Literario* (núm. 3, pp. 54–59). La Paz: Imprenta y Librería de M.C. Martinez.
Glick, T. F. (Ed.). (1974). *The comparative reception of Darwinism*. Austin and London: University of Texas Press.

Glick, T. F. (Ed.). (1978). La transferencia de las revoluciones científicas a través de las fronteras culturales. en *Ciencia y Desarrollo* (núm. 72, pp. 77–89). México.
Glick, T. F. (Ed.). (1982a). *Darwin en España*. Ediciones Península, Barcelona: introducción y traducción de José M. López Piñeiroi Barcelona.
Glick, T. F. (Ed.). (1982b). La polémica del darwinismo en Cuba. en M. Hormigón (Ed.), *Actas del II Congreso de la Sociedad Española de Historia de las Ciencias* (pp. 413–418). Jaca, Zaragoza: España.
Glick, T. F. (Ed.). (1982c). Perspectivas sobre la recepción del darwinismo en el mundo hispano. en M. Hormigón (Ed.), *Actas del II Congreso de la Sociedad Española de Historia de las Ciencias* (pp. 49–64). Jaca, Zaragoza: España.
Glick, T. F. (Ed.). (1987, enero-febrero). La transferencia de las revoluciones científicas a través de las fronteras culturales. In *Ciencia y Desarrollo* (Vol. 12, núm. 72, pp. 77–89).
Glick, T. F. (Ed.). (1988a). *El Impacto del Darwinismo en América Latina*. Conferencia en el Aula Magna de la Facultad de Ciencias, UNAM, 12.VI. (inédito).
Glick, T. F. (Ed.). (1988b). *The comparative reception of Darwinism* (2ª edición). Chicago: The University of Chicago Press.
Glick, T. F. (Ed.). (1989). *Darwin y el darwinismo en el Uruguay y en América Latina*. Uruguay: Facultad de Humanidades y Ciencias, Universidad de la República.
Glick, T F., & Henderson, M. G. (Eds.). (1999). Las recepciones científicas y populares de Darwin, Freud y Einstein: hacia una historia analítica de la difusión de las ideas cientfícas. en T. Glick, R. Ruiz, & M. A. Puig-Samper (Eds.), *El darwinismo en España e Iberoamérica*. Madrid: unam-csic, Ediciones Doce Calles.
Glick, T. F., Ruiz, R., & Puig-Samper, M. A. (Eds.). (1999). *El darwinismo en España e Iberoamérica*. Madrid: unam-csic, Ediciones Doce Calles.
Molina Enríquez, A. (1978). *Los grandes problemas nacionales*. México: Editorial Era.
Montserrat, M. (1999). La mentalidad evolucionista: una ideología del progreso en Argentina. en T. Glick, R. Ruiz, & M. A. Puig-Samper (Eds.), *El darwinismo en España e Iberoamérica*. Madrid: UNAM-CSIC-Ediciones Doce Calles.
Moreno de los Arcos, R. (1984). *La polémica del darwinismo en México: siglo xix*. México: UNAM.
Onna, A. F. (2000). Estrategias de visualización y legitimación de los primeros paleontólogos en el Río de la Plata durante la primera mitad del siglo XIX: Francisco javier Muñiz y Teodoro Miguel Vilardebó, en: Montserrat, Marcelo (comp.). In *La ciencia en la Argentina entre siglos* (pp. 53–70). Buenos Aires: Manantial.
Ordañana, D. (1892). *Pensamientos rurales sobre necesidades sociales y económicas de la República* (Vol. 2). Montevideo: Imprenta Rural a Vapor.
Poey, F. (1889). Discurso de contestación. In *Anales de la Real Academia de Ciencias Médicas, Físicas y Naturales de La Habana* (Vol. 26, pp. 291–293).
Rabasa, E. (1921). *La evolución histórica de México*. México: Editorial Frente Cultural.
Ruiz, R. (1987). Positivismo y evolución. Introducción del darwinismo en México. UNAM: México.
Sarmiento, D. F. (1900). Conflicto y armonías… In A. Belín Sarmiento (Ed.), *Obras* (Vol. 37). Buenos Aires.
Soler, R. (1968). *El positivismo argentino* (p. 999). Buenos Aires: Paidós.
Spencer, H. (1985). The Principles of biology. New York: Appleton.
Stanley, J., & Stein, B. H. (1974). La herencia colonial de América Latina. México: Siglo XXI.

Chapter 7
The Charles Darwin Foundation: Some Critical Remarks About Its History and Trends

Günther Reck

Introduction and Background

> "It is alarming to think what would have happened to the extraordinary ecological wealth of the islands if the Galapagos National Park and the international Charles Darwin Foundation had not come into being in 1959. Together, Government and Foundation have not merely halted but have actually turned back the tide of degradation, thus offering bright prospects for future generations. It has been a fortunate partnership. The Galapagos, Ecuador and the world have been the beneficiaries". (Corley Smith 1990, p. 5)

The "Charles Darwin Foundation for the Galapagos Isles" was created in 1959, and since then has been active in the Galapagos Archipelago. The events, discussions, and the background for its name have been discussed in various contributions to this book (Hennessy 2016; Quiroga 2016). This is largely a personal view of some tendencies or changes in thinking which have accompanied the Charles Darwin Foundation (CDF) in the more than 40 years that I have been more or less close to it, as a member of its board, as an ongoing member of its general assembly, and temporarily involved as director (1984–1989) of its "Charles Darwin Research Station" (CDRS).

The first aim of CDF is to protect Galapagos wildlife and habitats from human impact. However, the Foundations perceived role during the time of its existence has changed, just as social, political, economic, and institutional realities and relationships have changed. With a more than 30-fold increase in population in relation to the time when CDF was created and more than 200,000 tourists visiting the Islands every year, the perception about conservation needs cannot keep being the

G. Reck (✉)
Colegio de ciencias biológicas y ambientales, Universidad San Francisco de Quito, Quito, Ecuador
e-mail: greck@usfq.edu.ec

D. Quiroga, A. Sevilla (eds.), *Darwin, Darwinism and Conservation in the Galapagos Islands*, Social and Ecological Interactions in the Galapagos Islands,
DOI 10.1007/978-3-319-34052-4_7

same as when there were just 3000 people living in the islands, or 6000 tourists visiting every year. CDF has had problems in foreseeing those changes and adapting to them, which is one of the topics, which I try to explain in this chapter.

One of the main points I am trying to demonstrate is that CDF has been a heterogeneous assemblage of mainly scientific members with different backgrounds and positions, mostly living far apart from the reality of the islands and with a relatively weak capacity or power for imposing conceptual guidelines on different heads of its Research Station (CDRS) or executive Directors, as opposed to the idea of a strong international group pulling the strings from far away and exerting influence according to guidelines from foreign agencies or associations.

It all has to do with the definition or conception of human presence versus the fragility or continuity of the Galapagos Islands. At least in the beginning, conservation was conceived as the recovery of the island ecosystems as close as possible to the "original" state before human presence started to play a major role. To which degree this could be possible and how far changes imposed by human colonization could be neutralized or counterbalanced has been a main topic of discussion since then.

Why CDF?

CDF came into being because of the perception of the urgent need for conservation of the remaining wildlife of the Galapagos, which had been strongly decimated by human exploitation and introduced domestic animals and invasive plants. Those concerns had already been documented in the early twentieth century (Smith 1990), but for many reasons (Hennessy 2016; Grenier 2007; Cairns 2011) it took several decades until those worries were transformed into concrete action.

The creation of CDF can be considered as a positive response of the international scientific community to assist Ecuador in its intents to initiate practical conservation of the island. After decades of failed efforts (Hennessy 2016), in 1954 a young Austrian ethologist, Irenäus Eibl-Eibesfeldt, raised alarm about the condition of wildlife on the islands. He and the young ornithologist Robert Bowman from UCLA (who had previously studied the song of Darwin Finches) were, by invitation from the Ecuadorian government, sent to the islands on a mission to formally evaluate the situation and make recommendations on conservation and the possible establishment of a research station. Their reports independently reaffirmed the many threats to Galápagos ecosystems, but had also found that there was still a high presence of the unique wildlife of the islands, well worth to receive concentrated efforts for their maintenance (Eibl-Eibesfeldt 1958; Bowman 1960). The international Zoological Congress in Brussels 1959 reacted to this information and took action, establishing the "Charles Darwin Foundation for the Galápagos Isles," under Belgian law and under the auspices of a group of eminent and world-known scientists and conservationists not by coincidence (note that 1959 was the centenary of the publication of the "Origin of Species"), the Ecuadorean government under President Camilo Ponce Enriquez, in that year created the National Park (Emergency Decree 17, R.O. 873). Once CDF had been formed

(Smith 1990), it was allowed to build a Research Station (later on called CDRS, Charles Darwin Research Station) on the island of Santa Cruz, as an effective way to assist Ecuador, which at that time still had very few scientists and no administrative structures to take charge of this endeavor. Five years later, a modest infrastructure had been finished, ready to receive a group of international scientists. At this time, the then ruling military junta signed a 25-year agreement with the Charles Darwin Foundation entrusting it to do as much as possible to help restoring the wildlife and to advice on its conservation. Concurrently, an executive decree (Nr. 523, R.O. 234, April 1964) authorizes the Charles Darwin Station (mentioning UNESCO and IUCN as originators, but not CDF) to define the limits of the areas to be protected, to define conservation priorities and start with the active extermination of introduced species.

This was a big responsibility for the Darwin Station. Conservation of biological diversity did not yet have a long history, had very limited worldwide support and financial resources (both UNESCO and IUCN were formed just before 1950), and the scientists or field staff sent to Galápagos by CDF were mostly young scientists with a lot of enthusiasm, but little experience in terms of what conservation really ought to be and how it should be carried out. The Station consisted basically of one man at a time who had to recruit the local help among Ecuadorian and foreign settlers in order to build the modest infrastructure with very little support, limited resources, and considerable logistical difficulties (Smith 1990; Lundh 2004). Station directors Raymond Leveque, André Brosset, and David Snow replaced each other in rapid succession between 1960 and 1964.

CDF and Its Research Station: Who Decided What?

Despite the international interest in helping and contributing to the conservation of the islands, channeled through CDF, once that the Research Station had been created, its staff was pretty much left alone in deciding on conservation actions and priorities, within the very narrow financial framework available. After the first group of Directors, in the 1970s, the newer generations at least could count with some orientation from more experienced people, such as the new presidents and some of the board members had been CDRS Directors before (as in the case of Peter Kramer, visiting scientist in the 1960s, CDRS Director 1970–1973, CDF President 1974–1984, and Craig McFarland, Ph.D. Student in the late 1960s, CDRS Director 1974–1977, CDF President 1984–1996). In my case, before becoming CDRS Director (1984–1989), I had been working in the Galapagos for 10 years as guide and as fisheries scientist, and Robert Bensted-Smith (1994–2000) and Graham Watkins (2004–2008) had been working as guides long before returning to CDRS and becoming the Directors. During my tenure as Director of the Research Station (1984–1989), with no internet, or even functional telephone service, and although I receive orientation from CDF officials during yearly board meetings, most decisions had to be taken on the ground, on the base of our own local experience, knowledge, and best judgment, adding some scientific advice from visiting scientists or experts, consultations with local staff or Park personnel.

For most years during the 1960s, 1970s, and early 1980s, the Secretary General of the Foundation was Corley Smith (a knowledgeable, wise gentleman and diplomat, former UK ambassador to Ecuador). Both he and the president lived far away from the day-to-day business of CDRS with correspondingly little interference. CDRS was the core of the operation, and CDF an international supportive organization. After Corley Smith, the position of Secretary General (SG, the person who coordinated the day to day business) of CDF was laid into the hands of Juan Black, first National Park Officer and later representative for CDRS in Quito. During Juan Black's tenure, both as representative and later Secretary General of CDF, a particularly close relationship to the Ecuadorian Government and scientific community arose, and with his experience and skill, local diplomats, politicians, business representatives, and scientists from Ecuador became members of CDF. The day-to-day business of CDRS (contacts to continental institutions, reception and logistical support for visiting scientists, contacts local volunteer, and thesis students) was handled by the SG office although the Director of CDRS was still the legally responsible executive of the organization. A very symbiotic relationship, as I perceived it during most of my time with Juan Black, eventually turned into occasional conflicts of power and decision-taking, and discussions about the role of CDF as organization, represented by the SG, and CDRS as actual field operation. During the 1990s, those conflicts increased, leading finally to the integration of both positions (SG of CDF and Director of CDRS) into the position of Executive Director of CDF, along with a change of wording: from then on CDRS disappeared from logos and T-shirts, CDRS was basically not to be named any more, and only CDF continued to be used both as supporting international as also as locally operational unit.

Why mention those organizational details? Well, for the further line of reasoning it is important to understand that CDRS Directors were mostly totally new to CDF when being appointed although with varying previous knowledge of the Galapagos. Also, both directors and staff scientists did not receive any essential instruction about institutional policies towards conservation issues, the local public, or also international or national politics. Consequentially, several staff scientists perceived conflicts of interest between their own research interests or priorities and expectations about complying with research for conservation needs, coordination and administrative obligations, and training and supervising young Ecuadorian volunteers or thesis students (also documented in Grenier 2007).

There was never a clear conceptual orientation of CDF as which would mastermind everything which was done or decided, and CDF meetings were mostly worried about financial sustainability and budget issues, leaving little time to discuss conservation and science-related topics and many board members also had a more than distant knowledge of the local or national conservation context. The accumulated institutional experience which CDF was supposed to have was mostly concentrated in its representative library, but certainly not among many of its young and inexperienced staff.

It must be understood therefore, that, whenever I mention CDF, I mostly talk about decisions, actions taken, or pronouncements made by CDRS staff (or later CDF staff) on the ground without significant intervention or consultation with the board of the CDF, which on the other hand was never a very well-organized body of international

conservations managers with clearly defined policies and orientations, but a group of scientists with different origins and positions and varying levels of understanding of problems and local knowledge further than their very specific field of experience.

Growth of the National Park Service and the Onset of Joint Planning

Some protected areas did exist in Latin America before 1950, but the creation of UNESCO in the late 1940s, the creation of the IUCN (the World Conservation Union nowadays) and it's for many years main fund-raising partner WWF, together with the initiatives of the United Nations Food and Agriculture organization FAO brought about a whole movement for the propagation of Protected Areas in Latin America and World Wide. Most governments had no experience and no personnel to get involved. International training programs were established locally and internationally (such as the CATIE in Costa Rica), where even now Ecuadorian Park professionals get trained. The Galapagos National Park was a precursor of national parks in Ecuador, and international assistance made it possible to establish it. But the goal was eventually to establish a national protected area system and train personnel. All protected areas were national territory and eventually had to be administrated by the Ecuadorian state and its institutions.

In 1968, the first two National Park Wardens arrived in Galapagos as part of the newly formed Wildlife and Protected Area department within the Forestry directorate. Coincidentally, at the same time, the first continental Nature Reserve was created in the Cotacachi Region in Mainland Ecuador. Juan Black and José Villa started to work from the offices of CDRS and basically under advice and orientation by the CDRS Director, at this time Roger Perry. This development fulfilled the expectation of CDF in so far as finally there was a specialized Ecuadorian state agency as counterpart with the guarantee of continuity for conservation. CDF was finding its niche in advising and supporting with a local presence.

In 1973, the first management plan for the National Park (written by foreign consultants with intense participation of CDRS) was finished (Kramer 1975 a). At that time, the National Park Service had few employees. Early in 1974, they moved to their own new headquarters located within the same area which the government had given to CDF for its operations, but conservation decisions and activities kept depending on cooperation and support by CDRS. The Park director (Miguel Cifuentes) was a pupil of the station director (Craig McFarland) and consultations were permanent.

Although the Darwin Station kept growing and expanding its activity, a large part of its efforts went into strengthening the National Park Service and its staff. It was one of the perceived functions of CDF (this was an unwritten consensus among all CDF members and staff) to keep strengthening the one Ecuadorian institution to be responsible in future for the conservation of the island's biodiversity and therefore also to contribute in the informal training and to create opportunities for professional practices of as many Ecuadorian university students as possible.

From 1970s onwards the National Parks field missions were financed by international funds (WWF and others) through CDF and slowly the professional capacity of the Park increased substantially. CDF, on the other hand, without directly paid scientific staff, had trouble keeping up with the demands for conservation-oriented research, monitoring, training, and advisory functions (Kramer 1975 b). With the creation of the National Galapagos Institute (INGALA, 1980) for the first time the Ecuadorian government directed funds to CDRS for the hiring of—mainly Ecuadorian—scientific staff (trained previously at CDRS) in order to strengthen the capacity to do conservation-oriented research and monitoring. This was a recognition that the involvement of young Ecuadorian scientists was one of the goals and was the means for strengthening local capacities, and that the previous 10 years of training young people had had positive results. It also enhanced relations with the Ecuadorian Universities who sent most of the young volunteers, thesis students, or field assistants to be trained at CDRS: Catholic University and Central University from Quito and State University of Guayaquil.

Eventually, both institutions were becoming large, and simple consultations at the directive level were not sufficient any more to guarantee coordinated action. Prolonged joint planning sessions became necessary, starting in 1987 and were kept up for many years after. By many, particularly staff scientists, these meetings were perceived as time lost for research and doing "serious work". At the time, they did not recognize the essential function of collaboration and the goal of reducing the barriers which eventually would rise between the two institutions. This example shows some of the narrow-mindedness, which was in the way of the pursuance of long-term common interests.

Nevertheless, there was agreement about the most urgent priorities for action: find out as much as possible about the current status of the native wildlife, do research oriented towards the most efficient conservation practices, save as many populations of endemic reptiles as possible, control or eradicate as many of the invasive mammals and plants species as possible, and educate local people starting at school age, (including the training of local teachers) to bring forward a positive attitude towards conservation. The lines were clear, the weight put on the different components changed, as also priorities for research on endemic wildlife or other issues varied through time.

Many of those principles were brought together in a (25 year!!) Master Plan for the Development of CDF, published in 1992, which was widely consulted and agreed among station scientists and foundation executives, and for which I had the opportunity to do the initial work as consultant, after my time as station director.

This Master Plan was a certainly valuable effort to leave behind the more spontaneous decision-making process of the past in relation to conservation challenges. CDF had passed the first 25-year agreement with the government (1964–1989), a new agreement had just been signed, and many new challenges were visible to which it seemed necessary to count with consistent and long-term positions and answers: immigration-based population growth and resource use, exotic species turning invasive, a new protected area (the Marine Reserve) and fisheries, the definition of the role of CDF/CDRS in face of a much larger and powerful GNP, decisions about the

use of the area where the Station is located. The reaction to this document reflects closely the dilemma of CDF through time, already mentioned above. Subsequent directors did not even take the time to read the document, and knowledge of it was not an obligation for later administrations. Each new executive established his own priorities, and it was obvious that there was nothing such as an institutional policy at the organizational level which would become an obligatory guideline for action. Besides some common principles, there was no long-term policy established for CDF officials. Institutional memory is a relative issue, to say the least.

Those explanations seem necessary in order to understand that many of the activities, decisions, orientations, and concepts maintained over time were not responses to organizational guidelines or strategic discussions in the background but belonged to individuals or small groups in decisive positions at any one time. This may also explain changes in orientation or policies which also responded to donor preferences. There were discussions about how to respond to challenges regarding major threats such as introduced species. But major uncertainties existed about the most appropriate way to go in regard to increasing socioeconomic issues and pressures. How to react to tourism growth? Are fisheries sustainable and under which circumstances? What would be a sustainable future for a growing population under Galápagos conservation norms? What should the niche of CDF be under the context of a growing organizational and institutional complexity and with increasing local capacity to manage conservation concerns?

Tourism and the Darwin Foundation

In the 1950s, just a few 100 people lived in the islands. The government even gave incentives for people to colonize the islands, as I was told by an old settler who came by the end of the 1950s, that most of them were dedicated to agriculture, livestock, and some to Bacalao fisheries. But impacts were ample, particularly in the humid highlands, as there were no limits as to where people could go with their cattle and other domestic animals and plants. The reports produced by Eibl-Eibesfeldt (1958) and Robert Bowman (1960) based on the evaluation of the conservation situation of the islands stated that there were many challenges that needed to be addressed, but it also concluded that many problems could be resolved with active conservation efforts, and that tourism could be an adequate alternative for local people to use the GPS resources without using more land. These reports eventually led to the establishment of the Charles Darwin Foundation (Smith 1990; Lundh 2004; Grenier 2007).

In the 1960s, there were many initiatives of people who wanted to invest in tourism. Several studies about the tourism potential of the islands were funded. There was an active participation of the Foundation in the second half of the 1960s in the study of tourism. Thus, for example, one former director (David Snow) participated in a consultancy on the management of the National Park, including the proposed tourism management, which had been promoted by Corley Smith (Grimwood and

Snow 1966) and CDRS staff advised on potential visitor sites and itineraries, proposed as part of a feasibility study prepared for the National Finance Corporation of the Government of Ecuador (Jennings 1967).

Locally driven tourism during the 1960s was very basic. Ecuadorian cargo and supply ships took tourists along and as part of their circuit, and they landed wherever they wanted without any rules or controls. But after the above-mentioned feasibility study several initiatives started to materialize. The international nature cruise operator Lindblad came with its cruise ship MV Explorer several times during 1969, but also cooperated on a permanent basis with the sailing yacht Golden Cachalot, which started to execute regular 14-day cruises for 14 passengers at a time. Logistics to and from Galapagos was offered by the Ecuadorian Agency Metropolitan Touring, which during the same year acquired its own ship under Greek flag, the MV Lina A. Most of those early initiatives came from outside the Galapagos, but this still marked the beginning of economic opportunities for the local population. Europeans and Americans who had settled in the Islands started their own tour operations or tourism-related business, the Schiess family operated a laundry service, Forrest Nelson already had his Hotel, the Angermeyers as experienced sailors became essential as pilots or early guides. Ecuadorian families such as the Herreras, who were cattle farmers in the highlands, provided fresh meat, and Raphael Ortiz, later a representative from the Islands in the Ecuadorian Congress and a Hotel owner started out selling T-shirts, to name just a few.

CDF/CDRS as Servants of the Tourism Industry?

Of course, there were worries about the compatibility of the initiating "big-scale" tourism operations with conservation principles and goals. However, as already expressed by Eibl-Eibesfeldt (1958) and Corley Smith (1990), who was a promoter of the Grimwood-Snow report, tourism was seen as a potentially compatible way of using nature without destroying it.

Right from the beginning there was a very close relationship between the tourism industry and the CDRS, and after 1968, this included the new National Park service. This association has been criticized, trying to reduce conservation efforts of CDF and others to a sort of service for the benefit and at disposition of the large tourism enterprises. It has also been suggested that the CDF interested in an irresponsible way in tourism development as a source of continuous and stable funding (Grenier 2007). The fact is that at this time, tourism was seen as a potentially compatible alternative to other extractive activities, and its contributions to the economic development of the country would have been recognized with or without the contributions of CDF. How Galápagos acquired the particular status as tourism Mecca is described by others (Grenier 2007). To help guaranteeing that tourism be controlled adequately, not only rules for good tourism practice were developed, but also CDRS assisted in the recruitment of a number of biologist worldwide as naturalist guides and as honorary Park Wardens that would also help to control the Park. An activity that the Park Service, with its limited personal at the time could never guarantee.

In my case, I became aware about the opportunity to become a naturalist guide through Frankfurt Zoological Society, a conservation organization which was by then one of the important sponsors of CDF, and which distributed the information on behalf of CDRS. Without knowing very much, my first reaction was one of worry. Writing to the CDRS Director Peter Kramer, he pointed out the importance of tourism, and its compatibility with conservation if it was well done and the important role of knowledgeable and conscious guides. CDRS played its role in receiving the guides in their facilities, where they made friends with its own and Park personal. The training was very informal; the small group of guides had full access to all library resources, and participated in conversations with the director, staff scientist, and park wardens. Together with my colleagues from several countries, we were proud to become a part of the "conservation establishment," be a friend of CDRS scientists and be respected in our role by park and Station alike.

The National Park and Darwin Foundation saw the guides as crucial elements to their conservation efforts; this also meant that the tourism companies other than paying for the housing of the guides were saving money by not paying for their guide's training, despite the enormous aggregated value towards the quality and fame of their operations. The relationship between CDF and tourism industry was symbiotic and collaborative. Park officials regularly went along on cruise ships, not to control, but to learn, interact with guides, and improve the design of visitor sites.

Once the larger tourist vessels became established and a permanent need for dozens of guides had developed, the CDRS started to develop guides courses. Later, CDF developed guides courses in a more systematic way. This was initiated by Craig McFarland. CDRS Director from 1974 to 1977, and later CDF President for many years. It was interesting that not only naturalist guides from abroad were trained, but also that specific course for local auxiliary guides, sailors, and other personnel were offered. The National Park kept depending on this free contribution from CDRS for many years until the late 1980s, when the organization of course slowly was taken over by the Park, but teaching still was sustained by CDRS.

Carrying Capacity

In most of the 1970s, there was no clear awareness of how tourism would eventually grow and influence population increase in a way, which would get out of control. It was however recognized at the time that tourism was an important source of financing and international support for the Charles Darwin Foundation and the National Park Service, despite the concerns about tourism impacts, and there was a clear idea of a maximum carrying capacity, which could soon be exceeded.

For CDRS scientists and guides alike, this carrying capacity was already reached with the number of 12,000 tourists, which had been identified at that time. There was the conviction that wildlife would go away with increasing pressure. We were all suspicious about any fluctuation in the presence of sea lions or birds, attributing those variations to undue visitors or guides behavior. I remember the filmmaker from WWF, using

the CDRS facilities, who located microphones underneath the blue-footed boobies and based on the increasing heartbeat at the approach of tourists tried to insinuate the unsustainability and unfriendliness of continuous tourist operations.

CDRS staff scientists Tjitte de Vries (later one of the first ecology and field biology teachers who trained dozens of Ecuadorian field biologists) and Robert Tindle (Medical doctor turned Ornithologist) measured during several years the impact of people on tourist trails on the behavior and breeding success of seabirds (Tindle 1983). They supervised students from the Central and later Catholic Universities of Ecuador who spent months in the field evaluating transects along and across visitor trails at some of the most frequented visitor sites such as Punta Suárez on Española Island and Darwin Bay on Genovesa. Those were some of the few important opportunities for field practice for biology trainees in the country at that time. Finally, this line of study was abandoned as no apparent direct impact could be shown (Tindle 1983). It soon became clear that the model of cooperation between Park, the tourism industry, and the Foundation was so successful that it prevented any kind of visible impact, such as the abandonment of breeding colonies or the disturbance of breeding cycles. On the other hand, without this type of impacts, it became difficult to argue against further tourism growth. The conviction about the existence of a maximum carrying capacity of Galápagos visitor sites and wildlife nevertheless persisted, and until today there are still quite a few scientists, guides, and members of conservation NGOs who keep being suspicious of the potential direct impacts of tourism on wildlife, feeling guilty at the same time about previously having favored tourism as a sustainable and beneficial activity.

Tourism and Population Growth, Was CDF Part of It?

Only slowly the awareness grew, that the real long-term impact on Galapagos nature was much more closely linked to the growth of the resident population, and the permanent arrival of new immigrants. The number of residents in the Islands has grown in the order of 6–7 % every year. It was very obvious to everybody that this was incentivized by the many labor and enterprise opportunities created by a rapidly growing and service demanding tourism industry. A floating population nowadays of more than 3400 visitors every day needs considerable service and accommodation infrastructure provided by a nearly ten times larger permanent population organized within strongly development and growth-oriented local governments.

The Darwin Station, which at the beginning played an active supporting role for tourism development, abandoned this role slowly in the 1980s becoming a somewhat helpless observer of the new social and demographic dynamics, which acquired their own speed and direction. Population and tourism growth were clearly recognized as interdependent, but no nonpolitical response was seen for this development, and CDF saw itself limited by its international status in warning and insisting on government responses. On the other hand, maybe quite opportunistically, growing tourism was also considered as a potential source of donations, which could be used to

strengthen active conservation and restoration initiatives. The lack of evidence of negative tourism impacts on wildlife as such within the protected areas was certainly a factor, which reduced the sense for urgency about those issues.

The ambiguous condition of CDRS was expressed by Nelson Herrera, Puerto Ayora's mayor in the late 1980s, who pointed out to me that his village had grown and become relatively prosperous, mainly because CDRS and its tortoise raising Center was a nearly obligatory visitor site for many tourism operations, creating therefore opportunities for business for hundreds of locals who sold souvenirs along the road which led back from the Station to the village dock. Which means that CDF in itself was one of the drivers for population growth. During Nelson Herrera's time as mayor there was another event which pointed out towards the growing conflicts and the ambiguous position of the CDRS. This happened at the end of my time as Director of CDRS. The municipality started to build a road to Tortuga Bay (the site that originally had been proposed for CDRS). CDRS staff and volunteers (quite a few of them locals) prevented the heavy machinery from going on with this endeavor pointing out the dangers of this unique site being taken over and privatized by international Hotel chains, and reducing the value for local people. In a town meeting, those arguments were broadly supported and finally led to the building of a broad and comfortable walking trail, which until nowadays is the only terrestrial access to this site.

CDF as Public Representative of Conservation Concerns

Despite this support, it became evident, that conservation was not a significant concern for the local population, and that the resident population was neither prepared, nor ready, nor motivated to be involved in conservation actions at the community level. It was also clear how precarious our position was, as an international organization, in directly shaping local politics, and that there was too much reliance on CDRS for representing conservation interests at the local level. CDF had several internal and external conflicts. Internally, there were quite a few representatives of the tourism industry in the board of the Foundation but no fishermen or farmers. The tourism industry had a greater interest in conservation since iconic nature was the main product that they were selling. But certainly those members also influenced membership discussions in not directing efforts towards more control of tourism growth, which was not to the likening of all. But on the other hand, externally, this awarded a certain stigma to CDF of being overly influenced and controlled by the tourism industry and of neither being independent nor having a critical stance towards uncontrolled growth.

Until today, both CDRS personal at the local level, as many CDF members have a mixed attitude towards tourism. What started first as an outspoken support, turned into growing wariness and worry about the loss of control and the recognition that tourism is not a threat in itself, but the driver and motor for increasing the loss of isolation and growing interconnection of islands and the main cause of population growth. As time went along, it was evident that the original argument of CDF against

tourism growth became more and more unsubstantial. As the very successful model of tourism management prevented on-site damage, the slogan of "killing the goose of the golden eggs" (related to surpassing the carrying capacity of the islands and therefore risking the wildlife which attracts tourists in the first place) did not work.

In 1985, Emilio Bruzzone, tourism director under President Febres-Cordero, proposed increasing tourism numbers in the islands to about 150,000 visitors. He was not only thinking about revenues out of Galapagos, but about an obligatory stay over in Guayaquil, whose Hotel industry he wanted to benefit. There were less than 40,000 tourists coming to the islands at that time, and this type of growth was simply unconceivable! Emotional protests on behalf of conservationists and universities at the national level resulted in the national press getting involved. During the World Conservation Congress 1984 in Madrid, I had to prepare a Congress resolution asking the Ecuadorian government to be careful and not risk what so far had been a successful management of the islands. At the same time, the French Journal "Le Monde" depicted Bruzzone as an irresponsible developer endangering the world heritage and with a Dollar sign on his face instead of eyes. Bruzzone was not successful with his plan, but all this shows to me the long-term futility of our efforts. In the light of the number of tourists having surpassed 210,000 during 2014, one might think that CDF and its national and international allies might have delayed the growth rate just a little bit, but without having any significant influence on tourism growth as such.

Fisheries

CDF was an active promoter of the conservation of the marine area (Reck 2014). Management proposals by Jerry Wellington in 1986 (Reck 2014, Wellington 1984) and later on the creation of the Marine Resource Reserve (1986) included the acceptance of marine fisheries at the local, artisanal level. Fisheries research during the 1970s under my coordination, carried out by the National Fisheries Institute, had the full support of CDRS (Catrejón et al. 2014). However, the sudden informal but near explosive growth of the sea cucumber exploitation at the beginning of the 1990s took everybody by surprise. Something had happened without us being aware of it! How could that happen? It was an extremely profitable activity. Sea cucumbers are sluggish, unmoving animals, and hundreds of thousands of them were apparently just lying around in shallow water. With little skill needed in the beginning to gather many of them and with simple technology induced by outside merchants, people could make lots of money in a short time. The flow of money was able to corrupt politicians and mafia-like organization operations appeared. People fought the authority, and a poaching culture arose that had never before been present in the Galapagos. Serious governance problems made their appearance.

Our first concern at the time was not the over-exploitation of the sea cucumbers, but the illegal temporary camps created by the fishermen on highly sensible islands like Fernandina where no introduced species were present. The people in those camps gathered dead mangrove wood and cooked their cucumbers, docking directly

against the rocky seashore. The probability of rats or cockroaches reaching the shore from dirty uncontrolled boats was high. Suddenly, the marine department of CDRS, which for years was rather small, became important, and at times over 40 people were working there. The National Park had hardly any influence and experience in the marine area. CDF, from the Secretary General's office in Quito, started promoting a management plan for the marine resource reserve in the beginning of the 1990s (Reck 2014). These efforts to regulate the fishery lead to violent occupations and threats for CDRS and the Park.

Marine conservation and the creation of marine protected areas had suddenly become a worldwide conservation priority, and funding was now available at a much more generous level. Suddenly, the marine environment of the Galapagos came to international attention, and the call for conservation measures became strong, covering many other more terrestrially centered conservation concerns. Before the sea cucumber fisheries started, marine conservation was of some concern due to El Niño in 1983 and the fact that there was rising pressure on endemic species such as the Galapagos grouper (Bacalao). Once sea cucumber fisheries started, however, suddenly non-endemic species of a rather wide geographic distribution became important because of their economic and sociopolitical impact. A similar problem resulted from the spiny lobster fishery.

None of those fisheries could be understood and managed without a profound knowledge of the socioeconomic context, and for the first time Station scientists were confronted with the need of not only creating good biological science but also understanding social issues and negotiating and participating in conflict management efforts. The Station was hardly prepared for this new challenge which brought CDRS into a situation were not only scientific capacity was needed but socioeconomic investigation (for the first time real social scientists were contracted) and political action which had been out of the focus of CDF for nearly two decades. One side effect of this concentration on marine research, conservation and politics of the 1990s was that tourism was basically forgotten as a matter of major concern, despite some review of the carrying capacity issue. Another revelation was the extremely opportunistic attitude of the tourism industry, which betrayed their original invested interest in conservation. At this time, their main concern was just preventing international scandal arising around the fisheries problems which went public with the violent attitudes of the fishermen. This meant that the policy of the tourism sector was basically accepting any demand from the fishing sector as long as this kept the fishermen quiet and the tourists coming. One must credit CDRS at that time for pushing forward the process for creating a very stringent and technical participatory process for the management of the Marine Reserve and a rather innovative and pioneer way of participatory management of the Reserve. As an advisor to the Minister of the Environment at this time, I could do little more than recommending the full support for this process. The Charles Darwin Foundation was also actively involved in the creation of the Galapagos Marine Reserve (Reck 2014).

With the growing importance of marine conservation management, once again a situation was created which was similar to the initial relationship between CDRS and the Park Service in the early 1970s: GNP, without much experience in the

management of marine resources, depended on the advice and support from the CDF structure. The quotas were proposed by CDRS, fisheries monitoring was carried out by CDRS scientists, and CDF played an active role in the marine management authority, and the participative management group. This time however, the critical role that the CDF had to play was understood much sooner than in the decades before, as national and local agencies as well as an important group of marine scientists at the national level discussed the direct involvement of an international organization such as CDF. This discussion was carried out also within the organization, with an important number of members advocating a much lower level of involvement in decision processes or gremials which had power of decision.

Goals for Conservation. What Is Conservation?

Evolution on oceanic islands happened without human presence and in many cases the absence of large terrestrial (mainly mammal) predators or grazing competitors. The Galápagos was recognized as an exceptional place to do evolutionary and ecological research, particularly due to the simplicity of its ecosystems. The application of the principles of the World Conservation Strategy in the 1980s, that were later included into the Convention on Biological Diversity (CBD) and an integral part of the principles of the emerging scientific discipline of Conservation Biology, meant that the management of the Galapagos was directed not only on the maintenance of the existing biological diversity as such, but also of the capacity of wildlife populations to undergo further evolutionary and adaptive processes in order to be resilient to environmental change.

In the case of the Galápagos, as a "Living laboratory of evolution," those principles took a special significance. The goal was keeping processes as little affected by human presence and its direct (habitat change, hunting) and indirect (bringing invasive species) impacts as possible, maintaining the biotic identity of each islands where differential evolutionary processes had brought about island endemic representatives of many plants and animals. Those principles were included into a 25-year plan for the Darwin Station in 1992, with my participation, and later on, they were also included into the principles of the Galápagos Law of 1998, where a glossary introduced additional definitions of sustainable development, which included the maintenance of those principles. My own participation in this process (as coordinator on behalf of the Ministry of Environment) once again enables me to talk about the role of CDF. Although not a member of CDF at the time, and acting with the direct support only of Universidad San Francisco de Quito (USFQ), I could not deny my past as former CDRS staff and CDF member, and kept being identified by many in this affinity. CDF, with Secretary General Alfredo Carrasco, supported the law-making process channeling international funds for logistic purposes (providing the cost of transport for Galapagos residents and similar) but also participating with constructive recommendations and text proposals in the law-making consultations, with a particularly active role of CDRS Director Robert Bensted-Smith.

It is with this baseline of principles and conservation postulates that one must look at the different ways of going about conservations policies and actions and research priorities, as they are a point of reference, from the late 1990s onwards, not only for the activity of CDF (including its field station CDRS) but also of other conservation NGOs (such as Fundación Natura, WWF, The Nature Conservancy, Conservation International, WildAid, Sea Shepherd) which started to complement, but also to compete with, the activity of CDRS. A Biodiversity Plan of Action elaborated with the participation of a large group of terrestrial and marine scientist together with WWF in the framework of a large workshop, defined necessary conservation goals and research for biodiversity (Snell et al. 2002), but failed to some degree taking into account necessary adaptations to socioeconomic and political development.

The aforementioned principles, even at that time were quite utopic, with the permanent flow of cargo ships, and fishing and tourist boats increasingly moving between all islands. But they were a necessary backup for the efforts to implement a quarantine system which is still in constructions nowadays (nowadays transformed into the Agency of Biosecurity for Galapagos, ABG, with agents in every port controlling incoming cargo and luggage). It was considered to be of primary importance to cut down on introduced species, but also to drastically reducing the probability of new introductions, proportionally related to the number of people in the islands and the growing dependence on supplies from the mainland in this by now widely open assemblage of ecosystems. What to do if you cannot get rid of those species and on the other hand being unable to influence the population growth to which the increase in introduced species is proportional? It should be mentioned that despite the emerging efforts, some of the maybe most dangerous species were introduced during the last two decades (!!) and these are little insects, whose later control and eradication is extremely difficult. It was CDF and its staff, which in the late 1980s elaborated the bases for the quarantine program and took the first coordinating and facilitating steps, which is the base for what originally was the "System of Quarantine for Galápagos" and is nowadays ABG. CDF also was a driver in the establishment of a system for the control or sterilization of pets or the control of introduced species (like wasps or pigeons) within human populations, with the goal of reducing health risks, but also to prevent their spread into the protected Park space, which was later integrated into the functions of ABG.

How to Reduce Human Development?

Whereas many CDF members and staff recognized the reality of human presence and population growth in the islands, for many of them the long-term conservation goals for Galápagos were (or are) still conceived as only being reachable if human population could be reduced or at least the growth rate drastically reverted. Howard Snell was one of the main resident scientists and conservation biologists for CDF and the

Station during much of the 1980s and the 1990s. A pioneer in iguana conservation, his worries were about the maintenance of viable populations of the different islands taxa of all Galapagos reptiles, and from there towards many other terrestrial vertebrates. We were the main organizers of an international Workshop on reptile conservation in 1988, in order to define priorities for reptile research and conservation.

His analysis (Snell et al. 2002) concluded that on most islands biodiversity had been lost heavily through human presence for whatever reasons and that there was no evidence that more controlled and conscious human presence would change that. Professor Snell was highly respected and liked in the local population, but his concern was the future of Galapagos with an increasing population. He demonstrated clearly, that the large islands contributed most to the biodiversity of the Archipelago, with a clear species/surface relation just as in other oceanic islands, and pointing out that it was precisely those large islands, which because of their ecological characteristics also were heavily colonized by humans. Isabela, for example, is the largest island of all, and contributes with over 40 % of plant biodiversity. Preservation of biodiversity on those large islands was a priority, and this made the human presence an even more serious issue.

Snell showed that there is a relation between the time of human presence on oceanic islands and species extinction. Snell's view suggested that there is very little correlation with what people were doing and this tendency of species disappearance. In a matter of centuries, oceanic islands had lost many species due to human presence. Conservation or no conservation, species were disappearing because people were there. The evidence showed that particularly oceanic islands are fragile and that many of them, with a longer human presence than in the case of Galapagos, had lost proportionately a much higher percentage of their biodiversity than comparative continental environments. He showed that several archipelagos even had had giant tortoises before the arrival of humans. For the case of Galapagos, Snell's analysis was pessimistic since the goal of conservation efforts was to maintain the remaining biodiversity intact, but increasing human presence seems to be principally incompatible with it. If the idea were that in the long run people would lead to higher rates of extinction, the solution therefore would be to make people leave the islands, reduce the human population, or at least prevent its growth. So what if you want to be as cost-effective as possible, if you want to gain the most with the least amount of economic investment and social cost, working on the conservation of biodiversity of Isabela seems like a good starting point.

Finally, in comes Robert Bensted-Smith, Director of CDRS between 1995 and 2000, who, based on Snell's thinking introduces a sense of realism and creative thinking about how to solve problems in a practical way. So, people are already living in the Galapagos, and they are going to stay there forever. It was no longer possible to understand Galapagos without the presence of people, whether desirable or not. They had become an intrinsic part of the reality. Isabela, the biggest Island, with its very large percentage of the biodiversity of the Archipelago, had still a relatively small and manageable human population of no more than 2000 people (against over 10,000 in Santa Cruz and maybe over 6000 on San Cristobal). If there would be an adequate set of

incentives, why not redistribute those people on the other inhabited island (San Cristobal and Santa Cruz, two islands that in the conservationist's minds are gone because of their high demand on resources and advanced human development). Maybe the whole thing could be feasible. Furthermore, Isabela's project of goat eradication proved to be highly effective. Using helicopters, goat population was eliminated north and south of Isthmus Perry. But if the local human population remained, domestic animals would always be a source for reintroduction. Domestic animals are associated with humans. People cannot live without them so there will always be a risk factor in the long run.

During the work on the Galapagos Special law during 1997, there was a lot of awareness about the problems related to population growth. Policies were being proposed to reduce the population, stabilize it and prevent rapid growth. Bensted-Smith's idea has to be understood under this framework. It was all part of an open discussion, how could there be, for example, an incentive for having people emigrate? It was clear that forceful, mandatory reduction of the population, apart from the legal control of immigration, would not be possible. Those were probably necessary, constructive although unrealistic, contributions to a discussions to which eventually the society would have to react and decide which policies would be feasible or not. In terms of realism, let us look at Isabela. People from Isabela have a lot of local pride and identify with their island. They do not want to live in Santa Cruz or San Cristobal. They are actually worried about the immigration from other island to their Island. Do not even think about making them go away from their island and leave the islands altogether or even move to one of the other islands!! The seeping out of those ideas in an unpublished internal discussion document led to a considerable polemics, and was quickly misinterpreted, and identified with positions of CDF as a whole. It was particularly controversial, as it coincided in time roughly with the making of the Galápagos law, were specific suggestions about incentivizing emigration from Galápagos were discussed, and with the elaboration of the conservation vision (Snell et al. 2002).

Sustainable Business??

CDF/CDRS during Robert Bensted's time was proposed legal measures to control fishing activities, with particular ways of incentivizing the reduction and regularization of fishing rights and to convince fishermen of the benefits of sustainable use. Graham Watkins, Executive Director of CDF (the replacement of the position of CDRS Director and CDF Secretary General) between 2005 and 2008, was thinking along a different path. His attitude was that of sustainable business: people do live in Galapagos, and they need to make a living. There is an enormous number of young people in high schools who eventually must obtain a job and become economically active. Which economic activities in the Galapagos are sustainable and compatible with conservation issues? He emphasized the need of more research

and action in the socioeconomic context and proposed, among others, that Galápagos is a socioecological system (Tapia et al. 2009; Watkins 2008). In a more practical way, he personally started supporting the local high school in its effort to run a teaching restaurant.

If we want to achieve sustainability and conservation of local environments, we do not have to get people out of the Galapagos, but people should find and be assisted with finding activities that are compatible with the conservation of the islands. Together with Felipe Cruz (a Floreana native, Conservation project leader, and long-term staff member of CDRS), Watkins spread a white paper: Galápagos at Risk (Watkins and Cruz 2007a, b), where they denounced the excessive amount of bureaucracy in the islands, the socioeconomic dynamics that led to ever more growth, and the risks of this for the spreading of introduced invasive species and the reduction of the resource base. Watkins tried hard, CDF being under permanent financial stress, to reengineer CDFs administrative and operational structure and to present long-term planning (Watkins and Cruz 2007a, b). Probably, Watkins was too late to turn around the tide. Population growth is going on, tourism is increasing, environmental management of service infrastructure has only marginally improved, and there is still a lack of a common vision in the islands (Epler et al. 2008). The power of CDF in 2005 and later had vanished, and an increasing competition with other institutions made it difficult for CDF to find an effective way of influencing what was going on.

On the other hand, it is during this time when one of the most ambitious and successful conservation projects ever undertaken occurs: Prepared for several years, the Isabela project took on the elimination of some of the most destructive species, whose control and eradication had been considered to be impossible for several decades. Bold thinking, systematic planning, high levels of organization, a totally new level of funding and access to technology, but also effective interinstitutional coordination made this possible. Goats had been devastating Santiago Island for nearly two centuries, and a large part of the northern Isabela volcanoes for decades. On the relatively small island of Pinta, goat eradication took several decades, and could not be completed. With the Isabela project, eradication of goats, pigs, and donkeys from the much larger areas of Santiago, and the huge surface of northern Isabela took just a few years.

The point here does not explain the details of this project, which has been amply described and published. Maybe this was one of the last big projects, in which CDF and the Park Service cooperated closely together, with advice and financial supervision of the United Nations. Despite this extremely successful experience, on other levels, the relationship between the National Park Service and the Darwin Foundation became more and more strenuous, and difficult, as GNP depended less and less on CDF for advice, and seriously intended to build and establish its own research capacities, cooperating with different academic institutions parallel to CDF. This was also the decade of a growing competition of scientific organizations. Research was not necessarily done through the CDF any more.

Embrace Invasive Species??

Before the problem of human population was even considered, the issue of large introduced species was recognized in the Galapagos Islands as a fundamental problem for the survival of wildlife. Introduced species were a legacy from the past, some of them, such as rats and cockroaches probably having come during the time of the Spanish colonists and on pirate vessels, whereas goats and donkeys were probably brought by whalers and other invasive animals during the settling intents of the nineteenth century. CDF had a clear view of the necessity of fighting against introduced feral animals and introduced plants (with this order of priority). Some of the first and most important conservation programs starting in the 1960s and even more in the 1970s, with the help or even carried out together with the GNP, was the eradication of large introduced species that were clearly identified. It started initially on small islands: goats on Plazas, goats on Española, goats on Pinta and Santiago. The danger and the devastation these animals had caused to the original ecosystems were seen as constant threats. Much less was done with other species such as pigs, that for example in Santa Cruz threatened nesting areas. Nothing was yet done against donkeys, horses, or cattle. The only other major problem in the beginning was the rats, as a legacy that was exacerbated by the spread from one island to the other especially during the 1982–1983 El Niño.

The dispersal of "garrapateros" (the smooth billed ani) was another threat. This case showed a first conflict of views on conservation issues between CDRS and GNP officials at the time. When Anis started to spread after the El Niño of 1982–1983, and were suspected to feed on native birds hatchlings, we imported a number of shotguns in order to start an eradication intent (few had spread to other islands at the time). However, the Park stopped this project, for fear of affecting the interests of farmers who held the belief that the "garrapateros" (translated: tick-eaters) were useful birds which ate the parasites from their cattle. One success of these early strategies was the eradication in 1978 of wild dogs in Isabela and Santa Cruz. Nevertheless, there were never sufficient funds to be very effective; the efforts were usually palliative while the threats seemed endlessly growing: news arrived of goats invading Isabela Island from the South.

Regarding introduced animals, the vision of the Foundation was quite clear. For example, concerning the black rats in Pinzon Island it was clear that they had prevented turtles from reproducing successfully for many years. Felipe Cruz in the early 1980s, for example, had begun his program of rat control in Cerro Pajas in Floreana Island to protect the "Patas pegadas" (Galapagos Petrel) population. The concept of complete eradication was very strong. Any effort was considered useless if it did not eradicate the introduced species. Nevertheless, in the case of rats this philosophy reached a limit. In fact, rats had never been eradicated in any island bigger than 20 acres in any part of the world. Eradication was not the solution, control programs were performed to keep the invasive populations in small and controllable numbers. The idea that eradication was not a viable option in some cases, but should be replaced by long-term monitoring plans of low populations in localized areas came

into debate. Floreana Island, for example, could be managed under such a paradigm. But there were very limited opportunities to finance internationally such control programs. There was no funding, it seemed impossible to keep people on Floreana all the time. Permanent sources of financing were needed. The same thing happened in Pinzon. How to protect the nesting grounds of giant tortoises? Rats had to be controlled in these specific areas. However, the common view among scientists at the time was that the only solution was to eradicate the entire population even though this would be very difficult. 1988 and 1989 were very dry years and many rats had died in Pinzon Island. In a joint effort between the National Park and the Charles Darwin Station, an eradication campaign was executed under the very bold claim that it could be possible to eradicate the entire rat population. Poison would be used throughout the island. It almost worked, but a wet spot remained where the rats lingered (Epilogue to this: with new methods and funding available, the eradication of rats on Pinzon finally became a success story in 2014, another historical landmark in restoration practice).

The same battle was fought around the issue of introduced plants: Guayabas in Santa Cruz, Cinchonas and blackberries in Cristobal; and an array of aggressive herbs that occupied wetlands. Many experiments were done with herbicides despite an important debate regarding the use of these chemicals. But the eradication efforts were not effective in the long term. In fact, they consumed large amounts of funding and had to cope with a permanent source of reintroduction from populated areas. It was also very difficult to cover large islands as a whole. The amount of introduced species was much higher than previously thought. Furthermore, despite the quarantine program started in the early 1990s, new introductions became noticeable, such as wasps, ants, flies, mosquitoes, frogs, or snakes. The problem of introduced species was no longer a historical legacy; in fact, seeds, diseases, and insects arrived to the islands in increasingly bigger proportions due to human activities. One of the most visible phenomena of recent introductions was the red fire ant, (*Wasmannia auropunctata*, there are even more species now) an aggressive ant species that had not only reached populated areas but also more isolated regions like Santa Fe and Marchena. In this scenario, one of the most radical eradication strategies was put forward: the ant population in Santa Fe was diminished by a series of controlled fires! A risky and radical operation, which finally proved to be successful.

Any human occupation in oceanic islands worldwide had led to the extinction of many species. The main cause was not the exploitation of resources, but the introduced species. That was an almost inevitable phenomenon. People arrive and nature is exterminated, species are lost. The story is predictable. Why would the Galapagos be any different? In this negative scenario, the only effective solution could be to reduce the human population and in this way control the invasive species? There was in fact another current of thinking. One that considered that human activity could be counterbalanced in order to reduce its consequences. It is possible to mitigate the control of introduced species through organized conservation activities or to reduce the risk for further introductions. There was a realistic feeling of what could be accomplished and what was simply impossible. Basically, it was quite clear that some species could be tackled (e.g., goats) but that in many other cases the

solution would be much more complicated; in the case of invertebrates and some plants, for example. Even though there was a very successful eradication program of cotton cushion scale bug using ladybugs, not much progress was made with other species. The ants could not be eradicated. There is a realization that if it is not possible to eradicate many of the new entries of insects, parasites and plants that could potentially be invasive their introduction should be prevented.

The SICGAL (System of Quarantine for Galapagos, now ABG, see above) program was a step in this direction. It hoped to bring consciousness to the local population regarding introduced species, which affect the environment but also agriculture and human health. People were beginning to realize that the problem of the introduction of species was not only a problem of conservationists. CDF promoted this system in the early 1990s after several years of preparation and succeeded in creating a partnership with local stakeholders. Programs such as CIMEI for the control of introduced species in human population (sterilizing dogs and cats) was another result of this line of action. This program, now integrated into ABG, however never succeeded in changing attitudes among people and in general had only limited success. In this context, it becomes quite clear that with the existing methods many species could not be eradicated. Particularly species such as the Guayaba in Isabela that occupies thousands of acres, the Cinchona in Santa Cruz that is very distributed, the Cedrela that in the 1990s suddenly began to invade areas of the park and the Raspberry in San Cristobal.

Following these conclusions, some botanists have arrived at the conclusion that in some ecosystems introduced species can coexist with the local flora and fauna without necessarily displacing it. Mark Gardener was one of the head botanists of the Charles Darwin Foundation until 2012. Before leaving CDF, he came to a conclusion that shocked many established Galapagos conservation professionals. Gardener recognized that introduced plant species were an irreversible reality and had to be dealt with as such. This in itself was not a new perception. But he and some others went a step further challenging the main philosophy of the Foundation and generating a considerable polemic among CDF members. He considered that new qualities of ecosystems characterized by the ecological role of introduced plant species had not just to be tolerated (with the obvious hope that sometime and somehow a successful eradication program such as in Isabela would be possible) but that with the irreversibility of such introductions the new quality of ecosystems had to be fully accepted and categorized as new island communities, using the term “embrace” in order to emphasize the full acceptance of those irreversible conditions. For many scientists, not only CDF, the sole idea of “embracing” was intolerable. One could tolerate, resign oneself, but never “welcome” introduced species! Will evolutionary processes in the Galapagos no longer be possible under natural, prehuman conditions?

One way to explain the resistance to those new views has to do with a certain fear in the security of funding. As in the case of the rats in Pinzon, the issue is that the control of introduced species population is a permanent, long-term, and highly expensive activity. Trying to keep certain populations at low sizes is a continuous effort that needs permanent financing and permanent staff. Having no security of financing in the long term, it is preferable to eradicate. In this sense, spending eight million dollars to kill goats is more comprehensible. But this strategy is only effec-

tive at the level of large animals: In a sense, the idea of control is seen as not very effective, it will be a headache forever, and people are afraid of that headache. As Gardener's case shows, CDF and the Research Station have difficulties to admit that in the case of certain species the struggle to try eradication must be abandoned and new strategies should be developed. There are exceptions: the rats on Pinzón seem now to have been successfully eradicated, the scale insect is being controlled in the long run by an introduced species (a lady bug) and the little fire ant has probably been exterminated on Santa Fé and Marchena. Are those exceptions to the rule or positive indicators for the future lines of action?

The Difficult Task of Adapting to New Institutional Environments

The Darwin Foundation in recent years has basically worked on maintaining its institutional stability, which among other things means that there are few discussions among experts on technical issues. Members are rarely consulted outside certain specific issues. The Foundation works inwards with its staff. It seeks to maintain certain strategic projects to survive under an increasing marginalization by the National Park and a low representation in the international sphere of conservation. For these reasons, the Foundation has lost much of its capacity to engage in conceptual discussions. The growing avalanche of NGOs and academic institutions had all difficulties in finding unique niches for their respective field of actions. A multi-institutional project, financed by USAID and coordinated by WWF between 2002 and 2004, included among others USFQ and showed the problems of coordinating between institutions, which all were potential competitors.

The Galapagos Archipelago was extremely popular worldwide. Having an independent presence in the islands should allow to look for independent funding. World Wildlife Fund, Conservation International, WildAid, Sea Shepherd, Island Conservation were all establishing in the Galapagos by the end of 1990s and 2000. These new organizations brought new views related to human development issues. World Wildlife Fund, for example introduced fields of action, which clearly emphasized support of human sustainability in the production of related fields of fisheries, tourism and waste management, and strengthening of public institutions, fields in which CDF never had dared to get involved. CI went into a similar direction. WildAid and Sea Shepherd on the other hand, saw their role in directly strengthening the control capacities of the National Park, whereas CDF scientists still tried to maintain some freedom for deciding on their own fields of research. The incursion of these new actors exercised a pressure on the Darwin Foundation. Including once again a social scientist and geographer, who formerly was one of its main critics, Cristopher Grenier.

CDF lost its leadership role, and in many fields, particularly related to socio-environmental issues, CDF doesn't seem to be a reference any more. Instead of "embracing" new institutions in the Galapagos, CDF seems to have been withdraw-

ing in itself, jealously guarding valuable information, which of course had been gathered with many efforts. But its resistance to cooperation with other institutions (partially on a somewhat arrogant attitude towards newcomers) has isolated CDF. Formerly, visiting scientists would necessarily work in consultation and with logistic support from CDRS. Now scientific visitors will more and more work directly with the GNP or through other channels. It doesn't help, of course, when in this situation members of CDF's own supporting network "Friends of Galapagos" organizations, such as the Galapagos Conservancy, sharing the same Logo and the same member databases, start to dissociate themselves and to support or carry out projects independently, exerting an additional debilitating effect.

In the 1980s, CDRS was still an important employer at the local level, and there were very close ties with the community. However, also this has changed over time. What could be an advantage, having high-level scientists doing the best possible research, on the other hand was not compensated by the maintenance of a close involvement, also personally, with community groups and institutions. People increasingly became ignorant about the role and presence of CDRS/CDF, thinking about a rich international institution without large social responsibility. Financial sustainability measures, such as the reduction of educational and community activities, putting one-sided emphasis on science, have further increased the distance to the local public. A recent incident, which was widely commented in the press and social media, where the opening of a souvenir shops by CDF was prohibited by the Santa Cruz Municipality, ceding to the pressure of local merchants, is a good indicator of the distance created. Whereas the income of the shop was supposed to finance unbudgeted spending (particularly the support for local students and volunteers), it was also seen as an undue competition for local commerce, which had no participation in the running of this facility.

CDF has an important presence within Galapagos with an established infrastructure in close proximity to the National Park offices. GNPS has not had a history of stability, despite an apparent bonanza, which came particularly with the exclusive funds guaranteed by the Galapagos Special Law. Many directors have changed over time. In this situation, one essential role attributed to CDF has been that of providing stability and continuity through up and down periods within the Park. Also, GNPS as a state institution is exposed to political whimsies, and independent institutions with both international and national membership such as CDF could potentially help maintaining continuity in conservation principles. However, all this is not possible without financial independence and strength. The permanent dependence of CDF on short-term and low-level funds without long-term security, absorb most energy on fund-raising and producing attractive projects, and leave little time for concentrating on advisory and supporting research functions.

One of the goals of CDF from its very beginnings was the empowerment of Ecuadorian conservation and management capacities, with the implicit assumption that, once this goal would be reached, the organizations would have outlived itself. There are many people, however, not only foreign, but also Ecuadorians, who believe, that the continuing existence of CDF and its Darwin Station as independent institutions is necessary and advisable for several reasons, not only because it could guarantee better access to international funding.

Relations between CDF and the Ecuadorian Government and its institutions (particularly GNP and Ministry of the Environment) has not always been easy; taking into account that the Ministry has suffered many changes, related to frequent GE changes as well, and that GNP has suffered even more managerial instability. CDF, with its Research Station, however, have guaranteed continuity of support and cooperation, and also strong adherence and compliance with national norms for international cooperation.

Keeping this in mind, the continuing existence of CDF as an independent advisory and research organization (although with very strong Ecuadorian involvement) could be favorable to the country, if at the same time participation and cooperation with Ecuadorian institutions, government offices, and individuals would be strengthened once again, and if the membership would reflect the institutional panorama of the moment. This would also imply stable finances both from external as well as from government sources and direct working agreements with major research centers in the country. An adequate working and cooperation relationship with other international NGOs and academic institutions, such as the Galapagos Science Center, must also be found, and it should be CDF pushing for this.

If those problems are not solved and in order to maintain the important legacy of CDF, the continuing existence of a research station under the same name under a consortium of Ecuadorean academic institutions could be an alternative to be considered. It would depend on the strategic planning capacities of CDF members to guarantee an adequate transition and the positive recognition of the rich experience and history of the organization, and the continuing access to the large academic and scientific potential of scientists and educators which now exists in Ecuador, and among which a considerable number are alumni of CDF itself.

References

Bowman, R. (1960). *Report on a biological reconnaissance of the Galápagos Islands during 1957* (p. 65). United Nations Educational, Scientific, and Cultural Organization.

Cairns, R. (2011). *A critical analysis of the discourses of conservation and science on the Galápagos Islands*. Ph.D. Thesis, University of Leeds.

Catrejón, M., Defeo, O.,Reck, G., Charles, A. (2014). Fishery Science in Galapagos: From a Resource-Focused to a Social–Ecological Systems Approach. In Denkinger J. y Vinueza L. (eds.) The Galapagos Marine Reserve, Series Social and Ecological Interactions in the Galapagos Islands pp 159-185. Springer International Publishing.

Corley Smith, G. (1990, June). A brief history of the Charles Darwin Foundation for the Galapagos Islands 1959–1988. *Noticias de Galapagos, 49,* 1–36.

Eibl-Eibesfeldt, I. (1958). *Survey on the Galápagos Islands* (p. 46). Brussels: UNESCO/IUCN.

Epler B., Watkins, G., & Cárdenas, S. (2008). *Tourism and the Galapagos economy.* Galapagos Report 2006–2007.

Grenier, C. (2007). *Conservación Contra Natura: Las Islas Galápagos* (Vol. 233). Editorial Abya Yala.

Grimwood, I. R., & Snow, D. W. (1966). *Recommendations on the administration of the proposed Galápagos National Park and the development of its tourist potential*. Puerto Ayora, Galapagos.

Hennessy, E. (2016). Mythologising Darwin's islands. In D. Quiroga & A. Sevilla (Eds.), Darwin, Darwinism and conservation in the Galapagos Islands: the legacy of Darwin and its new applications: Springer Science and Business Media.

Jennings, K. (1967). *Planes para el turismo en las Islas Galapagos, Informe a la Corporacion Financiera Nacional* (p. 63). Quito: Arthur D. Little.

Kramer, P. (1975a). The master plan. *Noticias de Galápagos, 23*, 9–12.

Kramer, P. (1975b). The disquieting outlook for Galapagos conservation. *Noticias de Galápagos, 23*, 9.

Lundh, J. (2004). *Galápagos: A brief history*. Unpublished manuscript, Oslo, Norway. Retrieved from http://www.galapagos.to/TEXTS/LUNDH1-1.php

Quiroga, D. (2016). Darwin, emergent process and the conservation of the Galapagos ecosystems. In D. Quiroga & A. Sevilla (Eds.), Darwin, Darwinism and conservation in the Galapagos Islands: the legacy of Darwin and its new applications: Springer Science and Business Media.

Reck, G. (2014). Development of the Galápagos marine reserve. In J. Denkinger & L. Vinueza (Eds.), *The Galapagos marine reserve, a dynamic social-ecological system* (pp. 139–158). New York: Springer.

Smith, C. G. (1990). A brief history of the Charles Darwin Foundation for the Galapagos Islands 1959–1988. *Noticias de Galápagos, 49*(June), 1–36.

Snell, H. L., Tye, A., Causton, C. E., & Bensted-Smith, R. (2002). Current status of and threats to the terrestrial biodiversity of Galapagos. In B. Bensted-Smith (Ed.), *A biodiversity vision for the Galapagos Islands*. Puerto Ayora, Galapagos, Ecuador: Charles Darwin Foundation and World Wildlife Fund.

Tapia, W., Ospina, P., Quiroga, D., Reck, G., Gonzalez, J. A., Montes, C, et al. (2009). *Toward a shared vision of Galapagos: the archipelago as a socioecological system*. Galapagos Report 2007-2008.

Tindle, R. W. (1983). Galápagos conservation and tourism—11 years on. *Oryx, 17*(3), 126–129.

Watkins, G. (2008). A paradigm shift in Galápagos research. *Galápagos Research, 65*, 30–36.

Watkins, G., & Cruz, F. (2007a). *Galapagos at risk: A socioeconomic analysis*. Galapagos, Ecuador: Charles Darwin Foundation.

Watkins, G., & Cruz, F. (2007b). *Galapagos at risk: A socioeconomic analysis of the situation in the archipelago*. Puerto Ayora, Province of Galapagos, Ecuador: Charles Darwin Foundation.

Wellington GM (1984) Marine environment and protection. In: Perry R (ed) Key environments: 641 Galápagos. Pergamon, Oxford, pp 247–263.

Chapter 8
Darwin, Emergent Process, and the Conservation of Galapagos Ecosystems

Diego Quiroga

The short visit that Charles Darwin made to the Galapagos Islands had an important, albeit mythicized influence in Darwin and his ideas. Conversely and often less recognized, Darwin's visit and legacy transformed the Galapagos in many and profound ways. His ideas and his legacy inspired a series of conservation measures, geographical delimitations, legal actions, business enterprises, and scientific work. Many institutions, such as the Charles Darwin Foundation and the Charles Darwin Research Station (see Reck, Chap. 7), were created under the umbrella of Darwinian view to conserve the Galapagos. On the other hand, Darwin was a symbol and an icon associated to the islands used by tourism companies to promote a growing industry that in their desire to see a pristine Archipelago, as supposedly Darwin saw, have contributed to the growth of the local economy and the local population and threaten the stability of that very construct. In this chapter, I explore the way Darwin and his ideas can guide our understanding of the socio ecological process and the type of strategies that can help protect the Galapagos.

The fauna and to a lesser extent the flora that Darwin observed and collected during his travels in the Galapagos made him reflect about diversity, speciation, and evolution. From these reflections, as we have seen (Sevilla, Chap. 3), derives one of the most important paradigm changes of the nineteenth century. A key element of these changes was the idea that there can be order without an ordering force and that emergent bottom-up processes can generate imperfect orders (Dawkins 1986; Dennet 1996). The idea of spontaneous order, however was not new one, it was already part of what has been termed the Scottish Revival. One of the original thinkers who conceived initially the idea of spontaneous order was Bernard Mandeville (1670–1733) who influenced the Scottish tradition of which Adam Smith was part.

D. Quiroga (✉)
Colegio de ciencias biológicas y ambientales y Colegio de ciencias sociales y humanidades, Universidad San Francisco de Quito, Quito, Ecuador
e-mail: dquiroga@usfq.edu.ec

D. Quiroga, A. Sevilla (eds.), *Darwin, Darwinism and Conservation in the Galapagos Islands*, Social and Ecological Interactions in the Galapagos Islands,
DOI 10.1007/978-3-319-34052-4_8

The idea of the "invisible hand" for which Smith is so famous was a way of dealing with the problem of unintended consequences and their beneficial effects of social actions (Smith 2006). The Scottish intellectuals of the seventeenth century were interested in generating a description of society based on the creation of spontaneous order. They consider that humans look for order and adjust their behaviors according to their circumstances (Smith 2006). Humans have a universal drive to improve their individual position, a drive that generates a certain degree of social order. The evolution of stable institutions like the market often is an unconscious and unintended emergent result of individualistic process and motives. Planning, they thought, could never create a system as efficient as that created by the workings of individuals perusing their own individual interests. Different authors have (Petsoulas 2006; Smith 2006) identified the way in which social institutions can lead to the creation of social order under some ideas of *classical liberalism*.

Darwin used this idea of emergent order to explain not how society can create order without the intervention of the state but how nature can create order without the intervention of god (Marciano 2007; Smith 2006). Contrary to prevalent ideas of the time as that of Natural Theology, proposed by Rev. William Paley who argued that the existence of complex life forms and anatomies reflect the existence of a god that had to design these forms, and that of many leading biologists who thought that species represent this divine design and therefore cannot change. Darwin created a view of nature where flux and emergent order were based on complex physical process. Based on his observations during his trip around the world and in particular in the Galapagos, Darwin concluded years after his famous journey in the Beagle that species, physiologies, and anatomies are orders that result from individual organisms struggling for survival (Sulloway 1982). Darwinian paradigm shift was inspired, to a large degree, on the geographic and biological characteristics of the Galapagos Islands and the evolutionary processes that they produce. It was animals like the mockingbirds of the Galapagos, the Galapagos tortoises, and later the Galapagos finches, which provided the basic evidence for this scientific revolution (Sulloway 1982). Thus, the organization of species and the tree of life is not a top-down process but an emergent physical process such as natural selection, diversity, and the struggle for survival. This materialistic and gradualist evolutionary process explains better, Darwin argued, the distribution of species in the Galapagos and other oceanic islands than the different creationist versions popular at the time. According to Hayek, Darwin's idea of evolution is an adaptation of the Scottish tradition; he believes that Darwin got this idea from the Scottish geologist James Hutton (1726–1797), a member of the Scottish Enlightenment, and through the influence of Hume upon his grandfather Erasmus Darwin. Darwin then applied the ideas to nature (Smith 2006, p. 6).

Although for Darwin most of the selection occurs at the level of the individual, he realized that there were some processes of selection that at least in the case of humans occur at the level of the group (Marciano 2007). Altruism among animals was one of the most important issues that troubled Darwin. He understood the problem presented by altruistic behavior in some animals such as social insect as the conflict between what was later described as the principles of individual vs. kin

selection. Furthermore, in the case of humans, he argued for the existence of group selection. Darwin in his book, the Ascent of Man, states that morality had evolved in humans, as a mixture of biological and cultural processes. This conception of cooperation among humans complements other implications of Darwin's theory for human society, which considers competition among people, the ruthless logic of Darwinian selection and the struggle for survival. Many authors have emphasized the competitive aspects of Darwinism and thus social Darwinism means that successful people, organizations, firms, or nations survive and unsuccessful ones perish. However, few others have suggested that competition and cooperation both in the case of humans and animals coexist, as intergroup competition requires intragroup cooperation such as in the case of firms and companies (Johnson et al. 2013).

In the nineteenth century, there were different applications of Darwin's ideas to the social sciences, most of them came to be kwon as Social Darwinism and acquired a bad reputation due to their later implications. Some of these applications, such as those of Ernest Haekle, Francis Galton, and in a more Lamarckian manner Albert Spenser lead to the development of Social Darwinism, eugenics, craniology, and other problematic pseudoscientific ideas (Gould 1981; Weikart 2003); these ideas spread not only in the Anglo Saxon intellectual community but they also became important in the Latin American world (see Villamar, Chap. 6 in this volume). However, other intellectuals argued to apply the principles of Darwin to understand the emergence of order and the creation of well-being in different societies. These authors suggested that Darwinian mechanisms can be applied at the level of selection of institutions (Ritchie 1896) and of economic systems (Veblen 1898, 1899). David Ritchie in his 1891 book, *Darwinism and Politics*, proposes that social change follows many of the basic Darwinian processes as institutions compete with each other and the fittest one survive. Other scholars such as Walter Bagehot applied Darwin's ideas to explain the survival of groups, customs, nations, and business firms. In the early twentieth century, economists such as Armen Alchaim, used Darwin to understand the way modern capitalist economy consists of processes that take place without any central coordinating agency (Alchain 1950). Thus, many of these modern thinkers reconnect Darwinian ideas with the Scottish thinkers and their emphasis on spontaneous order and unintended results. Basically, they maintained that there was no need for an actor such as the government to organize and order the social interactions between people. Emergent processes and natural selection of social institutions can explain the way social order is created. Many of the modern thinkers that belonged to the Austrian School including thinkers like Carl Menger, Ludwin von Misses, and also later Frederick Hayek were some of the most successful exponents of these ideas.

Hayek is probably one of the best known thinkers of this tradition and one who directly or indirectly relied on many of Darwin's ideas to understand how society evolved and function (Hayek 1960, 1967). Hayek, who won a Noble Prize in economics in 1974, believed that social systems, rules, and individuals need to compete between each other, but he also argued about the importance of group selection for the evolution of social systems (Hayek 1988). Bands, tribes, nations, and firms compete with each other, it is a competion often of diverse cultural traditions and concepts,

rules, or what later Dawkins called memes (1976). Hayek conceived that some of these groups, namely those that have the most successful sociocultural arrangements will outcompete others. Hayek argued that systems like the market and language are examples of emergent efficient systems (institutions) that can generate order without the need of controlling or guiding forces. Controlling mechanisms like the state generate inefficiencies and often hinder evolution. Hayek thought that the market economy was successful because it was the most efficient system of communication ever developed, as he argued that prices in a healthy and open economy are an integral part of the communication system. The adequate flow of information makes a system efficient as it allows for the proper distribution of ideas and resources. Hayek has been accused of being a teleological thinker as he thought that the market economy and the liberal values of individualism, private property, and political liberties were the most successful systems and that most societies will eventually develop that way. However, as some authors have indicated (Marciano 2007), he is not a teleological thinker in the way he explains specific evolutionary social process.

One of Hayek's most important and controversial contributions is that for the Evolution of Society chance events, as is the case in Darwin's view of evolution, play a critical role. This idea however is in conflict with the notion that humans have a capacity to shape their world and their society, that societies are guided by laws that as in the case of the planets shape their trajectory, or that top down processes produced by the government can direct human destiny. There exists therefore a very important tension between social destiny and the capacity to order and shape social systems and uncontrolled and emergent results on human actions and agency; a tension that is key to understand the process of social evolution.

Hayek conceived that the systems developed in the West based on private property, individual liberties, and the market economy (Hayek 1988) were superior to other systems. Hayek has also been accused of falling into the naturalistic fallacy and of a functionalist trap since to some extent he conceives that this is a destiny which is based on the idea that the liberal institutions and social systems dominating all other possible social formations. He argued that in the case of the conquest of the Americas, more successful systems and institutions brought by the Europeans replaced the less successful ones, confusing what is military power with institutional superiority. The discourse of evolution and efficiency can justify the displacement of one group by another, ignoring issues such as social justice. Another issue that the traditional and the modern spontaneous order thinkers failed to address has to do with long-term environmental sustainability of the systems. A system can be successful in the short term but not necessarily in the long term due to its degradation of the resources on which it depends.

Another important contribution to the discussion about social evolution and the management of natural resources came from different scientists in the twentieth century. Based on the concept that selfishness drives evolution, William Hamilton (1964) and biologists developed the concept of kin selection that explains cooperation and altruism as another way of propagating genes by selfish Darwinian behavior of individuals. Robert Trivers (1971) suggested reciprocation as a basis for mutual assistance among animals, including humans and introduced the concept of

game theory, which was later expanded by many other authors. Some authors such as EO Wilson and David S. Wilson (Wilson 2012) argue that group selection can play an important role in the evolutionary process; Wilson terms this type of strategy eusociality. Wilson has indicated the way in which social systems in animals and humans are not only selected at the level of individuals but also at the level of groups, a process that has been termed group selection (Wilson 2012). A related concept is that of Multiple Level Selection Theory (MLST). MLST theorist maintains that we need to understand process of selection that takes place at different levels: the individual, the kin, and the group. These Darwinian principles can be generalized to many types of systems. Several authors have indicated the importance of these systems in the case of human evolution (Boyd and Richerson 1988; Cosmides and Tooby 1992; Richerson et al. 2003a, b). In fact, even in very competitive system such as the case of the relation among modern firms in the capitalist market there is cooperation (Wilson et al. 2013). This cooperation exists not only inside the firms (Johnson et al. 2013) but in some cases between the firms.

The idea of spontaneous order has also been developed by another group of thinkers that are trying to understand complex systems. As has been indicated by different authors (Kauffman 1995, 2011; Holland 1995; Holling 2001), complex systems have emergent properties. These self-organizing systems result in complex arrangements, where there are unintended effects of the actions of individuals. Thus, self-organization in the case of human social groups is the result of the emergent properties of the system as individual agents pursuing their own interests and following a set of simple rules generates complex social systems that show different characteristics such as resilience and threshold changes. Levin and others have argued that complex emergent systems go through the process of darwinian selection, and it is this process that explains the shape and the form that they finally take. Levin's (1998) three essential properties of complex adaptive systems (CAS) include "(1) sustained diversity and individuality of components, (2) localized interactions among those components, and (3) an autonomous process that selects from among those components, based on the results of local interactions, a subset for replication or enhancement" (Levin 1998, p. 432). In other words, people like Levin have argued that neither emergent process nor natural selection is by itself sufficient to explain existing order but requires the complementary presence of Darwinian mechanisms.

Spontaneous emergent systems are not necessarily sustainable in the long term; they can be destructive to their surrounding natural and social environment. This failure has been well documented by people like Garret Hardin in his classic article in 1968; he referred to groups of individuals that adapt to a situation by destroying the commons and eventually destroying their chances of long-term survival. Confusing the commons with open access areas, Harding created the idea that areas that are not privately owned could result in destruction of natural resources. To correct the so-called tragedy of the commons caused by some emergent systems, some authors have suggested the need for the intervention of the state or other higher governance system. In response to his assertion, Elionor Ostrom and her husband dedicated their lives to the understanding of how this tragedy has been avoided by

different systems of emergent social organizations. The Ostroms and their team, studied social systems that need not be directed exclusively by top–down mechanisms but that create self-generating strategies and rules that can result as part of the long-term adaptation to different environments. Ostrom constitutes an application of Darwin because of her reference to evolving needs, and her position regarding self-organization and natural selection process guiding emergent systems. She identified eight design principles that allow emergent groups to manage their common pool resources in a sustainable manner (Ostrom 1990; Wilson et al. 2013). These are: (1) clearly defined boundaries. (2) Proportional equivalence between benefits and costs; benefits earned must be explained as a result of greater work. (3) Collective choice arrangements; group members must be able to create at least some of their own rules by consensus. (4) Monitoring so that there are no free riders; a system to detect heating must be in place. (5) A system of sanctions that does not punish transgressors in an unfair and disproportionally heavy way. (6) Resolution mechanisms must be in place so that conflicts are resolved without destroying the group. (7) Groups should be able to organize, so that groups have the capacity to conduct their own affairs. (8) In the case of groups that are part of larger social systems, there must be appropriate coordination among relevant groups (Wilson 2012). These are a set of conditions under which social emergent systems can be structured in sustainable ways and thus be adaptive in the long term.

Galapagos

In the Galapagos, coupled social and ecological emergent processes have shaped the Islands. Social process such as migration, tourism, fisheries, and economic growth are closely connected to the introduction of species and changes in the habitats. This coupled natural-human system is thus in constant evolution and transformation. These transformations often threaten the very aspects that inspired Darwin almost two centuries ago (González et al. 2008; Watkins and Cruz 2007). Traditionally, top-down methods have been used to control these processes and the degradation of the environmental conditions; this strategy is often not successful.

Darwin and his legacy have influenced the Galapagos in several ways. Darwin was the source of inspiration for scientists who came to prove and disprove his ideas in the nineteenth and twentieth century (see Elisa Sevilla, Chap. 4). After Darwin wrote the *Origin of Species*, many thinkers went to the Galapagos to test his ideas creating the construct of the Galapagos as a natural laboratory (Quiroga 2009, Sevilla, Chap. 4). For example, during the last part of the nineteenth century Luis Agassiz, a creationist, and other scientists visited the Galapagos to disprove Darwin and his theories (Larson 2001, Sevilla, Chap. 4). The Galapagos became one of the main territories and geographies, where Darwinian ideas were tested. In the twentieth century, and after the modern evolutionary synthesis (Mayr 2002), some of the key scientists like David Lack, Robert Bowman, and Peter and Rosemary Grant who were involved in the development, or were influenced directly by the thinkers

who consolidated the new biological synthesis, went to the Galapagos to study Darwin finches and other organisms. In the mid twentieth century, Darwin's paradigm and the preservation of the process that favor the evolution of organism in the islands were the main inspirations behind many conservation efforts and the creation of the Charles Darwin Foundation (Reck, Chap. 7). It was also during that time that influential Darwinian thinkers pressured the Ecuadorian government and the international community, with the support of the UNESCO to establish the Galapagos National Park. During this period the connection between Darwin and the Islands was consolidated and reinforced as part of the arguments to conserve the archipelago (see Chap. 5, Elizabeth Hennessy in this book).

The metonymical connection between the figure of Darwin and the Galapagos was used by the tourism companies to generate an imagined experience for tourists who could feel that they are following on Darwin's footsteps. Darwinian science and tourism needs and concerns also frame the conservation efforts of species and ecosystems in the Galapagos (Grenier 2007). Local people were perceived as being responsible for the destruction of many Galapagos ecosystems. Often, the application of Darwin's ideas to conservation resulted in ecocentric strategies that not only ignored the inhabitants of the Galapagos, but often perceived them as a destructive force.

In order to control the effects of growth, several top down approaches were proposed and implemented to generate some order and maintain Darwinian process. The control and management of space through the creation of the National Park and some of the process of regulation of the Galapagos Marine Reserve (GMR) are examples of these largely top down process. Many of these regulations were intended to control the human actions and maintain what was constructed as a pristine environment. In the case of the GMR, however as we will see above both bottom–up and top–down process have directed its management. Many of the restoration efforts, meant to deal with the dynamic natural systems are another example of these top down control policies. The main assumption in many of these efforts is that local people constitute a threat to the order that exists in pristine nature.

One of the most dramatic examples of this ongoing tension between the desire to maintain a natural laboratory and the emergent properties of the natural and social systems is the fight against invasive species. As argued in Chap. 7 by Reck and in Chap. 9 by Quiroga and Rivas, the fight against introduced species has been successful in some cases but has backfired in many occasions. Many invasive species have spread despite the efforts to control them. Despite the fact that millions of dollars have been invested in combating invasive species and restoring the ecosystems to their pre-human state, the flux of people and goods to the islands keeps bringing hundreds of new and plants, insects and animals. There is concern on the part of several authors that a classic top down strategy to control invasive plants is not working (Hobbs et al. 2013a, b; Gardener et al. 2010; Gardener and Grenier 2011; Gardener 2013; Light et al. 2013). They have proposed the creation of novel or hybrid ecosystem as a more sensible way of fighting these invasive species. These ideas opened an important debate among conservation circles and have become a

threat to the old way of controlling the environments of the islands (Vince 2011; Light et al. 2013; Hobbs 2013; Light et al. 2013). Novel ecosystems evidence the fact that emergent processes are difficult to control from a top down perspective. Restoration to a Darwinian pristine landscape is paradoxically an effort to control the dynamic evolutionary processes that shape these environments.

Emergent vs. Top Down Systems

In the case of social systems, there has been a series of attempts to organize and control many emergent social processes, especially in the area of fisheries and tourism (Gardener and Grenier 2011). Fisheries are complex adaptive systems that organize as they change under new environmental conditions (Engie and Quiroga 2013). Different types of fisheries have emerged, changed and disappeared; a process of selection of some of these fisheries has shaped the Galapagos social and natural panorama. Fisheries are units of selection that must adapt to different social, legal and economic as well as ecological conditions. As they adapt to new conditions, these fisheries have also transformed the natural and social environment in which they flourish. Each fishery can be seen as a bundle of technologies, strategies, understanding that must survive in the context of diverse natural, legal and socio-economic environments. Despite the fact that some of these fisheries may survive for some years they are not sustainable in the long run. The local fishers of the Galapagos started capturing Galapagos grouper *Mycteroperca olfax* in the 1950s and 1960s, then the spiny lobsters fisheries (*Panulirus penicillatus* and *Panulirus gracilis*) emerged in the 1970s and 1980s; and the Galapagos sea cucumber *Isostichopus fuscus* in the 1990s. Sea cucumber and lobsters are caught by diving using a compressor system called hookah (Hearn 2008; Castrejon 2011). In the last four decades, the introduction of new technologies that include a shift from wooden boats propelled by oars or sails to modern fiberglass boats equipped with outboard engines, GPS, communication equipment, nylon nets along with sophisticated fishing rods and reels have changed the capacity of fishers to capture and transport their captures from ever more distant areas, including the little studied sea mounds that are part of the complex set of islands and islets that constitute the Archipelago.

The emergence of new technologies, markets and new regulatory schemes have also created a series of conditions to which the emergent systems have had to adapt. Part of this adaptation included the organization of the fishermen into larger units. In 1970s and 1980s fishermen became organized into four cooperatives and later an association emerged that groups all of the different cooperatives; these cooperatives have played a critical, and at misguided role in representing the fishermen interests in the 1990s and early 2000s. Their role was partly responsible for the collapse of some of the fisheries. Today these cooperatives have lost power and organization capacity. The establishment of the GMR in 1998 created not only a new zoning system but also a system of governance, through the creation of the Management Board. During that time conflicts between fishermen and the conservation sector, in

particular the Charles Darwin Station and the GNP threatened the long term sustainability of the Galapagos. At that time, the fishing coops fighting for what they perceived as the erosion of the rights of the fishermen due to an increase in regulations and conservation measures which they felt were generated by powerful sectors such as the conservation NGOs and the tourism companies that benefited from what these corporate interests claimed were their policies for conserving the Islands.

It is within this context of tensions and conflicts that the Galapagos Marine Reserve (GMR) was formed to a large extend as a result of some emergent bottom up processes. The first Marine Reserve was created as part of a top down process in 1986 but it protected just a few miles of the coastal area. The current reserve created in 1998 was the result of a mixture between emergent and top down process, one in which the local people were able to participate in the management of the marine resources. Originally, the GMR was at least in part the result of the local fishermen trying to stop the large industrial fishermen from Manta and the mainland. Several fishermen told me that they proposed the creation of a 60 and even an 80 miles reserve to protect not only the coastal areas but also the sea mounds (Carlos Ricaurte and Marco Escarabay personal communication) (Reck 2014). However, a general consensus was created about the increase of the reserve limits to 40 nm miles from the baseline. This proposal had the active support by fishermen's leaders of the coops who wanted to gain exclusive fishing rights within this area. A workshop to discuss the sustainability of the marine area was created at the beginning of 1996 with the support of the CDRS, and the participation of the fishing sector. Although antagonism between fishermen and scientists was at their peak a consensus document resulted, with clear recommendations (Reck 2014). Many of the recommendations of this workshop were taken into account in the final preparation of the Galapagos Law. During the negotiations, fishers who now had acquire power and money due to the sea cucumber fisheries and were backed by the influential group of the middlemen used the coops to opposed the regulations being charged against them (Reck 2014). The creation of the GMR was an important moment when most of the people in the Galapagos united for a common goal–the defense of their commons and of their resources. Although initially the development of the GMR followed many of the principles stated by Ostrom et al. which meant that people developed a sense of ownership of the GMR as we will see bellow it lost many of these characteristics with time.

To diminish conflicts and create a more manageable system, several actors lead by the conservationist sector, created the Junta de Manejo Participativo or JMP (Participatory Management Board). This collective body was meant to function as the manager of the marine commons. Five groups constituted the management board: the artisanal fishermen, the conservationists sector that used to be represented by the Charles Darwin Research Station, the tourism sector, the guides and the Galapagos National Park. The management board was a very interesting initiative to have the stake holders be part of the management of the resources, and that the management is made in a bottom up process. To defend the commons agreements on how the number of fishermen and fishing fleet as well as the places, the times and quotas for the fisheries were reached.

The JMP was not an unquestionable success and there were several structural issues that affected the functioning of the board. Scientists blurred the line between being active decision makers and being neutral scientists resulted in a loss of credibility on science. This dual role of the CDS meant also that the quality of the science suffered as scientist had to spend a lot of their time on political and advocacy efforts. The local population lost respect of the scientists who they felt that were arrogant and lack an understanding of the needs of the people and in some cases biased their science to achieve their goals. Other issues that weakened the JMP include the fact that many decisions were taken outside of the negotiation table. Fishers pressured, often successfully, for higher sea cucumber and lobster quotas by protesting on the streets, sometimes in a violent manner. Often, when they felt they were outnumbered they used protest and threats to press for what they perceived to be their legitimate rights. Fishermen complaint that issues related to tourism activities, especially those associated with the large cruise boats were rarely if ever discussed in the board meetings as the powerful businessmen could talk directly to the ministers and even to the president of the country in Quito to obtain benefits. The lack of trust on the JMP was an important reason why the GMR became increasingly a top down, command and control system. Lack of trust between sector and even within sectors, lack of monitoring, a sense that the benefits and the punishment were unjustly allocated are some of the problems that managers of the GMR face. In a way it was a lost opportunity to create a bottom up process involving in a real and transparent way the stakeholders. With overfishing of sea cucumbers and lobsters, environmental problems emerged that that affected the resilience of some of the marine ecosystems (Edgar et al. 2009). Researchers have indicated that the removal of lobsters and large predatory fish magnifies the impacts of ENSO through trophic cascades (Edgar et al. 2009) lowering the resilience of the system. In the case of the sea cucumbers, the populations are so low that after 2009, the fishery has been closed for several years.

The collapse of the lucrative sea cucumber fishery has resulted in fishers developing new adaptation, which means searching for new niches, new technologies and social organization. As the lucrative sea cucumber fishery collapse many fishermen are now adapting by trying to change their activity. This has resulted in the emergence of different, groups and practices. Most of these emergent practices that now employ many fishermen are related to tourism, such as artisanal experiential fisheries, diving, day tours, kayaking, biking, shops, selling of merchandize, hotels and restaurants (Engie and Quiroga 2013).

Although initially, the creation of the GMR and of the JMP constitutes an example of an emergent system where people united around a common goal of defending the commons, the system was not very successful in the medium and long term. The system partial failure can be explain by the lack of the adherence to several of Ostrom's principles such as proportional equivalence between benefits and costs as the fishermen felt that the rigor used to judge and punish them was not applied to the tourism companies and that the benefits were not distributed in just way. There was also a lack of an adequate monitoring mechanism as often fishermen and other transgressors and free riders where not punished and persecuted. Nonetheless, the

system has gained enough credibility so that most people in the Galapagos defend in principle the idea of having a marine reserve and a system that can permit their participation in the decisions. Furthermore as it created a large spillover effect, the GMR has benefitted the Manta based tuna fishermen who were some of the strongest opponents to the reserve when it was first created. The GMR often criticized by the fishermen because it has benefitted the tourism and the industrial fishing sector at the expense of the local fishermen.

The emergence of many new activities related to tourism among the Galapagos residents has changed the perception of the natural resources specially the different charismatic and endemic animals (Quiroga 2014). This has resulted in a process of increase sense of ownership of the commons in the case of the local population and specially the fishermen. The level of conflict has decreased in the last 10 years mostly due of the collapse of the sea cucumbers fishery, and the fact that now many fishers have found ways of shifting professions into tourism. This shift has meant that many fishermen are now more interest in the conservation of natural resources that they perceive as important for the development of their tourism activities. The emergence of these new alternative activities is an example of adaptive emergent process, actions and discourses generated by the local people to adapt to a new context and environment. The fact that more people are now involved in tourism means that there is an economic interest in maintaining the natural resources that attract the tourist to the Galapagos, which has created a change in mentality (Quiroga 2012). Often, local people complaint about the excessive top down regulatory practices imposed to them by the GNP and the Government. Many fishers say that often the creative, interesting and sustainable projects that the local people proposed found little support and often the opposition of the managers of the Galapagos. Recently there has been different top down efforts to control the fast and chaotic emergence of different land based tourism activities, such as SCUBA Diving, day tours to visit sites close to the ports, sport and vivencial fishing among other. The GNP has given permits to some of the fishermen and imposed schedules for the visits and the different activities. Many of these regulatory activities, however, have been done with little participation of the local community, which causes lack of support for the management system. The fishers feel that many areas that used to be owned by them are now in the hands of the tourism sector. They often claim that in the past they defended and protected many of these iconic places such as Kicker Rock that are now in the hand of large tourism companies. Vivencial fisheries was developed by fishermen as a way of having access to many of these areas that in the past they controlled. After many years of struggling few fishermen were given permits to take tourist with them, as long as they comply with a series of criteria including having the appropriate boat. They also were asking to have access to many different sites were the tourists can rest. After the President of Ecuador visited the Islands in 2015 some fishermen engaged in vivential fisheries, convinced the President of Ecuador, Rafael Correa, to open new sites for them to take the tourists. The president ordered the opening of the new sites for the local fishermen with little consultation with the GNP and other stakeholders. This type of clientelistic practices that favor one sector over the others does not help to establish long term management practices. They

create often conflicts and resentments between sectors and promote the tragedy of the commons. It is necessary that long term emergent strategy under which adaptive systems and practices are allowed to expand.

When one examines the history of management, one can see that many emergent social processes are difficult to manage using traditional top–down strategies. In the case of the Galapagos, managers perceived and manage the islands as an important natural laboratory, which is valued mostly from the optic of a Darwinian global perspective. According to this perspective in the case of the Galapagos and since its beginnings the local people became problems and a threat to the unique animals and plants. Because of the vision about the local people, one of the main failures of the reserve has been that often emergent processes were not used in a productive manner for the defense of the commons. The local population was not able to manage their commons in part due to the fact that the GMR administrators are very suspicious of their intentions.

Conclusions

Although Darwin short visit to the Galapagos was mytified by later scholars and explorers, his stay and the animals and conversations he collected in this and other archipelagoes were part of the evidence that inspired him to question the idea that design came from above, that species are stable and inmmutable and that the earth is of recent origin. These series of observations Darwin made while in the Galapagos, and the conclusions that he drew from them were the bases for his questioning of the stability of species and thus of the need of a top down mechanism that created and stablished the existing order in nature.

In the case of the social sciences, Darwin ideas are part of an older tradition that can be traced to the Scottish revival which mantains that there is an emergent order that can result in sucessful and adaptive social arrangements based on the actions on indivuduals persuing their own interests. Some authors have suggested that these emergent process may result in the destruction of the commons. Under certain conditions, as demonstrated by Ostrom, this emergent systems can lead to the evolution of goups that will not only outcompete other groups but will also be successful in protecting and mantaining the commons. Successul rules and practices can also evolve that will assure the long term sustainability of the resources on which the groups are dependend. These institutions and social formations that can guarantee the proper management of the commons are often the result of compromises between emergent and top down process.

In the case of the Galapagos, Darwin's short presence in the Islands had a profound influence in the archipelago. Darwin also became an inspiration for the tens of thousands of tourists that visit the islands every year. This massive amount of visitors have produce direct and indirect impacts on the islands that need to be adressed. Darwin's mythologized life, following the script of a hero's journey in the quest for knowledge and his incredible acheivement motivated many other scien-

tists and tourists to visit the islands, inspired by the the idea of the Galapagos as a pristine natural laborator. His legacy also guided various conservation efforts, many of which have not been successful because they ignored or tried to supressed the very same emergent processes that Darwin discovered in the Galapagos.

Another important development in the Galapagos has been the emergence of local fisheries that have caused important transformations on the ecosystems. These emergent fisheries created both environmental and social changes as people in the 1980s and 1990s engaged in unsustainable extraction of resources like groupers, lobsters and sea cucumber. In order to assure their long term sustainability these emergent systems must have the capacity to manage the commons. The evolution of different sustainable instutions in the Galapagos such as the Marine Reserve and some of the alternative fisheries and tourism initiatives need to be better understood for many of these emergent systems are often discourage by top down managing practices.

The conditions that assure that the system will be able to manage the commons have been described by Elinor Ostrom et al. Top–down management strategies, as has been suggested by Ostrom et. al. tend to ignore the emergent aspects of social systems many of which are actively promoted by the fishermen, and thus miss the oportunity to create appropiate conditions for their sustainability.

In the case of Galapagos, a combination of emergent process and top–down process have coexisted with mix results. The deficient management of emergent systems has meant that people like those involved in fisheries and tourism have not evolved a sense of ownership of their commons and a deficient governance systems. The lack of trust in the institutions and the governance of the commons on the part of the local people is in partially the result of powerful outsider groups that have specific interests in the mangement of the GMR. Both fisheries and invasive species are good examples of the failure to manage emergent systems by the impossition of a comand and control paradigm based paradoxically on the goal to preserve a darwinian system by promoting non darwinian practices such as top down solutions, often usrealistic restoration practices and a static view of nature with the consequent loss of biodiversity and governability.

References

Alchain, A. (1950). Uncertainty, evolution, and economic theory. *The Journal of Political Economy, 58*(3), 211–221.

Boyd, R., & Richerson, P. (1988). The evolution of reciprocity in sizable groups. *Journal of Theoretical Biology, 132*, 337–356.

Castrejon, M. (2011). Co-Manejo pesquero de la Reserva Marina de Galápagos: tendencias. In *Retos y Perspectivas de Cambio*. México: Fundación Charles Darwin y Kanankil. Plaza y Valdés.

Cosmides, L., & Tooby, J. (1992). Cognitive adaptations for social exchange. In J. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind* (pp. 163–228). New York: Oxford University Press.

Dawkins, R. (1976). *The selfish gene*. Oxford: Oxford University Press.
Dawkins, R. (1986). *The blind watchmaker: Why the evidence of evolution reveals a universe without design*. New York: Norton.
Dennet, D. (1996). *Darwin's dangerous idea: Evolution and the meanings of life*. Simon & Schuster; reprint edition (ISBN 0-684-82471-X).
Edgar, G. J., Banks, S. A., Brandt, M., Bustamante, R. H., Chiriboga, A., Earle, S. A., Garske, L. E., Glynn, P. W., Grove, J. S., Henderson, S., Hickman, C. P., Miller, K. A., Rivera, F., & Wellington, G. M. (2009). El Niño, grazers and fisheries interact to greatly elevate the extncion risk of Galapagos marine species. *Global Change Biology*. doi:10.1111/j.1365-2486.2009.02117.x.
Engie, K., & Quiroga, D. (2013). The emergence of recreational fishing in the Galapagos Marine Reserve: Adaptation and complexities. In J. Denkinger & L. Vinueza (Eds.), *The Galapagos marine reserve* (Social and ecological sustainability in the Galapagos, pp. 203–226). New York: Springer.
Gardener, M. (2013). The management framework in practice—Can't see the wood for the trees: The changing management of the novel Miconia–Cinchona ecosystem in the humid highlands of Santa Cruz Island, Galapagos. In R. J. Hobbs, E. S. Higgs, & C. M. Hall (Eds.), *Novel ecosystems: Intervening in the new ecological world order* (1st ed., pp. 85–189). Chichester: Wiley.
Gardener, M. R., Atkinson, R., & Rentería, J. L. (2010). Eradications and people: Lessons from the Plant Eradication Program in Galapagos. *Restoration Ecology, 18*(1), 20–29.
Gardener, M., & Grenier, C. (2011). Linking livelihoods and conservation: Challenges facing the Galápagos Islands (Chap. 6). In G. Baldacchino & D. Niles (Eds.), *Global environmental studies* (pp. 73–85). Japan: Springer.
González, J. A., Rodríguez, J., & Tapia, W. (2008). Rethinking the Galapagos Islands as a complex social-ecological system: Implications for conservation and management. *Ecology and Society, 13*(2), 13.
Gould, S. (1981). *The mismeasure of man*. New York: N. W. Norton.
Grenier, C. (2007). *Conservación Contra Natura: Las Islas Galápagos* (Vol. 233). Editorial Abya Yala.
Hamilton, W. D. (1964). The genetic evolution of social behavior. I, II. *Journal of Theoretical Biology, 7*, 1–52.
Hayek, F. A. (1960). *The constitution of liberty*. Chicago: University of Chicago Press.
Hayek, F. A. (1967). *Studies in philosophy, politics and economics*. Chicago: University of Chicago Press.
Hayek, F. A. (1988). *The fatal conceit*. Chicago: University of Chicago Press.
Hearn, A. (2008). The rocky path to sustainable fisheries management and conservation in the Galapagos Marine Reserve. *Ocean & Coastal Management, 51*, 567–574.
Hobbs, R. J., Higgs, E. S., & Hall, C. M. (2013a). *Novel ecosystems: Intervening in the new ecological world order*. Chichester: Wiley.
Hobbs, R. J., Higgs, E. S., & Hall, C. M. (2013b). Introduction: Why novel ecosystems? In R. J. Hobbs, E. S. Higgs, & C. M. Hall (Eds.), *Novel ecosystems: Intervening in the new ecological world order* (1st ed., pp. 3–11). Hoboken, NJ: Wiley.
Holland, J. H. (1995). *Hidden order: How adaptation builds complexity*. New York: Helix Books (Addison Weley).
Holling, C. (2001). Understanding the complexity of economic, ecological and social systems. *Scientific American, 272*(6), 390–405.
Johnson, D., Price, M., & Van Vugt, M. (2013). Darwin's invisible hand: Market competition, evolution and the firm. *Journal of Economic Behavior & Organization, 90S*(2013), S128–S140.
Kauffman, S. (1995). *At home in the universe: The search for laws of self-organization, and complexity*. New York: Oxford University Press.
Kauffman, S. A. (2011). Approaches to the origin of life on earth. *Life, 1*(1), 34–48.

Larson, E. (2001). *Evolution's workshop. God and science on the Galapagos Islands*. London: Penguin Press.
Leonard, T. C. (2005). Mistaking eugenics for social Darwinism: Why eugenics is missing from the history of American economics. *History of Political Economy, 37*(Suppl 1), 200–233.
Levin, S. A. (1998). Ecosystems and the biosphere as complex adaptive systems. *Ecosystems, 1*(5), 431–436.
Light, A., Thompson, A., & Higgs, E. S. (2013). Valuing novel ecosystems. In R. J. Hobbs, E. S. Higgs, & C. M. Hall (Eds.), *Novel ecosystems: Intervening in the new ecological world order* (1st ed., pp. 257–268). Hoboken, NJ: Wiley.
Marciano, A. (2007). *Hayek's theory of social evolution in the light of Darwin's descent of man*. Working Paper No. 4/2007 International Center for Economic Research.
Mayr, E. (2002). *What evolution is*. London: Basic Books.
Miranda, M., & Vallejo, G. (2005). *Darwinismo Social y Eugenesia en el Mundo Latino* (p. 670). Buenos Aires: Siglo XXI Editores.
Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge, MA: Cambridge University Press.
Petsoulas, C. (2006). *Hayek's liberalism and its origins his idea of spontaneous order and the Scottish Enlightenment in Adam Smith's Political Philosophy: The invisible hand and spontaneous order*. New York, NY: Routledge.
Poundstone, W. (1992). *Prisioner's dilema: John von Neumann, game theory and the puzzle of the bomb*. Oxford: Oxford University Press.
Quiroga, D. (2009). Crafting nature: The Galapagos and the making and unmaking of a "natural laboratory". *Journal of Political Ecology: Case Studies in History and Society, 16*, 123–140.
Quiroga, D. (2012). Changing views of the Galapagos (Chap. 2). In S. Walsh & C. F. Mena (Eds.), *Science and conservation in the Galapagos Islands: Frameworks and perspectives*. New York: Springer.
Quiroga, D. (2014). Darwin and the conservation of Galapagos ecosystems. In G. Trueba (Ed.), *Why evolution matters: The importance of understanding evolution*. Newcastle upon Tyne: Cambridge Scholars Publishing. Newcastle upon Tyne, UK.
Reck, G. (2014). Development of the Galapagos Marine Reserve. In J. Denkinger & L. Vinueza (Eds.), *The Galapagos Marine Reserve: A dynamic social-ecological system* (Social and ecological sustainability in the Galapagos, pp. 139–158). New York: Springer.
Renteria, J. L., Gardener, M. R., Panetta, F. D., & Mick, J. (2012). Management of the invasive hill raspberry (Rubus niveus) on Santiago Island, Galapagos: Eradication or indefinite control? *Invasive Plant Science and Management, 5*(1), 37–46.
Richerson, P., Boyd, R., & Heaysnrich, J. (2003a). Cultural evolution of human cooperation (Chap. 19). In P. Hammerstein (Ed.), *Genetic and cultural evolution of cooperation*. Cambridge, MA: MIT Press.
Richerson, P., Boyd, R., & Henrich, J. (2003b). Cultural evolution of human cooperation. In F. Hamerstein (Ed.), *Gentic and cultural evolution of cooperation*. Cambridge, MA: MIT Press.
Ritchie, D. G. (1896). Social evolution. *International Journal of Ethics, 6*(2), 165–181.
Rogers, A. (1972, April–June). Darwinism and social Darwinism. *Journal of History of Ideas, 33*(2), 265–280.
Smith, C. (2006). *Adam Smith's political philosophy: The invisible hand and spontaneous order*. London: Routledge.
Sulloway, F. J. (1982). Darwin's conversion: The beagle voyage and its aftermath. *Journal of the History of Biology, 15*, 325–397.
Tooby, J., & Cosmides, L. (2005). Evolutionary psychology: Conceptual foundations. In D. M. Buss (Ed.), *Handbook of evolutionary psychology*. New York: Wiley.
Trivers, R. (1971). The evolution of Reciprocal Altruism. *The Quarterly Review of Biology, 46*, 35–57.

Veblen, T. B. (1898). Why is economics not an evolutionary science? *Quarterly Journal of Economics, 12*(3), 373–397.
Veblen, T. B. (1899). *The theory of the leisure class: An economic study in the evolution of institutions*. New York: Macmillan.
Villacis, B., & Carrillo, D. (2013). The socioeconomic paradox of Galapagos (Chap. 4). In C. F. Mena & S. J. Walsh (Eds.), *Science and conservation in the Galapagos islands* (pp. 69–85). New York: Springer.
Vince, G. (2011). Embracing invasives. *Science, 331*(6023), 1383–1384.
Watkins, G., & Cruz, F. (2007). *Galapagos at risk: A socioeconomic analysis of the situation in the archipelago*. Puerto Ayora, Province of Galapagos, Ecuador: Charles Darwin Foundation.
Weikart, R. (1998). Laissez-Faire social Darwinism and individualist competition in Darwin and Huxley. *The European Legacy, 3*(1), 17–30.
Weikart, R. (2003, May). Progress through racial extermination: Social Darwinism, Eugenics, and Pacifism in Germany 1860–1918. *German Studies Review, 26*(2), 273–294.
Wilson, E. O. (2012). *The Social Conquest of Earth*. New York: Liveright.
Wilson, D., Ostrom, E., Cox, M. E. (2013, June). Generalizing the core design principles for the efficacy of groups. *Journal of Economic Behavior & Organization, 90*(Supplement), S21–S32.

Chapter 9
Darwinian Emergence, Conservation, and Restoration. Novel Ecosystems and Hybrid Environments

Diego Quiroga and Gonzalo Rivas

Introduced species have been identified as a major threat to the native and endemic species in many oceanic islands (Whittaker 1998). In the case of the Galapagos, many of these species have proven very difficult if not impossible to eradicate. Such dramatic situation has motivated some people to suggest that it is necessary to change our current paradigm which pretends that we can eventually win the fight against invasive species and restore pristine environments. This chapter presents a debate about the way in which introduced species create emergent and Darwinian processes that threaten not only what are considered to be pristine environments but also our sense of stability and order.

One of the outcomes of the introduction of significant numbers of invasive plants into islands is the transformation of historic recipient native ecosystems into new plant assemblages "novel ecosystems," which are mostly dominated by these exotic and pervasive organisms (Hobbs et al. 2006; Lugo 2009; Mascaro et al. 2008). These novel ecosystems, occurring as a product of direct or indirect human action are estimated to cover ~40 % of the ice-free land of the planet (Bridgewater et al. 2011). Recently, some authors have suggested that the best way to handle some invasive species, which have shown to be very resilient and difficult if not impossible to eliminate is to manage and control this novel ecosystems (Hobbs et al. 2006). This discussion opens a series of questions about the somewhat arbitrary line that divides natural and human systems. In the modernist western tradition, advanced social systems and their effects are seen as being outside of the process of natural evolution—a divide has been created to separate human from natural process, imposing dualistic categories that demarcate the somewhat shifting boundary between the two domains.

D. Quiroga (✉) • G. Rivas
Colegio de ciencias biológicas y ambientales y Colegio de ciencias sociales y humanidades, Universidad San Francisco de Quito, Quito, Ecuador
e-mail: dquiroga@usfq.edu.ec; grivast@usfq.edu.ec

D. Quiroga, A. Sevilla (eds.), *Darwin, Darwinism and Conservation in the Galapagos Islands*, Social and Ecological Interactions in the Galapagos Islands,
DOI 10.1007/978-3-319-34052-4_9

The Galapagos Islands: Between a Darwinian Sanctuary and Invasive Species Threat

In the Galapagos, the effort to control invasive species, the restoration of whole islands, and the existence of "novel ecosystems" have started to generate interesting debates about the best conservation practices. Arguing about the need to restore this unique "Natural Laboratory," many conservation organizations and tourism companies have created a construct of the Galapagos as being a relatively pristine archipelago and until few centuries ago one of the few places untouched by humans, and have urge for the need to protect these ecosystems from human intervention.

As we have seen, Darwin's trip around the world in H.M.S. Beagle played a crucial role in the development of the theory of evolution. Personal observations in South America and in the Galapagos laid the foundation for his questioning of the idea that species are immutable, and that differences, change and structure are the result of bottom-up processes. Darwin's legacy has also played a key role in the evolution of Galapagos in terms of its human as well as its recent natural history. Through his travels and writings, the legendary figure Darwin has become associated in the imaginary of the Global North to the Galapagos as a "Natural Laboratory" for the study of biological evolution (Quiroga 2009). Although the idea of the Galapagos as a natural laboratory did not appear until, many years later, after Darwin's death, the association of Darwin, evolutionary science, and the Galapagos started with his visit to the islands. Furthermore, although Darwin mentions the fact that people were living in the islands and that there were already some invasive species when he visited the Islands (Lundh 2006), the idea that Darwin visited a pristine set of Islands becomes an important part of the mythologized narrative about Darwin and the Galapagos. The appearance of the Great Evolutionary Synthesis in the 1930s and 1940s consolidated the Darwinian Theory as well as the myth of Darwin's scientific conversion and his immediate transformation while he was in the Galapagos. Based on this mythical association, some of the leading scientists of this synthesis such as Julian Huxley played a key role in creating the conservation schemes for Galapagos (Hennessy, Chap. 5).

Darwin understood the importance that multiple isolations—between the islands and the mainland and between islands within the archipelago—play in maintaining the evolutionary processes. It was this biogeographic characteristic of the Galapagos that to a large extent inspire his search for new explanations of the "mysteries of mysteries," the evolution of species. Later, in the twentieth century the idea of protecting Darwin's Natural Laboratory and the conditions that will guarantee the evolutionary process guided top-down policies, which have been created to manage this unique "Darwinian sanctuary." However, ongoing emergent social and natural systems have become a threat to the stability of this construct. To maintain the idealized and utopic construct of the Galapagos as a pristine "Darwinian natural laboratory," expensive, time consuming, laborious, and often unsuccessful efforts have been made to control and direct emergent and dynamic process that are perceived as a degradation of the untouched environment. Many of these efforts have often been unsuccessful or have had a partial success at best (Gardener et al. 2013; Engie and Quiroga 2013).

Since the middle of the twentieth century, a group of scientists, conservationists, tour agencies, and political leaders, using Darwin ideas and his discoveries, generated the narrative of the Galapagos as a pristine natural laboratory. The creation of the Darwin myth was part of this conservation effort. A new perspective was thus generated, which framed needed human intervention in the Galapagos as an effort to conserve the native and endemic species and the supporting ecosystems that Darwin saw and studied. This narrative thereafter, produced an influx of tourists, scientists, and conservationists to the archipelago. Increasingly, Ecuadorians have also been migrating to these Islands, attracted by the monetary benefits that the flow of visitors generates. At the moment, at least 30,000 people reside in the islands and more than 220,000 tourists visit the islands every year. An ever-increasing number of cargo boats and planes that nowadays connect the Islands to the mainland. This increasing connectivity between the Galapagos and the mainland, and the fast process of change and transformation it generates has meant that the isolation that is essential for the unique, endemic biota is now being threatened by the arrival of hundreds of new exotic species brought intentionally and unintentionally. Emergent processes such as those generated by the introduction of new species have created cycles of destruction but also of restoration in the Galapagos (Gonzalez et al. 2008).

To stop the negative effects of this increasing flux of people, goods, and introduced organisms, a series of conservation and restoration measures have been implemented principally by the Galapagos National Park directorate-GNP, which is the national authority responsible for controlling and monitoring the archipelago. These efforts have been directed at insuring that the Galapagos maintains its iconic ecosystems and biodiversity as well as its integrity as a place to study the workings of nature and where tourist can enjoy a pristine landscape as similar as possible to the one observed by Darwin during his visit. The process of restoration focused on iconic species and the ecosystems that support these species. An effort has been made during the last decades to reproduce what are supposed to be the conditions that existed before humans arrived to the Galapagos. This desire to maintain and in some case recreate the historical landscape has resulted on a strategy to control and regulate both human and natural processes.

The desire to maintain pristine areas generated a constant tension between the effort to shape and control natural and social processes and the emergent and unpredictable nature of complex human and natural systems that follow Darwinian evolution. As part of the effort to restore and reshape these islands, scientists and conservationists as well as government authorities have implemented a schemata of classification of animals and plants into endemic, native and introduced species and a rather arbitrary ordering of the marine and terrestrial spaces based on a zoning system, and the creation of artificial boundaries of the protected land and marine areas (Fig. 9.1). These boundaries and classificatory schemes are nowadays officially recognized and reproduced by many stakeholders such as tourism operators, conservationists, and scientists.

The creation of the Galapagos Marine Reserve (GMR) in 1998 is a good example of the effort to order the oceanic and coastal areas of the archipelago. The zoning system represents an effort to order and control the activities taking place in the GMR. No Take Zones, other areas assigned to non-extractive activities such as

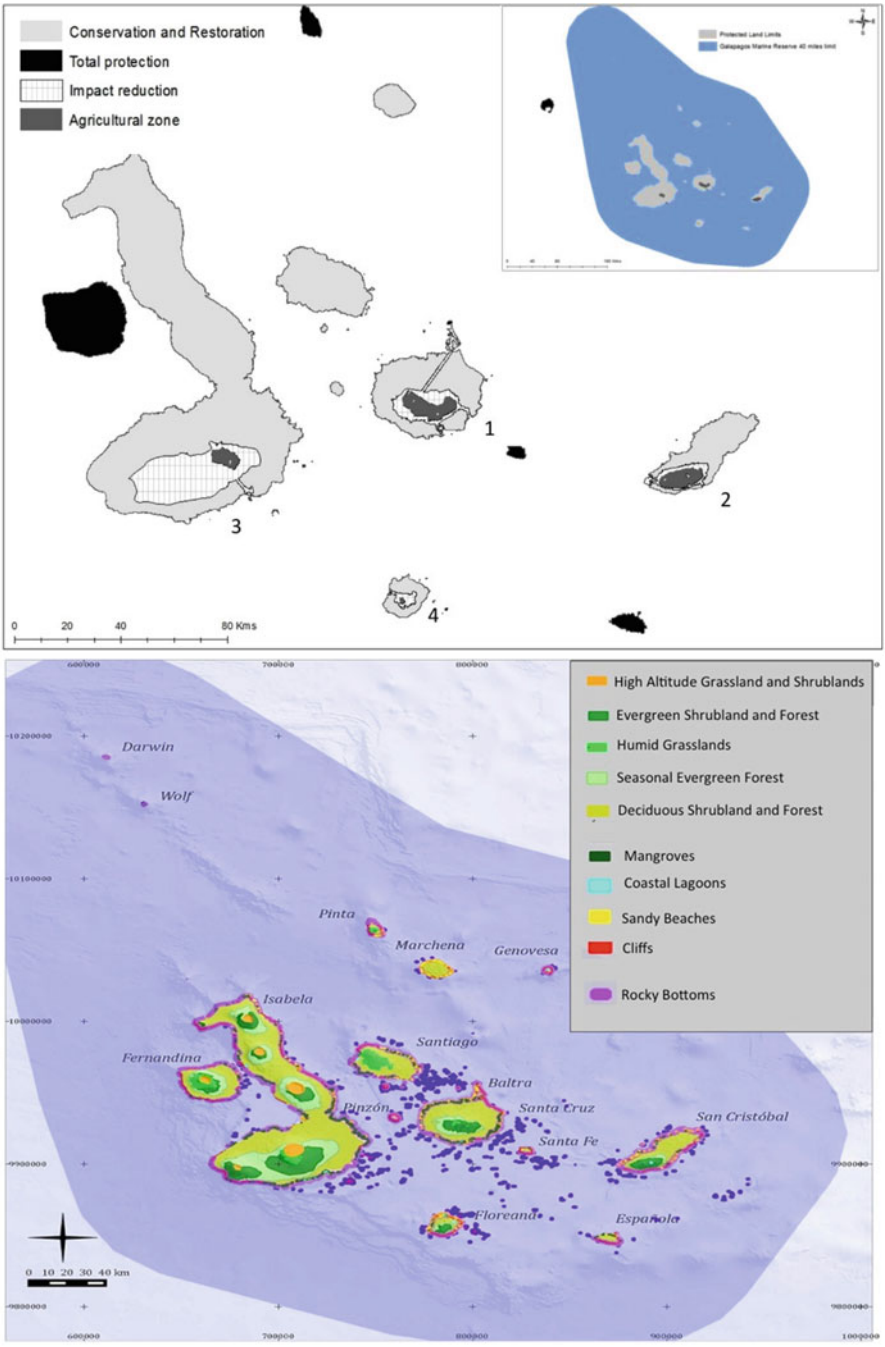

Fig. 9.1 Conservation and Restoration in the Galapagos. *Above*, map is showing how Conservation and Restoration area is surrounding the Agricultural or developing area in the Galapagos. *Numbers* denote inhabited islands: Santa Cruz (1), San Cristobal (2), Isabela (3), and Floreana (4). Baltra islands, located just north from Santa Cruz also present a developing area and Ecuadorian military bases including an airport. Darwin and Wolf Islands (north) are absent. In this figure, *blue* represents 40 miles comprising the Galapagos marine reserve and *grey* the protected land limits. *Below*, map (modified under permission

tourism, a large area for the use of local fishermen, and an area of multiple uses, were placed on the maps detailing the GMR. However, it can be argued that the establishment of the GMR created a false sense of control of the marine area, since many conservationists, fishermen, tourism operators, and biologist who are familiar with the workings of the GMR have expressed concerns about the effectiveness of the current zoning of the terrestrial and the marine-protected areas. As a consequence, a new zoning system is now being developed to take into account the dynamic and interactive process occurring in the Galapagos. This time the zoning system will include marine and terrestrial areas, but it seems that the process of desinging the new zoning system will not involve the stakeholders in any substantial manner.

Tension Between Terrestrial Ecosystems' Conservation and Emerging Human-Driven Processes

A similar zoning system is used for the management of the terrestrial reserve where four islands in the archipelago (plus the small Baltra Island; Fig. 9.1) present developing zones were settlers are allowed to perform extractive and agricultural activities (Fig. 9.1). These developing zones, encompassing around 3 % of the total protected terrestrial area, are generally surrounded by a belt-shaped protected area that is under the GNP jurisdiction. The spatial arrangement of the inhabited areas inside the protected land creates a continuous pressure over the latter, mainly from the agricultural expansion and the constant migration of exotic species commonly nurtured in high densities in the agricultural and urban settings (Fig. 9.1). To make things more complex, in some agricultural areas, human intervention provides a sort of barrier against invasive species that are more ubiquitous in the so-called pristine area. Abandoned agricultural plots are also an area where many invasive species proliferate.

One of the most dramatic examples of the ongoing conflict between the desire to maintain an "untouched natural laboratory" and the emergent properties of the natural and social systems is the fight against invasive species (i.e., introduced species from other areas outside Galapagos that can colonize vast areas threatening native organisms; *sensu* Richardson et al. 2000; Gardener and Grenier 2011). Today, Galapagos records more introduced than native plants and more than a third of the introduced species are now naturalized—meaning that they grow and disperse without human intervention (Guézou et al. 2010). Most of these naturalized species escaped from agricultural settings and present traits that have been artificially selected as yielding crops which gives them a competitive advantage over species growing in native ecosystems. The risk of introduced organisms dispersing naturally in recipient communities is the probability that some of them can become

Fig. 9.1 (continued) from GNP Management Plan 2014) shows the nine ecosystems proposed for Galapagos with details on the marine reserve rocky bottoms. *Source:* Dirección del Parque Nacional Galápagos. Plan de Manejo de las Áreas Protegidas de Galápagos para el Buen Vivir. 2014. Puerto Ayora, Galápagos, Ecuador

invasive given their fast colonization rates and adaptive capacity to new environmental conditions, causing significant negative impacts to the indigenous organisms that have been living in the islands for hundreds of years (O'Dowd et al. 2003).

The idea that introduced species can outcompete native organism due to certain traits that facilitate their faster colonization of new landscapes was also in Darwin's mind. He was aware of lower competitive capacity of native species in oceanic islands and, also consequently of the advantage provided to artificially human-selected organisms introduced on purpose or accidentally to insular ecosystems (Denslow 2003). This thought might have been reinforced by his visit to the islands and perhaps by the fact that he already recorded as many as 17 introduced species in the small Floreana Island (Fig. 9.1), product of old gardens created by tortoise hunters, and the many earlier human settlers that colonized this region in the past (Gardener et al. 2013). This assessment has been currently demonstrated by several examples of invasive species that have been relatively recently introduced to the Galapagos and have become real pests mainly because of their apparent higher competitive capacity to outperform native species or to occupy empty niches available.

For example, nowadays the tree known as Red Quinine (*Cinchona pubescens*) which was introduced to the island of Santa Cruz at least by the 1940s covers more than 11,000 ha only on that island (Jaeger et al. 2007). This invasive tree is not only reducing indigenous plant species cover but it is also reducing the abundance of other threatened fauna such as the Galapagos rail (*Laterallus spinolota*; Gardener et al. 2013). Hill Raspberry (*Rubus niveus*), Guava tree (*Psidium guajava*), and Cedar (*Cedrela odorata*) are also examples of invasive shrubs and tree species that are colonizing high extensions of the archipelago and thus are seriously threatening the survival of native and endemic plants (Renteria and Buddenhagen 2006; Rentería et al. 2012, Rivas et al. *in review*). Recent investigations testing the effects of the dense cover created by the invasive *C. odorata* and *R. niveus* has proved these plants are preventing the establishment of highly threatened endemic trees, i.e., existing only in the Galapagos (Rentería et al. 2012, Rivas et al. *in review*), which may also impact the dynamics of native ecosystems and change community composition of such unique spots within the archipelago.

In addition to exotic plants, invasive animals are also a constant harm to indigenous organisms in the Galapagos. Introduced rodents such as the Black Rats (*Rattus rattus*) have caused up to 70% reproductive failure in the dark-rumped petrel (*Pterodroma phaeopygia*) and are also predating on endemic plant seedlings hence reducing its probability to successfully establish under current restoration practices (Gardener et al. 2010; Clark 1981, Rivas et al. *unpub data*).

Because of the evident negative impacts of introduced and invasive organisms over native taxa in the Galapagos, mentioned above and constantly recorded in the scientific literature (Fessl et al. 2010; Gottdenker et al. 2005; Harris 2009; Riofrio-Lazo and Paez-Rosas 2015; Wikelski et al. 2004), there has been significant resource and time-consuming efforts to eradicate invasive plants and animals in this World Heritage Site (Gardener et al. 2010; Gardener and Grenier 2011). Some of these efforts are worldwide examples of successful eradication campaigns. This is the case of the goat eradication program in Northern Isabela and in other Islands of the

Archipelago. Pig eradication and apparently rat eradication are also well-publicized examples of successful programs to combat invasive species (Nicholls 2013). However, many other eradication campaigns, particularly those directed to control invasive plants have resulted in mixed outcomes (Gardener et al. 2010). It is calculated that more than one million dollars were spent in an attempt to eliminate 34 invasive plants and only four were successfully eradicated (Vince 2011). Eradication in these four cases occurred mainly because invasive plants population was small and its management was feasible due to lower control costs.

Some introduced insect species that have large population sizes and cover significant extensions of land might be more difficult to eradicate. The difficulties with erradicating some invasive plants and animals occurs not only with many invasive plant species but also occur with many of the invasive insect species also recorded in the islands. The little fire ant (*Wasmannia auropunctata*), for example, which due to its aggressive behavior and painful sting is known to cause very pervasive impacts to native biota and even to human settlers. Although it has been virtually eradicated from small islands of Galapagos, the control and eradication of these ants in bigger islands, where it has spread in thousands of hectares and sometimes present in very inaccessible sites, seems to be totally infeasible. The high costs to use in situ mechanical techniques to reduce population sizes of invasive insects and plants are the main concern for many conservationists (Causton et al. 2005). Currently, the GNP and related conservation organizations are spending a significant amount of time and money to prevent the expansion of invasive ants in small and uninhabited islands (Herrera et al. 2013; Wauters et al. 2014).

In Galapagos, biological controls have been used in few occasions to combat invasive species that are widespread and present significant challenges to the traditional eradication efforts. One relatively successful example is the ladybug (*Rodolia cardinalis*) brought from Australia to combat the cottony cushion scale (*Icerya purchasi*) in the Islands. However, the introduction of biological agents for the control of invasive species can be a particularly long and expensive process, which often backfires. Candidate species must undergo a series of tests to reduce the probability of these organisms to become invasive after its intentional introduction. It can be argued that this type of introduction generate new ecosystems as many times that introduced biological control becomes established and naturalized.

Another important challenge to conservation and to the simple dualistic construct that perceives introduced species as being all negative is the recent study describing the way in which some invasive species may be useful for endemic species such as is the case with the introduced plant species such as guava that are an important part of the diet of the Giant tortoises (Blake et al. 2015). Some of these not only serve as food for endemic fauna, they can also provide habitat for some endemic and native epiphytes, which brings difficult questions about need and even desirability of eradicating some of these invasive species. In the case of some species, such as with guava, besides producing a habitat for endemic epiphytes they can also they can be useful in humanized and transformed ecosystems.

Despite the fact that millions of dollars have been invested in combating invasive species and attempting to restore the ecosystems to their prehuman state, the flux of

people and goods to the islands, in addition to the presence of settlers living permanently in some of the islands, constantly creates new opportunities for the establishment of invasive species. Residents utilize invasive species such as *C. odorata* for timber and construction and illegally bring dogs, cats, and other domesticated animals to the islands that can later escape and impact the delicate balance of the endemic ecosystems of the archipelago. Despite efforts by different NGOs and different government agencies to control the growth of the population of dogs and cats, there is an increasing risk of them bringing infectious diseases that can spread to native fauna (Levy et al. 2008), and predating in the native and endemic species of birds and reptiles. Many of these domesticated animals brought illegally often abandon the inhabited areas.

Post-eradication Issues and the Management of New Dynamics

In areas where the large herbivores like the tortoises have gone extinct or are now found in very low numbers, the eradication of invasive species such as the goats generates new problems including the overgrowth of native and introduced vegetation. For instance, even in the case of flagship eradication programs for the Galapagos, such as the removal of large invasive mammal species like pigs and goats, the lack of large endemic and native herbivores in some of these islands has resulted in the uncontrolled growth of invasive plants (Rentería et al. 2012). To solve the problem, the GNP has decided to introduce tortoises from other islands to control the overgrowth of native and introduced plants, thus sterilized tortoises from Española have been introduced to Pinta and Santa Fe, two sites that were once dominated by large invasive mammals (Hunter 2012). Likewise, the eradication of invasive herbivores in Santiago, an uninhabited island in the Galapagos archipelago, is also apparently influencing the decline of the threatened Galapagos hawk living on that island, reducing its population size due to the lack of preys that can evade this predator raptor hiding in vegetation that has not been grazed (Rivera-Parra et al. 2012). These two examples are showing how native ecosystem processes can be affected not only by the presence of introduced species but also after the control and management of invasive organisms, which after enough time of naturalization have created new dynamics. These novel conditions and processes need to be included in future conservation agendas in order to have more efficient managerial actions for this archipelago.

Deliberate introductions of endemic animals from one island to another are nothing new. It was already happening before Darwin arrived to the Islands as the whalers and probably pirates released tortoises in different islands (Caccone et al. 1999) and it also happened in 1934 when Allan Hancock expedition released iguanas from Baltra in North Seymour (Larson 2001). Hence, due to the use of different restoration and control techniques, the Galapagos landscape rather than being a pristine natural laboratory is a constantly reengineered one. Because of the increasing uses

of biological controls even environments that are considered to be pristine are now increasingly populated by introduced species, a sort of newly formed ecosystems have thus been created in the last hundreds of years in Galapagos, some unknowingly, unconsciously and even unwillingly while others in a more conscious and orchestrated manner. This is for example the case of the ladybugs (*Rodolia cardinalis)* that are now found in many of the islands. Thus, the Galapagos have become a highly managed ecosystem where constant human intervention is paradoxically needed to reproduce its "pristine nature."

Embracing Novel Ecosystems or Depicting Novel Conservation Approaches

Recent investigations comparing plant composition between past and current vegetation types in Galapagos found that as much as 13 novel vegetation states have derived from three historical assemblages that dominated in the past the highlands of the abovementioned Santa Cruz Island, one of the bigger and inhabited islands of the Galapagos archipelago (Trueman et al. 2014). Some of these contemporary modified systems are actual novel forests presenting not only different plant assemblages but also very distinctive physiognomy (i.e., tall canopies) when compared to the historical stages (i.e., small-statured forests replacing shrublands; Jaeger et al. 2007; Trueman et al. 2014). One of the most conspicuous novel forests occurring nowadays in Santa Cruz Island is the so-called *Cedrela* forest (named after the invasive tree *Cedrela odorata* L. that dominates its canopy, Rivas et. al. *in review*) that densely invades around 28 % of the historical range previously occupied by the native forest at that altitude, which apparently presented a very different plant community composition in the past (Trueman et al. 2014).

Recently, several scientists, some of which have been associated with the Galapagos, have proposed that trying to eradicate many of the invasive plants and animals that now form novel ecosystems in many fragile conservation areas has been a waste of time and money (Hobbs et al. 2013; Vince 2011). In 2011, Gaia Vince, in Science Magazine, published an article in which Mark Gardener, at that point head of restoration at the Charles Darwin Research Station, is quoted as having admitted defeat in the fight against invasive plants in the Galapagos. They refer to a series of expensive projects that with few exceptions have failed to produce the desired results. This is one of the reasons why many of these scientists advocate for a drastic change in the way conservationists address the issue of introduced and invasive species (Hobbs et al. 2006), suggesting in some cases, invasive species might be accepted as part of new communities and ecosystem dynamics. This idea of accepting invasive species and that novel (mostly dominated by invasive species) or hybrid (a mix of invasive and native species) ecosystems may provide in some cases a more efficient way of fighting detrimental invasive organisms (Aronson et al. 2014; Murcia et al. 2014; Simberloff 2011) has not only opened an important debate in conservation, but it has also become a threat to the old way of restoring

environments worldwide and especially on islands ecosystems (Hobbs et al. 2013, 2014; Perring et al. 2013; Vince 2011). The appearance of the novel ecosystems concept is in part the result of the lack of success in imposing top-down solutions to control dynamic, unpredictable, complex, and emergent processes.

Murcia et al. (2014) have criticized the idea of novel ecosystems in many accounts. Among them they have argued that crossing a threshold does not necessarily indicate irreversibility. They are also critical of the idea that ecological restoration is wasting resources to create false expectations, and this novel ecosystems approach is a more realistic one. They argue instead that "[a]ll ecosystems should be considered candidates for restoration, regardless of the requisite resources" (2014). Murcia et al. (2014) do not maintain that all damaged ecosystems should be restored immediately, in light of highly limited resources, but instead that individual decisions should be made on a case-by-case basis, and all the different factors should be considered first. However, as Hobbs et al. have argued it is not the case that defenders of novel ecosystems consider them to be a positive and desirable situation. Instead, novel ecosystems must be seen as either a realistic way of dealing with degraded ecosystems or as a temporary solution in cases where lack of resources makes it impossible to return to pristine environments.

The novel ecosystems idea is controversial because it is a threat to the simplistic dualism that envisions pristine nature as unaffected by human intervention and ignores the fact that the complexities of these ecosystems call for a new conservation paradigm (Hobbs et al. 2009). These emergent processes defy the efforts of Darwinian conservationists to restore an ecosystem to their imagined pristine state. Restoration to a Darwinian pristine landscape in many cases is a top-down effort based on utopic imaginaries and pretends to paradoxically control social and biological evolution, which is by its very nature an emergent and dynamic process.

We now know that in some cases the control and eradication of invasive species, which most of the time can change dramatically previous ecosystems' dynamics, may result in "unexpected"—negative—outcomes that need the incorporation of new and "last minute" managerial actions.

Moving Forward: Novel Conservation Approaches for Invaded Areas

Novel ecosystems should not be taken as a "down strike" strategy that just accepts that different species should be moved and introduced everywhere. The concept should work to help understand the impacts, caused to organisms and ecosystems that invasive species are causing to native systems, and then to plan efficient and feasible conservation strategies created around cost-effective plans. Some invasive species are easier to eradicate than others and restoration ecologists and conservation planners should identify them beforehand and focus on this group as a primary eradication target. This identification must be performed in collaboration with all members of society involved in the specific strategy, as many times the best examples

of successful eradication depended on the participation and willingness of groups outside of the scientific world (Estévez et al. 2015; Ewel and Putz 2004).

We suggest then that eradication of invasive species, in particular in very dynamic systems such as the ones presently occurring in Galapagos, has to follow creative and adaptive strategies. In the Galapagos, as a result of increasing human presence is experiencing an accelerated rate of species introductions (for plants it is calculated ten species can be recorded per year entering the archipelago = 100,000 times more than the expected natural rate of species colonization Tye 2001), which in some cases and as mentioned before may promote the appearance of novel biological communities. This fast ecological change is occurring not only in the main inhabited islands like Santa Cruz which presents some transformer plants that were intentionally introduced by settlers and are creating novel assemblages, but is also occurring in other more pristine non-inhabited islands (Rentería et al. 2012). Hence, it seems necessary for these oceanic islands and for other isolated systems recording a significant amount of noxious introduced species to move away from generalized top-down recipes based on the re-creation of imagined pristine landscapes to a new way of thinking that can create different responses based on the analysis of the complexities and the unpredictable emergent properties of particular situations.

One efficient and feasible position could be that invasive species need to be controlled at levels that the existing diversity and evolutionary process could be guaranteed in such unparalleled site. Understanding these complexities and tradeoffs is in fact feasible but requires long-term and well-designed investigation projects. For instance, some recent studies have shown how endemic species like Galapagos tortoises in Santa Cruz, one of the most invaded islands in Galapagos that is exhaustively managed for invasive organisms, are thriving in the presence of invasive plants, demonstrating a balance is now achieved between introduced and native species in this particular system (Blake et al. 2015).

Current conservation strategies to a large extent are based on the static preservation of the environment, whereas the emergent processes that change previously existing dynamics which appear after introduced organisms are naturalized defy the static top and down logic of these strategies. The discussion regarding ecosystems conservation and invasive species in Galapagos and in all highly invaded areas has to transcend from a merely idealistic discourse about restoration based on simplistic processes to the inclusion of more significant measurements of habitat change such as ecosystem services provided by novel ecosystems. The acceptance of this idea does not mean the abandonment of conservation projects especially those targeting emblematic endangered species (many in the Galapagos) but on the contrary is intended to initiate the analysis of including those species—and the dynamics they affect—under new scenarios like the ones established by invasive organisms that allow them to prevail over time.

On a more fundamental manner, Darwin, who constitutes transformative figure in the development of the modernist vision, both blurred and defied this dualism between culture and nature. In the Origin of the Species, he made the distinction of natural vs. artificial selection as he argues that the same principles apply to both process, whereas in the Descent of Man (1871) he traced morality and other human

sentiments to instincts and the process of biological evolution is seen as the basis for cultural evolution, both being part of the same continuum. As we have seen throughout this book, the dialog between Darwin's ideas and theory and the Galapagos social and natural systems continues centuries after Darwin's death and both in discourse and in practice, the two are constantly transforming the other. One of Darwin's most important conclusions is that emergent processes are a vital part of nature and the evolution of natural-human systems. Darwinian mechanisms based on the process of natural selection are the bases for the existence of emergent systems. Emergent processes, particularly in present times occur in coupled human-natural systems and as such, they required a revision of traditional dualistic view of humans and nature as they require an understanding of interactions and networks. Understanding these emergent processes, their non-teleological nature and thus the uncertainties and transformations that are necessarily part of these systems, opens the door for new conservation strategies in the Galapagos and elsewhere—that depend on harnessing the energy of bottom-up Darwinian systems.

References

Aronson, J., Murcia, C., Kattan, G. H., Moreno-Mateosa, D., Dixon, K., & Simberloff, D. (2014). The road to confusion is paved with novel ecosystem labels: A reply to Hobbs et al. *Trends in Ecology & Evolution, 29*, 646–647.

Blake, S., Guézou, A., Deem, S. L., Yackulic, C. B., & Cabrera, F. (2015). The dominance of introduced plant species in the diets of migratory Galapagos tortoises increases with elevation on a human-occupied island. *Biotropica, 47*, 246–258.

Bridgewater, P., Higgs, E. S., Hobbs, R. J., & Jackson, S. T. (2011). Engaging with novel ecosystems. *Frontiers in Ecology and the Environment, 9*, 423.

Caccone, A., Gibbs, J. P., Ketmaier, V., Suatoni, E., & Powell, J. R. (1999). Origin and evolutionary relationships of giant Galapagos tortoises. *Proceedings of the National Academy of Sciences, 96*(23), 13223–13228.

Causton, C. E., Sevilla, C. R., & Porter, S. D. (2005). Eradication of the little fire ant, *Wasmannia auropunctata* (Hymenoptera: Formicidae), from Marchena island, Galápagos: On the edge of success? *Florida Entomologist, 88*, 159–168.

Clark, D. A. (1981). Foraging patterns of black rats across a desert-montane forest gradient in the Galapagos Islands. *Biotropica, 13*, 182.

Darwin, C. (1871) Descent of Man, and Selection in Relation to Sex. London: John Murray, Albemarle Street.

Denslow, J. S. (2003). Weeds in paradise: Thoughts on the invasibility of tropical islands. *Annals of the Missouri Botanical Garden, 90*, 119–127.

Engie, K., & Quiroga, D. (2013). The emergence of recreational fishing in the Galapagos Marine Reserve: Adaptation and complexities. In J. Denkinger & L. Vinueza (Eds.), *The Galapagos marine reserve* (Social and ecological sustainability in the Galapagos, pp. 203–226). New York: Springer.

Estévez, R. A., Anderson, C. B., Pizarro, J. C., & Burgman, M. A. (2015). Clarifying values, risk perceptions, and attitudes to resolve or avoid social conflicts in invasive species management. *Conservation Biology, 29*, 19–30.

Ewel, J. J., & Putz, F. E. (2004). A place for alien species in ecosystem restoration. *Frontiers in Ecology and the Environment, 2*, 354–360.

Fessl, B., Young, H. G., Young, R. P., Rodriguez-Matamoros, J., Dvorak, M., Tebbich, S., & Fa, J. E. (2010). How to save the rarest Darwin's finch from extinction the mangrove finch on Isabela Island. *Philosophical Transactions of the Royal Society B-Biological Sciences, 365*, 1019–1030.

Gardener, M. R., Atkinson, R., & Rentería, J. L. (2010). Eradications and people: Lessons from the plant eradication program in Galapagos. *Restoration Ecology, 18*, 20–29.

Gardener, M., & Grenier, C. (2011). Linking livelihoods and conservation: Challenges facing the Galápagos islands. Chap. 6 Island futures. In G. Baldacchino & D. Niles (Eds.), *Global environmental studies* (pp. 73–85). Japan: Springer.

Gardener, M. R., Trueman, M., Buddenhagen, C., Heleno, R., Jäger, H., Atkinson, R., & Tye, A. (2013). A pragmatic approach to the management of plant invasions in Galápagos. In L. C. Foxcroft, P. Pyšek, D. M. Richardson, & P. Genovesi (Eds.), *Plant invasions in protected areas* (pp. 349–374). Netherlands: Springer.

Gonzalez, J. A., Montes, C., Rodriguez, J., & Tapia, W. (2008). Rethinking the Galapagos Islands as a complex social-ecological system: Implications for conservation and management. *Ecology and Society, 13*, 13.

Gottdenker, N. L., Walsh, T., Vargas, H., Merkel, J., Jiménez, G. U., Miller, R. E., Dailey, M., & Parker, P. G. (2005). Assessing the risks of introduced chickens and their pathogens to native birds in the Galápagos Archipelago. *Biological Conservation, 126*, 429–439.

Guézou, A., Trueman, M., Buddenhagen, C. E., Chamorro, S., Guerrero, A. M., Pozo, P., & Atkinson, R. (2010). An extensive alien plant inventory from the inhabited areas of Galapagos. *PLoS One, 5*, e10276.

Harris, D. B. (2009). Review of negative effects of introduced rodents on small mammals on islands. *Biological Invasions, 11*, 1611–1630.

Herrera, H. W., Sevilla, C. R., & Dekoninck, W. (2013). *Pheidole megacephala* (Fabricius 1793) (Hymenoptera: Formicidae): A new invasive ant in the Galápagos Islands. *Pan-Pacific Entomologist, 89*, 234–243.

Hobbs, R. J., Arico, S., Aronson, J., Baron, J. S., Bridgewater, P., Cramer, V. A., Epstein, P. R., Ewel, J. J., Klink, C. A., Lugo, A. E., Norton, D., Ojima, D., Richardson, D. M., Sanderson, E. W., Valladares, F., Vilà, M., Zamora, R., & Zobel, M. (2006). Novel ecosystems: Theoretical and management aspects of the new ecological world order. *Global Ecology and Biogeography, 15*, 1–7.

Hobbs, R. J., Higgs, E. S., & Hall, C. (2013). *Novel ecosystems: Intervening in the new ecological world order*. The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK: Wiley.

Hobbs, R. J., Higgs, E., & Harris, J. A. (2009). Novel ecosystems: Implications for conservation and restoration. *Trends in Ecology & Evolution, 24*, 599–605.

Hobbs, R. J., Higgs, E. S., & Harris, J. A. (2014). Novel ecosystems: Concept or inconvenient reality? A response to Murcia et al. *Trends in Ecology & Evolution, 29*, 645–646.

Hunter, E. A. (2012). *Ecosystem restoration through the introduction of ecological analog giant tortoises to Pinta Island, Galapagos*. New York: State University of New York College of Environmental Science & Forestry.

Jaeger, H., Tye, A., & Kowarik, I. (2007). Tree invasion in naturally treeless environments: Impacts of quinine (Cinchona pubescens) trees on native vegetation in Galapagos. *Biological Conservation, 140*, 297–307.

Larson, E. (2001). *Evolution's workshop. God and science on the Galapagos Islands*. London: Penguin Press.

Levy, J. K., Crawford, P. C., Lappin, M. R., Dubovi, E. J., Levy, M. G., Alleman, R., Tucker, S. J., & Clifford, E. L. (2008). Infectious diseases of dogs and cats on Isabela Island, Galapagos. *Journal of Veterinary Internal Medicine, 22*, 60–65.

Lugo, A. E. (2009). The emerging era of novel tropical forests. *Biotropica, 41*, 589–591.

Lundh, J. P. (2006). The farm area and cultivated plants on Santa Cruz, 1932–1965, with remarks on other parts of Galápagos. *Galápagos Research, 64*, 12–25.

Mascaro, J., Becklund, K. K., Hughes, R. F., & Schnitzer, S. A. (2008). Limited native plant regeneration in novel, exotic-dominated forests on Hawai'i. *Forest Ecology and Management, 256*, 593–606.

Murcia, C., Aronson, J., Kattan, G. H., Moreno-Mateos, D., Dixon, K., & Simberloff, D. (2014). A critique of the "novel ecosystem" concept. *Trends in Ecology & Evolution, 29*, 548–553.

Nicholls, H. (2013). Invasive species: The 18-km2 rat trap. *Nature, 497*, 306–308.
O'Dowd, D. J., Green, P. T., & Lake, P. S. (2003). Invasional "meltdown" on an oceanic island. *Ecology Letters, 6*, 812–817.
Perring, M. P., Standish, R. J., & Hobbs, R. J. (2013). Incorporating novelty and novel ecosystems into restoration planning and practice in the 21st century. *Ecological Processes, 2*, 18.
Quiroga, D. (2009). Crafting nature: The Galapagos and the making and unmaking of a "natural laboratory". *Journal of Political Ecology: Case Studies in History and Society, 16*, 123–140.
Renteria, J. L., & Buddenhagen, C. (2006). Invasive plants in the Scalesia pedunculata forest at Los Gemelos, Santa Cruz, Galapagos. *Galapagos Research, 64*, 31–35.
Rentería, J. L., Gardener, M. R., Panetta, F. D., Atkinson, R., & Crawley, M. J. (2012). Possible impacts of the invasive plant Rubus niveus on the native vegetation of the Scalesia forest in the Galapagos Islands. *PLoS One, 7*(10), e48106. doi:10.1371/journal.pone.0048106.
Richardson, D. M., Pyšek, P., Rejmánek, M., Barbour, M. G., Panetta, F. D., & West, C. J. (2000). Naturalization and invasion of alien plants: Concepts and definitions. *Diversity and Distributions, 6*, 93–107.
Riofrio-Lazo, M., & Paez-Rosas, D. (2015). Feeding habits of introduced black rats, Rattus rattus, in nesting colonies of Galapagos petrel on San Cristobal Island, Galapagos. *PLoS One, 10*, e0127901.
Rivera-Parra, J. L., Levenstein, K. M., Bednarz, J. C., Vargas, F. H., Carrion, V., & Parker, P. G. (2012). Implications of goat eradication on the survivorship of the Galapagos hawk. *The Journal of Wildlife Management, 76*, 1197–1204.
Simberloff, D. (2011). Non-natives: 141 scientists object. *Nature, 475*, 36.
Trueman, M., Standish, R. J., & Hobbs, R. J. (2014). Identifying management options for modified vegetation: Application of the novel ecosystems framework to a case study in the Galapagos Islands. *Biological Conservation, 172*, 37–48.
Tye, A. (2001). *Invasive plant problems and requirements for weed risk assessment in the Galapagos islands*. 1st International Weed Risk Assessment Workshop, Australia.
Vince, G. (2011). Embracing invasives. *Science, 331*, 1383–1384.
Wauters, N., Dekoninck, W., Herrera, H. W., & Fournier, D. (2014). Distribution, behavioral dominance and potential impacts on endemic fauna of tropical fire ant *Solenopsis geminata* (Fabricius, 1804) (Hymenoptera: Formicidae: Myrmicinae) in the Galápagos archipelago. *Pan-Pacific Entomologist, 90*, 205–220.
Whittaker, R. J. (1998). The human impact on islands ecosystems: The lighthouse keeper's cat and other stories. In *Island biogeography: Ecology, evolution and conservation* (pp. 228–256). Oxford: Oxford University Press.
Wikelski, M., Foufopoulos, J., Vargas, H., & Snell, H. (2004). Galapagos birds and diseases: Invasive pathogens as threats for island species. *Ecology and Society, 9*, 5.