ON THE BACKS OF TORTOISES:
CONSERVING EVOLUTION IN THE GALÁPAGOS ISLANDS

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ABSTRACT

Elizabeth Ann Hennessy: On the Backs of Tortoises:
Conserving Evolution in the Galápagos Islands
(Under the direction of Wendy Wolford)

The Galápagos Islands are today considered a world-renown "natural laboratory of evolution" and one of the best-preserved ecosystems on earth. Yet even this remote archipelago is not immune from global environmental crises: in 2007, UNESCO put the Galápagos on its list of World Heritage Sites In Danger because of booming tourism development. Most analyses explain this crisis as a Malthusian problem of over-development on fragile islands. However, I argue that adequately understanding current problems in the Galápagos requires a return to the annals of evolutionary science to analyze how that history shaped the islands. This dissertation traces this history on the backs of the islands' most iconic species, giant tortoises, to show how the development of evolutionary science has reshaped understandings of island nature and how it is managed.

The dissertation traces a "history of the present" through detailed archival and ethnographic attention to shifting human engagements with giant tortoises over the past century. Chapters chart the shifting biopolitical strategies through which endangered nonhuman life has been managed, from natural history and zoological collection to *in situ* conservation breeding. They analyze how changing methods of biological science—from morphological taxonomy to phylogenetics—articulate with different modes of valuing and saving nonhuman life. In particular, they track how scientific valuations of the islands as a natural laboratory justified both conservation work and tourism development. By detailing the relationship between conservation and tourism through which giant tortoises became charismatic icons, the dissertation reframes the recent crisis not as the intrusion of globalization into a space of pristine nature, but as produced through an alliance between scientific conservation and global capitalism.

By engaging with the science and nature of evolution, the dissertation returns to the disciplinary history of geography. To avoid re-inscribing determinist interpretations that marked early twentieth century disciplinary engagements with evolutionary theory, the dissertation uses the Galápagos case to elaborate a *critical geography of evolution*. This perspective foregrounds the contingent, politicized processes through which nature and society co-evolve. It demonstrates how the circulation of evolutionary science orders relationships between nature and society and shapes the discursive and material production of landscapes.

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PREFACE

On a Sunday morning in June of 2012, long-time Galápagos resident and tortoise keeper Fausto Llerena made his usual morning rounds at the Galápagos National Park's Giant Tortoise Breeding Center, which has been named for Don Fausto since 1999 in honor of more than three decades of service. On this particular morning, Don Fausto found something unexpected: Lonesome George, the most famous Galápagos tortoise, had passed during the night. The news broke quickly across international media; Lonesome George was eulogized in *Nature, The Economist*, and the *New York Times*. For hundreds of thousands of tourists, George had become an icon of conservation efforts. The last of his particular species of Galápagos tortoise, from Pinta Island, he had lived in captivity since he was found alone on Pinta in 1971. His solitary plight was said to sound a clarion call about the human role in species extinctions.

For centuries, Pacific sailors depended on Galápagos tortoises as a key source of fresh meat. Tortoise hunting was also taken up by island colonists when the Galápagos were first settled in the nineteenth century. The large, slow creatures were relatively easy catch in a landscape dense with lava rock, brambly bushes, and very little fresh water. On low, dry islands, where tortoise species evolved to be smaller and better suited to the limited vegetation, small populations dwindled quickly. On larger islands with more green vegetation and correspondingly larger tortoises, more difficult hunting meant populations survived longer. But by the early twentieth century, naturalists were increasingly alarmed about the fate of tortoises and the islands' other unusual species and pushed for the creation of the national park to protect island flora and fauna.

Today, the Galápagos are one of the world's most storied tropical archipelagos, famous for their unusual species, inspiring Darwin's theory of evolution, and as a top eco-tourism destination. Tortoises today are consumed mainly through tourism, where they continue to shape people's livelihoods. Nearly 30,000 people live in the Galápagos today—the majority are Ecuadorians who work in tourism and support industries, in government jobs, and as conservationists. Residents inhabit only three percent of the archipelago; they live mostly in three coastal towns and adjacent land in the highlands, where six months of misty *garua* rains make agriculture feasible. The vast majority of land is protected national park, accessible only to tourists in carefully managed visitor sites and scientists working with research permits. Because of the cost of tours, most residents have never seen the Galápagos represented in nature documentaries. Nor have most seen a giant tortoise in the wild, although in places on the most populated island, Santa Cruz, tortoises and people co-inhabit agricultural areas.

Because of such inequalities, tortoises—particularly Lonesome George—have been lightening rods for political protests among island residents upset at the resources spent on conservation and the way that conservation goals often infringe on their rights, particularly to fish in the Galápagos Marine Reserve. The legacy that George leaves then is not a straightforward tale of human destruction of the natural world. The human community in the Galápagos—residents, conservationists, scientists, government officials, and tourists—is diverse and multifaceted, much like the islands' landscapes and the nonhuman creatures that inhabit them. Exploring the history that produced Lonesome George as an iconic animal and the entangled human and nonhuman lives that he leaves behind reveals a much more complex story that speaks of the politics of different ways of knowing and interacting with nature. This dissertation traces the story of Galápagos tortoises to begin to examine these relationships, focusing particularly on the production of evolutionary science, how it has shaped conservation, and their relation to the development of the tourism industry.

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CHAPTER I: INTRODUCTION

> "The natural history of these islands is eminently curious, and well deserves attention. Most of the organic productions are aboriginal creations, found nowhere else; there is even a difference between the inhabitants of the different islands; yet all show a marked relationship with those of America, though separated from that continent by an open space of ocean, between 500 and 600 miles in width. The archipelago is a little world within itself, or rather a satellite attached to America..."
>
> – Charles Darwin, *Journal of Researches,* 1845, p. 358

Charles Darwin once wrote that the austere landscapes and fauna of the Galápagos Islands were a key piece of the "origin…of all my views" (1959, p. 7). Since Darwin's visit in 1835, the archipelago has become world-renown as a "natural laboratory" for the study of evolution. Today, work in the field of island biogeography—much of it conducted in the Galápagos in Darwin's wake—has shown why oceanic archipelagos are places where evolution can be readily visible (Quammen 1996, MacArthur et al. 1967). As one scholar explained, the Galápagos were significant to Darwin because the isolation, demanding ecological conditions, and relative absence of competitor or predatory species allowed for unique evolutionary adaptations—adaptations that make the archipelago's species vulnerable to change.[1] Many of the plant and animal species found on the Galápagos are endemic—found nowhere else in the world. Of the 560 species of vascular plants in the archipelago, 180 species—32 percent—are endemic (Lawesson et al. 1987). Fifty-nine percent of vertebrate fauna are endemic—including the islands' giant tortoises, flightless cormorants, land and marine iguanas, and famous finches

[1] William Durham, "What Darwin Found Convincing in Galápagos," Presentation at the 2009 Galápagos Science Symposium, Puerto Ayora, Santa Cruz, Galápagos, Ecuador.

(Snell et al. 2002). Over the past fifty years, considerable efforts to protect these fabled islands have made them one of the best-preserved ecosystems on earth: a place where scientists and tourists alike can go to witness this nature as it supposedly was before the influence of man. Since 1959, 97 percent of the remote archipelago, which straddles the equator 600 miles off the coast of Ecuador in the Pacific Ocean, has been protected as a national park. As a result, scientists estimate the islands retain 95 percent of their original (pre-human discovery) endemic biodiversity (CDF and WWF 2002).

But over the past 10 years, the islands have been in news headlines around the world not for the success of conservation efforts, but as a site of crisis. Today, this iconic site of "pristine" nature faces a crisis of development that conservationists see as threatening the isolation that allowed for the development of the islands' endemic species. In 2007, UNESCO put the Galápagos on its list of World Heritage Sites In Danger because of booms in tourism and migration from continental Ecuador. Since the early 1980s, the number of tourists visiting the islands each year has increased more than ten-fold, from just fewer than 12,000 in 1979 to more than 180,000 in 2012. The local population has grown apace, from some 2,000 settlers in the 1960s to 25,000 in 2010. The Ecuadorian Government also declared the islands to be "at risk" because of a host of political, ecological, and social problems associated with growing development in the islands. The islands were removed from the UNESCO list in 2010 as the local government made progress in addressing key concerns. But the underlying question—as one journalist put it, "Can Darwin's Lab Survive Success?" (Conlin 2008)—remains. This laboratory for studying evolution has morphed into a laboratory for studying sustainability and a microcosm for sorting through problems of environment and development that are a hallmark of the twenty-first century world.

In the Galápagos, most analyses situate this crisis moment in a neo-Malthusian history of increasing developmental pressure over the past 30 years spurred by the growing popularity of eco-tourism (Gonzalez et. al. 2008, Watkins and Cruz 2007). However, in this dissertation I argue that adequately understanding current problems in the Galápagos requires a return to the annals of evolutionary science to analyze how this history has shaped the islands and their species. Before the islands were a world-renown eco-tourism destination and "evolutionary Eden," their stark landscapes were better known—in Herman Melville's words—as an "evilly enchanted" hell on earth (2002 [1854]). The rocky, volcanic islands have little fresh water and the still seas that surround them were a curse for becalmed sailors. The very conditions that made life difficult on the islands were those that proved so interesting for Darwin and biologists working in his wake. But it took more than Darwin's influence to shift popular imaginations of the Galápagos from a cursed purgatory to an evolutionary Eden. While an increasing number of naturalists visited the Galápagos in the late-nineteenth and early-twentieth century, in the 1940s the islands were mostly known for the Ecuadorian penal colonies they housed and as a refuge for European settlers who had fled the world wars. As the dissertation will show, this shift in popular imaginations of the Galápagos slowly evolved over the twentieth century, laying the foundation for the tourism industry that is seen as threatening the islands' nature today.

This is not a straightforward story of the spread of scientifically enlightened views of nature and conservationists' battle against the destructive forces of global capital. Beginning from this crisis moment, I trace a "history of the present" (Foucault 1977) that explores the contingent relationships and fractured moments that constitute the conditions of possibility for the current moment. Rather than reading the crisis as an intrusion of increasingly dense global flows—of people, money, material goods, and introduced species—into a space of isolated, "pristine" nature, I trace a history of the global flows into and out of this archipelago that made these islands into a desirable tourist attraction and place to live. The popular imagined geography of islands as isolated from modernity belies the fundamental role island landscapes have played in the development of modernity (DeLoughrey 2007). This is perhaps nowhere more true than where Charles Darwin is said to have "discovered" his theory of evolution by natural selection (but see Sulloway 2009 on the Darwin-Galápagos myth). Darwin, in 1835, did not strike upon the islands undiscovered or untouched, but as a territory of the nascent state of Ecuador and a landscape that had sheltered and fed whalers, pirates, and explorers for centuries. The Galápagos were foundational to modernity not only because of their role in inspiring Darwin, but also for supporting seventeenth and eighteenth century maritime economies, and for housing citizens cast out of both a new nineteenth century republic and the tumultuous twentieth century reordering of modernity's core.

The story of conservation in the Galápagos cannot fully be told as it often is—a tale of heroic naturalists stepping in to protect the pristine nature that was so instrumental for Darwin. This is not a straightforward declensionist story of the type often told about conservation in Latin America in which conservationists intervene to protect nature from the ravages of capitalist colonial extraction (Evans 2008, Dean 1995). The major landmarks of that narrative do not fit the history of these islands, where connections to capitalist economies and foreign presence have only grown since conservation started. Here we can neither assume a pristine state of nature nor its progressive degradation. The flows associated with the tourism industry at the center of crisis declarations are neither unprecedented nor necessarily in opposition to island conservation. Instead, they flow from celebrations of the Darwinian nature of the islands that have, since the mid-twentieth century, framed the archipelago as a "natural laboratory" of pristine nature. It is my contention that it is this history, and the variety of attempts it has inspired to manage the islands as a site of pristine nature, that shaped the crisis moment. But to say this is not to identify a direct cause, nor to attribute responsibility. Rather than a causal explanation that traces the roots of the crisis, I explore the particular, contradictory, and ever-changing assemblages of humans and nonhumans that have formed the natures, institutions, and flows that have made and remade the Galápagos Islands. Based on Foucault's reading of Nietzschean genealogies as a method of history, this genealogical approach does not trace a linear unfolding of history nor patterns of descent—as Foucault wrote, "Genealogy does not resemble the evolution of a species and does not map the destiny of a people" (1977, p. 146). Instead, it traces descent in all its complexity, attending to the false starts, contradictions, and struggles that move history as well as their various unintended consequences.

Tortoises All the Way Down

To trace a history of the present, I focus on the Galápagos Islands' namesake and most iconic species, the giant tortoises. When the islands were first mapped in the sixteenth century, they were named for the saddle-like shells of their largest residents—*galapago* is an old Spanish word for saddle. I use these large, plodding, and long-lived animals to ground an investigation of changing relationships between science, conservation, and development. Symbolically and materially the tortoises' heft (adult males can be 5ft long and weigh 500 pounds) brings this story of the development, celebration, commodification, and contestation of evolutionary ideas down to earth. Their longevity—living perhaps more than 200 years, they are among the world's longest-living vertebrates—provides a temporal anchor for shifts in management—from centuries of predation to natural history museum preservation to twentieth century protection.

Darwin wrote that the tortoises appeared “antediluvian” (1845, p. 356)—their leathery, gray skin and well-worn armor make them seem to be “survivors from a past age of reptiles” (Rothschild 1983, p. 197). But I use the more recent history of these other-worldly creatures as a foil for accounts that frame them as “prehistoric” nature. I explore how over the past century the development and celebration of scientific understandings of nature in the Galápagos have shaped the islands and the giant tortoises through transnational governance regimes, conservation work, and tourism development.

Galápagos giant tortoises have been a key species in world history for centuries. These animals have been at the center of scientific discovery, conservation imperatives, and controversies over the use of natural resources. They are not passive entities, but agents that work to organize the socio-ecological spaces around them in what Sarah Whatmore (2002) terms “wildlife topologies” (also Philo and Wilbert 2000, Wolch and Emel 1998). During the seventeenth and eighteenth centuries whalers and buccaneers visited the Galápagos to collect tortoises as food for long voyages—they were easy to catch, tasty, and could stay alive stacked upside down in the hulls of ships for months on end without food or water. Darwin’s visit in 1835, followed by the demise of the whaling industry in the 1860s, marked a turning point for tortoises, which became objects of scientific study that satisfied natural history collectors’ quest for unusual species from faraway lands. But collection—whether scientific or alimentary, and often both—decimated tortoise populations: there were once more than 200,000 tortoises in the Galápagos, but when the GNP was founded in 1959, surveyors estimated there were only 2,000 left. When the new national park and CDRS were founded in the late 1950s, breeding and repatriating tortoises was a top priority. Today, thanks to repatriation efforts and more thorough surveys, scientists estimate there are some 20,000 tortoises in the archipelago. As the islands’ largest herbivores, the tortoises are “keystone” species that act as “ecological engineers” and are thus central to the restoration of island ecosystems (Gibbs et al. 2010). Since the 1980s, giant tortoises have become icons of conservation and tourism. As such, they also organize other landscapes: images of tortoises adorn the logos of most all Galápagos conservation, science, and tourism organizations. Breeding centers and eco-farms are major attractions for an industry that has tripled in size over the past 15 years (Watkins and Cruz 2007). Yet tortoises have also been targets of political protest among Galápagos residents who see conservation as eclipsing opportunities for development (Ospina 2006). Over the past 25 years, Park guards have repeatedly found crushed eggs and sacrificed tortoises—acts apparently done by local residents in protest of conservation policies (ibid). In the Galápagos, it is tortoises all the way down.

By telling the story of the Galápagos on the backs of tortoises, I take both the symbolism and the materiality of nature seriously. Giant tortoises have long been associated with origin stories from various cultures around world (Chambers 2006)—that the Galápagos tortoises have come to be associated with Darwin’s theory of evolution presents a modern, scientific version of a long-standing tale. Stephen Hawking opened his *A Brief History of Time* (1988) with the popular story about how the world rests on the backs of turtles, “all the way down.” As he tells it, William James (or perhaps it was Bertrand Russell) gave a public lecture in the early twentieth century on the Copernican Revolution, explaining that the sun does not revolve around the Earth, but that the Earth is part of a vast solar system that revolves around the sun. At the end of the talk, an old woman gets up and says to James, “That’s all very well and good, but we all know that the Earth really rests on the back of a giant turtle.” James smiles, replying: “Ah, but what does the turtle rest on?” The old woman responds, “Nice try young man, but it’s turtles all the way down!”

The story is often used to speak to different cosmologies, different knowledge systems for understanding the world. Clifford Geertz (1973) uses the story—which he recounts as an Indian tale about an exchange between an Englishman and a local—to think through the task of anthropology as the interpretation of culture. He warns against searching for foundational turtles to explain culture, instead advocating thick description of the "hard surfaces of life." Philosopher of science Isabelle Stengers also recounts the story, this time to caution against the quest in modern science for a transparent foundation for knowledge, a quest that has too often led to "a foundation that makes reference to that which it is supposed to ground" (1997, p. 63). She uses the "theoretical turtles" to push us toward asking not "what they rested on, but with whom they lived," arguing that we should "recognize them as a rigorous exploration of problems accepted as both relative and fully positive" (1997, p. 65).

By invoking the turtles all the way down story, I follow Geertz and Stengers, but rather than think about turtles in the abstract, my project takes the figure of the tortoise seriously. In the Galápagos, popular myth holds that Darwin discovered evolution on the backs of tortoises after the islands' vice-governor commented that he could tell which island a tortoise came from because of morphological differences between the various populations. Although historians of science have widely refuted the idea that Darwin had a "eureka moment" in the Galápagos, the tortoises have not lost this cultural significance (Sulloway 2009). In the conservationist quest to protect wilderness, the prehistoric-looking species are said to be a window into a past world. Indeed, the ancestors of modern tortoises first evolved some 250 million years ago, meaning they lived in the age of dinosaurs. Even as relatively recently as 50,000 years ago, giant tortoises lived on every continent except for Australia and Antarctica (Auffenberg 1974). Today, the giant tortoises appear to be anachronisms still surviving from these earlier eras. In that sense, temporally they seem to take us all the way down to a pre-human, prehistoric landscape. As such, they are a powerful hold for conservationists' claims to manage the islands as a "bastion of pristine nature" (Watkins and Cruz 2007). But in offering a geographic perspective on the so-called turtle problem, I argue that taking the tortoise seriously, constructing a thick description of "with whom the tortoises live," demonstrates that even for this most prehistoric-looking species, it is nature-cultures all the way down. Even in these isolated islands, there is no foundational Nature on which to gain special insight into the origins of life or on which to base political claims to govern the islands. Instead, I analyze how and to what effect histories of evolutionary science, conservation, and development have materially and symbolically co-evolved with giant tortoises.

Critical Geography of Evolution

To take geographies of nature in the Galápagos seriously requires engagement with evolutionary theory and its Darwinian history. In the Galápagos today it is difficult to ignore Darwin's legacy; evolutionary allusions are canonized in the rhetoric of conservation and tourism, and Darwin literally watches, god-like over life in these fabled islands from numerous statues (see Figure 1.1, below). Exploring the intersection of histories of science, conservation, and development in the Galápagos, I seek to engage with Darwinian and evolutionary history to begin to articulate a critical geographic approach to evolution as one possible, understudied, and I argue important, avenue for "putting life back into the discipline" (Spencer and Whatmore 2001). I seek to explore how evolutionary understandings of Galápagos nature have shaped the islands over the past 200 years since Darwin's visit aboard the *Beagle*. This is by no means a comprehensive study of the role of the Galápagos in the production of evolutionary thought (see

Larson 2001 for an excellent study along these lines, before and after Darwin). Nor is my point to reassert the "Darwin-Galápagos myth" (Sulloway 2009) that he discovered evolution in the islands through direct observation of the various shapes of the beaks of finches or the shell shapes of tortoises.[2] Instead, I examine why such myths exist, how they have circulated in projects of island management, how they have affected social and natural life on the islands, and what all of this, in turn, might tell us about the relationships between nature and culture.

Figure 1.1 Darwin Watches over Puerto Ayora

Darwin watches over the fauna of the Galápagos Islands from an arch near the entrance to the Galápagos National Park and Charles Darwin Research Station in Puerto Ayora, Santa Cruz. In March 2012, another Darwin statue was erected below this, allowing Darwin to watch over himself as well. Photo/ E Hennessy.

By focusing on evolution, I return to a Darwinian history that was foundational to the development of Geography as an academic discipline (Livingstone 1992), but has long since fallen out of favor because of histories of environmental determinism and racist social

[2] Historians of science have disproven this myth of instantaneous discovery through what are now decades of sustained work on the importance of Darwin's experiments at Down House and his extensive correspondence with other naturalists for the development of his theory of evolution (Feeley-Harnik 2007, Browne 2002, Sulloway 1984).

Darwinism (Castree 2009, Stoddard 1966). My work advances a *critical geography of evolution* that begins from the assertion that evolution is not only a biological process, but also is shaped by social histories. This critical approach to evolution involves two related elements: (a) a relational understanding of evolution informed by philosophies of biology and critical environmental geographers' attention to the ways in which people's interactions with nature are culturally, economically, and politically mediated; and (b) attention to the geographies of evolutionary science in which the circulation and celebration of Darwinism order relationships between nature and society and in doing so shape particular places. Combining these theoretical approaches helps me to avoid reproducing determinist understandings evolution and the relationship between nature and culture that underwrote much early twentieth century geography. In this section, I briefly review this history before turning to discuss the three approaches.

History of Disciplinary Engagement with Evolution

Evolution has had a troubled history in geography. Part of the trouble, according to David Livingstone's disciplinary history, is that geographers have for decades broadly failed to engage with Darwinian thought (1992, but see Driver 2010). A good deal of attention has been paid in recent years to reconsidering some of the founders of geographic thought (e.g., Elden 2009). Yet despite assertions that Charles Darwin is among geographers' "most distinguished predecessors" (Kennedy 2004, p. 402), recent calls to reengage with his life and work (Castree 2009a, 2009b) have provoked debate (c.f., *Environment and Planning A* 2010 special issue), but do not seem to have inspired much sustained scholarship. This is despite longstanding engagement with biological and ecological concepts as well as calls over the past decade for "putting life" back into human geography (Spencer and Whatmore 2001, also Braun 2008), engaging with humans' own “species being” (Harvey 2000), and for “more than human” biogeographies (Lorimer 2010, Whatmore 2002).

So why is evolution not a central theme in a discipline broadly concerned with understanding nature-society relations and environmental change? There are several possible explanations for Darwin’s conspicuous absence in much disciplinary history (Livingstone 1992, for example, see Hartshorne 1939). Perhaps most notable is the trouble of the deterministic, racist, and imperialistic engagements with evolution that helped to institutionalize geography as an academic discipline (Livingstone 1992, also Stoddart 1966).[3] In his disciplinary history, David Livingstone contends that professional geography was launched as an academic discipline dedicated to “keeping nature and culture under the same conceptual umbrella” (1992, p. 177). Evolutionary thought was crucial to this undertaking and thus the discipline’s establishment (ibid, Stoddart 1966). Stoddart claimed that “much of the geographical work of the past hundred years…has either explicitly or implicitly taken inspiration from biology, and in particular from Darwin” (Quoted in Livingstone 1992, p. 178).[4] As Livingstone contends, echoing Stoddart’s review, British, German, and American geography were each shaped through engagements with evolutionary thought at the turn of the twentieth century as leading practitioners applied the biological metaphor to explain patterns of natural and social development. Stoddart identifies

[3] Other reasons include characterizations of geographic engagement with evolution as Lamarckian rather than Darwinian (something largely [and somewhat unfairly] considered an unscientific slur in much contemporary biological thought (cf, Oyama 2000; Livingstone 1992); belief that evolution only happens in geological time scales, not on human time scales (Russell 2011); and the divergence of such a field-based discipline from the increasingly laboratory-oriented science of molecular neo-Darwinism during the latter half of the twentieth century (Keller 2000; Kohler 2002). As far as the lack of contemporary re-engagement with evolution, there is also the fact that it is a dauntingly broad subject—Darwin has been one of the most influential ‘founders of a discourse’ in modern thought. Without a tradition of disciplinary instruction in even basic evolutionary biology (island biogeography is a large exception) it is difficult to know where to start.

[4] Not all geographers were willing to acknowledge this inspiration. Livingstone takes historians of geography to task for the “conspicuous absence” of evolutionary thought (c.f., Hartshorne 1939). Thus his 1992 history argues for a revision that recognizes geography’s evolutionary past.

four themes translated from Darwinian to geographical thought: (a) a focus on development through time; (b) an emphasis on the relationship between organisms and their environments, used to frame states and regions as organic beings; (c) struggle and selection, often applied deterministically in human and political geography; and, later, (d) the random nature of original variation, which had been largely ignored in the first waves of determinist thought (1966).

Both authors point to problematic interpretations of evolutionary thought, seeking in part to explain why Darwin fell out of fashion in the discipline. The turn of the twentieth century was a period of widespread "Social Darwinism" in which evolutionary idioms were applied to a diverse array of social processes: from a natural justification for imperialism and nationalist aggression to eugenic policies and laissez-faire individualism. Stoddart and Livingstone demonstrate that geography was certainly not immune to this, sharing similar reductionist interpretations of evolution. Evolution in geography was often framed as teleologically progressive and determinist (Stoddart 1966). As Stoddart noted, "for a time 'evolution' implied little more than the idea of change, development, and 'progress,' and Darwin was in spite of himself seen as its author" (1966, p. 688).

Early geographic engagement with evolution spanned the breadth of disciplinary themes. In physical geography, William Morris Davis's analysis of the evolution of landforms and "cycles of erosion" were demonstrative of a progressive interpretation of evolution that retreated from Darwin's focus on process to a more functionalist history (Stoddart 1966). In a political approach, Halford Mackinder used evolutionary language to position geography as a discipline tasked with "reintegrating society and environment" (Livingstone 1992, p. 190), writing that "communities of men should be looked on as units in the struggle for existence, more or less favoured by their several environments" (Quoted in Livingstone 1992, p. 192). The concept of the "survival of the fittest" (coined not by Darwin, but Herbert Spencer and only written into the *Origin* in its sixth edition) was a central theme of social Darwinism, used as what Richard Peet called a "legitimation ideology" to bolster American exceptionalism and monopoly capitalism (1985). In geography, it surfaced again in Ratzelian interpretations of states and regions as organisms in need of expansion to provide "living space" and was used in the service of imperial governments.

Another feature of evolutionary geographic thought were reductionist causal interpretations of the relationship between people and their environments (Huntington 1924 [1915]), Semple 1911) which are widely cited today for their environmental determinism.[5] Semple, for example, was a key figure of geographic education for several decades in the early twentieth century. Although she attempted to strip out a focus on the "survival of the fittest," she defined geography as the "scientific investigation of the physical conditions of historical events" (Semple 1911, p. 10) and thus reinscribed Spencer's focus on the "life-giving connection between land and people" (Peet 1985, p. 318).

Stoddart argued that the determinism that characterized geographic engagements with evolution was due in part to a lack of acknowledgement of the role of randomness and chance in shaping variation. He concludes that "biological influences in geography during the past century,

[5] Livingstone contends that these key figures' works were more inspired by Lamarckian belief in the inheritance of acquired (or environmentally influenced) traits than a Darwinian focus on hereditary traits. This is a distinction that has been used for decades to demarcate scientific Darwinism from "unscientific" Lamarckism. In the mid-twentieth century, the Modern Synthesis reinvigorated Darwinian theory by demonstrating that genes were the missing mechanism of inheritance in his theory of evolution by natural selection (thus firmly relegating Lamarck to the fringes of evolutionary theory). But before this, belief in the inheritance of acquired traits was widespread. (What's more, the distinction is increasingly called into question by modern evolutionary biology, particularly work in epigenetics that explores the role of environmental influences in shaping gene function [c.f., Oyama 2000].) What is at stake in Livingstone's revision of geographic work as Lamarckian rather than Darwinian then is not entirely clear—is he trying to clear Darwin's name in the problematic annals of disciplinary engagement in evolution? While it is evident that early geographers incorporated ideas about the inheritance of environmental influence, I follow Kennedy's (2004) assertion that whatever we label it now, early geographers saw themselves as working in a Darwinian tradition.

therefore, although often claiming descent from evolution or from Darwin, have been interpreted in ways which at times subtly and at times blatantly diverge from Darwin's actual philosophy" (1996, p. 697).[6] We might well classify uses of evolutionary theory to naturalize class politics as cases of Social Darwinism in which a theory about the natural world was inaccurately applied to social patterns. Indeed, as Steve Hinchliffe notes, this is a "wonderful ruse" in which "nature is made to adhere to social orders and in being so conveys a moral authority upon those orders" (2007, p. 33). As David Harvey puts it, the "…metaphors and patterns projected onto nature (and thought therefore to be encoded in our genes) are derived precisely from the human social institutions that thereby become 'naturalized' through biological enquiry" (1996, p. 166). But the distinction between natural laws and social theories in such a reading is problematic, for, as many scholars have pointed out, Darwin's theory of evolution was itself shaped by Malthus' theory of population growth (Hinchliffe 2007, Williams 2005 [1980], Harvey 1996, Livingstone 1992). Thus in conceptualizing evolution as based on competition for scarce resources, Darwin's account of nature was shaped by dominant political concerns of his day (Desmond and Moore 1991). [7] As Harvey explains, the problem is that "if values reside in nature, we have no scientific

[6] This is an important point, and one I will revisit in the next section. Yet reengaging with Darwin and evolutionary thought today in a way that does not reinstate its determinist past is not simply a matter of more closely adhering to "Darwin's actual philosophy." Though I agree with Stoddart that evolution as conceptualized by Darwin is far from the deterministic interpretations that swept geography, there is no one "true" version of Darwinian philosophy. This is a point Livingstone clearly makes in his comparison of dominant the interpretations of Darwinian thought across late nineteenth century Charleston, South Carolina, Wellington, New Zealand, and St. Petersburg. In each of these cities, local history and politics shaped the ways in which social groups interpreted evolution and mobilized the theory to certain ends: from justifications for slavery in Charleston, to moral authority for white colonialism in New Zealand, to accounts of selection that emphasized not struggle but mutual aid in St. Petersburg. Theories travel, and in doing so, are remade (Livingstone 2005, Said 1983).

[7] Despite Darwin's emphasis on chance and unpredictability, the idea of survival of the fittest invoked his framing of evolution as a "struggle for existence," a phrase he included in the *Origin*'s subtitle. The concept of struggle was often at the center of deterministic interpretations in geography (and broadly in social Darwinist interpretations) (Stoddart 1966). As Livingstone explains, it was a concept Darwin took largely from Malthus, but his interpretation of struggle in nature differed from popular emphasis on the violence of natural life:

> "Here was a pattern that Darwin could apply to all organisms – the idea of a struggle for existence. By transferring Malthus's social law to the natural world, Darwin

way of knowing what they are independently of the values implicit in the metaphors deployed in mounting specific lines of scientific enquiry" (1996, p. 162).

Such social constructionist critiques of the ideology of "universal nature" (Smith 1984) point to the particular histories and geographies of conceptions of nature (Hinchliffe 2007). But while constructionist accounts have convincingly demonstrated that what we understand nature to be is always shaped by the contexts of human society, they are problematic because they too often cast nature in a passive role or fail to account for how natures change in relation with human societies. To escape the pitfalls of social constructionism, human geographers have broadly turned to a relational instead of dualistic approach to nature-society relations that attends to the "co-production of nature and society" (Hinchliffe 2007, Braun 2008). For Hinchliffe, nature is best understood as "enacted": "…nature and society make one another (so thus are not independent), but are not necessarily reducible to one another (so thus are not strictly dependent)" (2007, p. 9). Although there are several perspectives from which to make this argument—from historical materialism, to hybridity (Hinchliffe 2007), Latourian nature-cultures (2004), or Deleuzean assemblages (Deleuze and Guattari 1987)—the overarching point is that neither nature nor culture can be taken as pre-given, determining forces, but emerge in relation to each other. This is a point also made by contemporary readings of Darwinian evolution, as I will explore in the following section.

> realized that organisms must die if they multiplied beyond the carrying capacity of their environments. Here, then, was the basis of another metaphor, that of a struggle for existence. Darwin did not mean by struggle, as Tennyson had earlier portrayed it, that nature was 'red in tooth and claw.' It was rather a question of some organisms being better adapted to their environments, and in every case better adapted in the terms of leaving more descendents. It was a struggle to reproduce, that is to say, it was a theory of relative reproductive success" (1992, p. 182-183).

Not all evolutionary theorists emphasized struggle. Instead of the Malthusian role of competition for scarce resources that Darwin emphasized as shaping selection, others focused on cooperation among organisms and the evolution of sociality (Kropotkin 2009[1902])—an approach that has since gained traction but remains on the outskirts of evolutionary biology (Haraway 2008).

Relational Approach to Evolution

The mutual shaping of natures and cultures is a central theme of critical environmental geographies. Accounts that stress the relational emergence of natures and cultures are now widely accepted by critical geographers. Assertions that nature and culture are hybrid (Latour 2003) or emerge relationally (Hinchliffe 2007) are now a starting point for analysis rather than a conclusion. Broad concepts such as "nature" and "environment" that implicitly posited distinctions between natural and social realms have been displaced by many other analytics – nature-cultures, actants, quasi-objects, assemblages, etc. (Braun 2008). The forms through which a relational understanding of nature and culture can be theorized are multiple, but share an emphasis on the "liveliness" of nature (Lorimer 2010) refusing to relegate nonhuman things to passive backgrounds or frame them as inert matter in accounts of human social worlds (Braun 2008). The key questions are how, why, and to what effect do natures and cultures co-emerge in particular ways in particular times and places. Answering such questions requires a variety of analytical tools to attend to different situations and contexts. Throughout this dissertation, I will draw on a number of such tools, particularly from accounts of capitalist production of nature (Castree 2003, Smith 1984), studies of how science enacts its objects (Law and Lien 2012, Callon 1986), and work on conservation as a form of biopower (Biermann and Mansfield 2014, Lorimer and Driessen 2013). Increasingly, detailed understanding of ecology informs such studies but the science of evolution remains understudied.

Only a handful of theorists frame a relational understanding in explicitly evolutionary terms (Haraway 2003, Hinchliffe 2007, Russell 2011). They use the term "co-evolution" to track the mutual interplay and interdependent emergence of natures and cultures. This is an expansion of the biological definition of co-evolution, which refers to organisms that developed traits with remarkable mutual adaptation—orchids and hummingbirds are a famous example. It recognizes that it is not only the changes in nonhuman natures that should be considered biological. As Donna Haraway has argued, "…it is a mistake to see the alterations of dogs' bodies and minds as biological and the changes in human bodies and lives, for example in the emergence of herding or agricultural societies, as cultural, and so not about co-evolution" (2003, p. 31). Instead, in addition to attending to the liveliness of nonhumans, critical scholars must also take into account how cultural preferences shape the evolution of other species (Russell 2011).

In this dissertation, I seek to further develop a critical co-evolutionary perspective. The point of this focus on co-evolution is not to apply evolutionary metaphors to explain or justify patterns of social life or environmental management, as did early evolutionary determinists. Instead, I am arguing for an understanding of evolution that takes into account patterns of social life, that does not start from the assumption that the natural world and social world are discrete realms, but attends to how social worlds shape biological processes and vice versa. The key questions are: How have past patterns of evolution shaped the conditions of possibility for the development of social processes (such as capitalist commodification, knowledge production, and state formation)? And how, in turn, do these social processes shape the conditions of possibility for the future evolution of species? The key to answering these questions is attention to difference and multiplicity—these interrelations are always happening, but in diverse, overlapping, and contradictory ways. This then, is the first element of a critical geography of evolution. But ascribing to a co-evolutionary understanding of the relationship between nature and culture necessitates critical engagement with evolutionary theory. Evolution must always be understood geographically, as situated in particular times and places, both for processes of "co-evolution" and for the production and circulation of evolutionary knowledge.

The first step in elucidating a relational, nondeterministic approach to evolution is an accurate understanding of what evolution is. Although there is no one truth of evolutionary theory, there are certainly better and worse interpretations.[8] To avoid the "errors of emphasis" (Williams 2005 [1980], p. 86) that led to troubling social invocations of evolution, I turn to readings that stress relational contingency in Darwin's texts and modern evolutionary biology. In doing so, my intention is to follow Doreen Massey's call to critically engage with natural science, neither refuting its contentions nor appealing to it as a natural truth. As she writes, "References to the natural sciences cannot be mobilized as some kind of final corroboration, nor as resort to a higher court whose forms of knowledge production give them an authority to which on occasions it is convenient to appeal" (2005, p. 35).

In contrast to popular invocations of evolution as a teleological unfolding of history, Darwin's work critiques both essentialism and teleology by "…provid[ing] a dynamic and open-ended understanding of the intermingling of history and biology" (Grosz 2004, p. 17). For Darwin life is not a state of being, but a process: he transforms life from "a static quality [alive] to a dynamic process [living]; being is transformed into becoming" (p. 36). I draw on Elizabeth Grosz's Deleuzean interpretation of evolution, which stands in contrast to the determinist

[8] Evolution is commonly defined as change in the inherited traits of a population over time (Russell 2011, p. 8). But in popular discourse, evolution is often used as a trope and taken to mean many things it does not mean to the vast majority of biologists. Popularly, to evolve is to progress, to reach a higher state of being—an accomplishment humans look back at and pride ourselves on. Or evolution is something that humans are now largely exempt from, a process of the natural world that we have superseded. But these are not accurate interpretations of Darwinian theory. Evolution is not something "natural" that takes place far in time or place from people. As "evolutionary historian" Edmund Russell writes, it is ubiquitous: "Evolution is ordinary, not exceptional. It happens all around (and inside) every one of us—you, me, the dog next door—every day" (2011, p. 5). Evolution is not a process that is largely complete, having reached its pinnacle in the human form. Nor is it progressive in such a sense as could be used to assert that humans are the "most evolved" species. It does not have a goal. It does not take place only in 'deep time,' requiring thousands of years. Nor, despite much contemporary attention to the genetic structuring of life (cf., Richard Dawkins), is it genetically predetermined.

accounts that remain popular in contemporary discourse. As she writes, “The movement of evolution is in principle unpredictable, in principle historical, in the sense that the nature of species in the past prefigures and provides the raw material for present and future species, but in no way contains, limits or directs them to any particular goal or destination” (p. 38).[9] For Darwin, evolution is not predetermined, but is processual, all the way down. All of the elements of evolutionary action, from genes to organisms to environments are relational products shaped through their interactions.

The relational interplay between genes, organisms, and environments is the crux of Darwin’s theory of evolution, at the center of which is natural selection. As Darwin wrote, “It may metaphorically be said that natural selection is daily and hourly scrutinizing, throughout the world, the slightest variations; rejecting those that are bad, preserving and adding up all that are good; silently and insensibly working, *whenever and wherever opportunity offers*, at the improvement of each organic being in relation to its organic and inorganic conditions of life’ (quoted in Grosz 2004, p. 48-49). There is no Nature consciously making selections, guiding the development of the “fittest” species.[10] Nor is selection only “natural.” Darwin also developed

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[9] The continued influence of determinist interpretations of evolution can be attributed in part to the metaphors we use to understand the processes of life—in this case, particularly the metaphor of development (Lewontin 2000). The word evolution is from the Latin *e-volvere*, meaning to unfold or unroll (Grosz 2004, p. 24), the same root as the word development: “the biological problem itself is described by a metaphor, the problem of ‘development.’ The word ‘development’ (*desarrollo* in Spanish, *Entwicklung* in German) means literally an unfolding or unrolling of what is already present, a making manifest of what is already latent” (Lewontin 2000, p. xii). This meaning is reflected in popular progressive understandings of development—analogies of adolescent maturation are applied widely to the development of nations, economies, even racial groups (Gupta 1998). Given the popular progressive understanding of development, it is little wonder that biological development is often taken to be genetically programmed to proceed along a linear path, as if ‘genes’ were blueprints or a ‘computer program’ (Lewontin 2000, p. xii). But information comes into existence only in the process of ontogeny: “Developmental information itself, in other words, has a developmental history. It neither preexists its operations nor arises from random disorder. It is neither necessary, in an ultimate sense, nor a function of pure chance, though contingency and variation are crucial to its formation and its function. Information is a difference that makes a difference” (Oyama 2000, p. 3).

[10] The term “survival of the fittest” is not Darwin’s, but Herbert Spencer’s. In his 1864 *Principles of Biology,* Spencer referred to natural selection as the “survival of the fittest,” coining a phrase that would come to broadly define Darwin’s theory of evolution.

concepts of sexual, methodological, and unconscious selection—the last two of which are often classed as "artificial" or human-influenced selection (Russell 2011). For Donna Haraway, "the distinction between artificial and natural selection is empty because all the way down the story is about differential reproduction" (2003, p. 30). Each of these forms of selection works to shape species populations according to their adaptation or the fitness of their traits to a particular environment. The essential components of evolutionary process thus include: a population (group of individuals of a given species living in a certain place); variation among individuals in heritable traits; reproduction; and change in inherited traits of a population over generations.[11]

Thus evolution shapes the genealogies of species and populations through a variety of interrelated processes. Attention to a relational understanding of evolution as shaped by interplay between genes, organisms, and environments provides a foundation for a nondeterministic geographic engagement. Instead of emphasizing any innate superiority, the concept of fitness is understood as an organism's ability to reproduce in stable and changing environments, where chance events may quickly tilt the playing field (Grosz 2004). Opposed to emphasizing struggle, or applying the idiom of "survival of the fittest" to naturalizing power relations, genealogies are highly contingent, shaped by collaboration as well as competition. Instead of progressing along a predetermined path, evolution is the production of endless variation, endless difference. As Grosz puts it, evolution is "the emergence in time of biological innovation and surprise" (2004, p. 19)—it is, in a Deluezean sense, the "elaboration of difference" (p. 24). I use this emphasis on difference to ask how and why do particular socio-natural landscapes change in particular ways? How do these changes shape evolutionary processes in different ways?

[11] Although Darwin never understood the mechanism of inheritance (genes) through which selection functioned (Russell 2011, p.8)

Placing a 'Universal' Theory – Geographies of Evolution

The other central element of a critical geography of evolution is the placing of a "universal" theory. In Biology, evolution by natural selection is as close as it gets to the natural laws celebrated in the so-called 'hard' sciences. It is *the* paradigm through which to understand the processes of life—as Theodosious Dobzhansky wrote, none of the "why" questions in Biology make sense without evolution (quoted in Mayr, 1997). Although Darwin sets out "broad principles rather than universal laws" (Grosz 2004, p. 21), evolution as a theory and a trope often operates as what Anna Tsing refers to as a "Natural Universal" in which "Nature, like God, forms the basis for a universal truth" (2005, p. 97). In Tsing's examples, Natural Universals work through classificatory frameworks, like Linnaean taxonomy, or theories of natural selection, that allow for generalization across otherwise disparate natural facts. In this way, they are a way of making sense of or finding patterns in chaos. A snapshot of Galápagos finches with various beak sizes means little other than a collection of data points, but compared across populations, environments and time, patterns emerge that shed light on the life and development of finch populations (Weiner 1994).

These generalizations in effect jump scale from the particularity of a specimen or data point collected in a specific time and place to reveal a place-less "universal" pattern or truth. This is what is going on when the Galápagos Islands are mythologized as the place where Darwin "discovered" evolution. Like Muir's Yosemite, the Galápagos appears to be a place that offers a window into the universal. As Yosemite was for Muir and thousands of other enthusiasts, the Galápagos stand "for the possibility of individual contact, through study and experience, with the hugeness of a global and universal nature" (Tsing 2005, p. 100).

The “Darwin-Galápagos myth” (Sulloway 2009) illustrates Tsing’s point. In jumping scale, universal generalizations effectively cover up the placed, social processes of science through which these facts are made—seeming in their universality to come from nowhere, what Haraway calls the “god’s eye trick” (1991). Indeed, for Tsing, natural universals depend on two moves: first, generalization from the particular, which requires a space of compatibility; and second, “tentative and contingent collaborations necessary to turn incompatible facts into compatible ones” (2005, p. 89). These two movements, she argues, “cover each other up: the specificity of collaborations is erased by pre-established unity; the a priori status of unity is denied by turning its instantiation in collaborations. Buoyed by axioms of unity, collaborations create convincingly agreed upon observations and facts that then appear to support generalization *directly*, that is, without the prior mediation of the collaboration.” Thus, the social relations of knowledge production are in effect erased, inconsequential to the universality of scientific facts.

Placing a universal theory must attend to the many sites and processes involved in the production of scientific knowledge. Attention to the production of knowledge is a central theme of science and technology studies as scholars have attended to the both the situatedness of all knowledge (Haraway 1991) as well as the socio-natural networks through which knowledge circulates (Latour 1987). This work pushes attention to the geopolitics of science. The notion that science has a politics is anathema to traditional understandings of scientific knowledge—facts are supposed to be value-free. Indeed, science and politics are often framed in linear relation: in a modern, rational society, objective scientific knowledge should be applied as the basis for political decision-making. But this simplistic understanding of the relation between science and politics is idealistic at best. Scientific knowledge is not itself free from politics, not a matter of objective observation of the natural world—a point made evident, for example, in Darwin’s adoption of Malthus's work. Instead, extensive work in science and technology studies has attended to the "co-production" of science and politics (Latour 1993).

"Co-production" is an idiom that stresses that "ways of knowing the world are inseparably linked to the ways people seek to order and control it" (Jasanoff 2004). Values adhere in facts. And because science is always situated, co-production has a geography. This is a point made clear in both Darwin's use of Malthus's theory, a geographically specific response to growing population and scarce natural resources in England (Desmond and Moore 1991) as well as in Livingstone's (2003) analysis of different interpretations and mobilizations of evolutionary theory in late-nineteenth century South Carolina, New Zealand, and Russia. In this dissertation, I do not present a new analysis of the production of Darwinian evolutionary theory because it has—for this most famous of scientists and theories—been done so extensively and so well (Browne 1995, 2002; Desmond and Moore 1991, Sulloway 2009). Instead, I explore the production of new evolutionary and ecological knowledge abut tortoises, particularly examining how genetic studies shed new light on processes of adaptive radiation the for which the Galápagos are so well known. (This is the subject of Chapter 5).

Attending to the geographies of science involves analysis of the spatial relations of co-production of science and social orders. This focuses on the role of science in shaping landscapes as well as social orders at the global and local scales. I ask how, why, to what ends, and under what circumstances do different actors invoke and manipulate evolutionary natures? I draw from scholarship on geographic imaginaries, techniques for visualizing and representing the world shaped through histories of exploration (Gregory 1994, Pratt 1992) to explore how Darwin's work in the Galápagos reshaped the islands from an evilly enchanted hell on earth (as Melville characterized them in 1842) to the so-called birthplace of evolution. I put these representations of space into conversation with geographies of traveling theory (Livingstone 2003) as well as histories of conservation (Adams and Hutton 1997, Neumann 1998, Barrow 2009) and environmental governance (Drayton 2000).

Together, this work addresses the networks and institutions through which scientific knowledge is mobilized to shape resource use—for, as Richard Drayton noted of the relation between natural history and colonialism, "knowledge of nature would allow for the best possible use of resources" (2000, p. xv). As Livingstone (2003) shows, tracing the geographies of science is a broad and complex undertaking because evolutionary theory has been taken up differently in different contexts. I focus narrowly on the Galápagos Islands, examining both how the islands came to be famous as the "birthplace of evolution" (given much recent work demonstrating deconstructing the myth) and how evolution has operated as a "natural universal" to shape social and natural orders in the Galápagos through interrelated projects of conservation, capitalism, and social governance. This is a theme specifically addressed in Chapters 3 and 6. I use this framework to analyze the geopolitics of environmental governance, exploring how the islands' Darwinian history was used to justify their conservation, focusing on the creation of the Galápagos National Park and Charles Darwin Research Station in 1959. This is the topic of Chapter 2, which explores how evolutionary theory was mobilized through networks of scientists and conservationists working in early institutions of transnational environmental governance to shape the beginnings of Latin American conservation.

These elements of a critical geography of evolution fold together to explore how the science of evolution has shaped social and natural life in the Galápagos. It is certainly not the only approach to a geography of evolution, in the Galápagos or elsewhere. If evolution is the production of difference, then its geographies will take endless forms (to paraphrase Darwin).

Opposed to reductionist and determinist accounts of evolution that characterized geography a century ago, it is a highly situated and relational approach. I see this framework as a starting point for a critical engagement with evolutionary science analysis. I seek neither to uncritically accept evolution as a natural truth through which to explain patterns of life, nor to deconstruct the validity of this well-proven scientific theory. Instead, I seek to explore the work that evolution has done and continues to do in the Galápagos as celebrations of Darwin and applications of his insights structure productions of nature and social life through conservation and tourism and in doing so rework the very natures so famous for inspiring the theory.

Methods

To show how social histories become embodied in tortoises—and how tortoises in turn shape social histories—requires an interdisciplinary approach that uses mixed-methods, including extensive archival work as well as ethnographic research. Combining these methods is necessary for tracing a genealogy of the present in the Galápagos and for understanding the quotidian practices through which evolutionary processes and social conflicts are shaped. To structure this study, I examined three major paradigms that structure human-nature relations—science, conservation, and development—across three key historical moments in the Galápagos: Darwin's visit in 1835, the founding of the Galápagos National Park (GNP) and Charles Darwin Research Station (CDRS) in 1959, and recent crisis declarations. I posed three research questions and hypotheses to guide fieldwork, as shown in **Table 1.1**, below.

Table 1.1 Research Questions and Hypotheses

Research Questions	Hypotheses
Question 1 [Production of Scientific Knowledge, 1830-1930]: How did Darwin's work on the Galápagos change how scientists conceptualized and used giant tortoises (or not) and to what effect?	*Hypothesis:* With Darwin's theory of evolution, Galápagos tortoises went from being seen primarily as a food resource to a scientific curiosity, but despite this change, human-tortoise relations remained characterized by processes of *collection* by natural historians that decimated island populations. These processes of collection were shaped by (and in turn shaped) the unusual nature of tortoises as well as the development of Western centers of scientific study.
Question 2 [Construction of a Conservation Space, 1950-1980]: How and by whom was conservation of the islands rationalized, and how did conservation policies re-structure relations between people and tortoises?	*Hypothesis:* In the mid-1950s, scientific interest in tortoises shifted from a desire to collect them to a need to protect them *in situ*, in parallel with the rise of transnational governance. Conservation rhetoric focused on *protecting* tortoises by separating them from people, but this was made possible only by processes of the *production* of tortoises through both breeding programs and capitalist commodification via tourism. This intertwining of protection and production worked to isolate tortoise populations from their natural habitats as well as to restructure human social relations on the islands around ideas of who were (and were not) appropriate conservation actors.
Question 3 [Development and Crisis, 1990-present]: How are contemporary declarations of crisis restructuring relations between science, conservation, and development on the islands and to what effect for tortoises?	*Hypothesis:* The crisis discourse centers on a critique of a development model that is out of line with conservation goals. In response, new policies focus on melding conservation and development through participatory environmental management that no longer seeks to separate (most) people from the environment. This emerging paradigm, based on human *care for* instead of *control over* and separation from nature, is sending tortoises back to their native habitats and disproving long-held assumptions about the detrimental effects of their coexistence with humans.

Geography

Tracing a "history of present" (Foucault 1977) of a moment of crisis necessitated combining contemporary and historical data. Completing this mixed-method and interdisciplinary study required multi-sited research, specifically archival research, ethnographic work in the Galápagos Islands, and in-depth interviews with tortoise scientists and conservationists who work with Galápagos giant tortoises, but live in the United States. I conducted a total of 16 months of research during dissertation fieldwork, building on 3 months of pre-dissertation field work in the Galápagos during the summers of 2007, 2008, and 2009. From July to November 2011 and March to April 2012 (a total of 6 months), I lived in Puerto Ayora and Bellavista on Santa Cruz Island, where the GNP and CDRS are headquartered and the tourism industry is centered. During this time I also took short trips to visit Puerto Baquerizo

Moreno on San Cristobal Island, the seat of provincial government, and Puerto Villamil on Isabela Island. These are the two other major settlements in the Galápagos. As a participant observer-tourist, I visited the small settlement on Floreana Island, camped at a tortoise eco-farm on Isabela Island, and toured the southern part of the archipelago on a sailboat cruise.

As I discuss below, following tortoises and the humans who study them also led me on a circuitous path through the United States and Europe. I visited archives in San Francisco, New York, Washington, DC, London, and Paris as well as zoos in London, New York, and San Diego. I also visited tortoise scientists at Yale University, the State University of New York-College of Environmental Science and Forestry, the University of New Mexico, and Colorado State University—and caught up with many more by phone when time and funding would not allow visits. (Tracing the tortoises through museums is certainly a project that could be extended—my choice of archives depended both on my language fluency in English [I did not spend much time at all in the Paris Natural History Museum, nor did I venture to Belgium nor Germany] as well as limited funding.)

I followed the tortoises closely to ground a wide-ranging study. At times, this meant literally hanging out with tortoises all day—particularly during the month I spent as a volunteer doing participant observation at the Galápagos National Park's Giant Tortoise Breeding Center—or following them during days I spent hiking Santa Cruz with park guards and members of a tortoise telemetry monitoring project. But at other times, following the tortoises was about following their traces—around town in Puerto Ayora where their images adorn numerous tourist shops, in the memories of retired park guards, scientists, and local residents, in correspondence at natural history museum archives, and in published scientific papers and unpublished reports.

The lived experience of conducting this research varied tremendously, from arduous muddy hikes to the dry quiet of museum archives. The combined methodology gave me very different perspectives on giant tortoises and the socio-natural relations in which they are embedded (and dis-embedded). Hiking their natural landscapes on Santa Cruz Island—where hours of hopping across lava rock or losing boots to several inches of mud were the norm—gave me newfound understanding for the expedition narratives I read in the archives and the fieldworkers who had been my predecessors (and who could not return home at night to a hot shower and bottle of wine). The thought of doing some of these hikes without guides who know the routes and while "shouldering" a 50-100 pound (or more!) tortoise is nearly inconceivable to me. In the reverse, the experience of working at, for example, the Tring Museum on an estate outside London and the American Museum of Natural History on Central Park West, and reading letters traded among elite naturalists at these and other scientific institutions shed light on how these tortoise specimens moved not only from vibrant tropical habitats to dusty museum shelves, but also across social worlds following networks of power and wealth. Being able to physically follow some of the paths through which tortoises move and have been moved has centrally shaped my understanding of tortoise histories—the project would have been incomplete with out them.

Interviews and Participant Observation

In the Galápagos, I conducted a total of fifty-one in-depth interviews with a range of informants that included national park guards, local government officials, visiting scientists, people working in tourism, other island residents, and people working for conservation groups other than the national park. In the United States, I conducted twenty-two interviews—some with zookeepers at the San Diego Zoo, but most with tortoise scientists, several of whom were closely involved with the Charles Darwin Research Station but have now retired or are teaching in the United States. I also conducted two interviews in Quito with scientists teaching at Ecuadorian universities who have been heavily involved in the Galápagos during their careers. Altogether, I completed seventy-eight interviews with sixty-nine different informants.

Table 1.2 Ethnographic Research Methods

Interviews		**Participant Observation**
Scientists	20	9 months in Galápagos, 5 trips
Conservationists	27	Giant Tortoise Breeding Center
Island Residents	22	Tortoise Telemetry Project
Total	**78**	Tourism

As shown in the chart above, I generally classify these interviews into three groups for the sake of clarity: scientists (distinguished by the PhD, although one informant was finishing a master's thesis at the time I interviewed her), conservationists, and island residents. These are necessarily arbitrary and overly simplified classifications. I use education to delineate one group, geography of residence to delineate another, and moral outlook to delineate the third. This is problematic, as any classification would be, if not least because many "conservationists" and "scientists" also live in the islands. (All the PhDs I interviewed were foreign-born, not Ecuadorian. This is telling, but by no means representative of Galápagos scholarship—there are many Ecuadorian PhDs working in the islands, just not on tortoises. This is likely because, as one informant told me, foreign scientists have tended to "own" species in the islands, although this is diminishing today. Once a project on certain species is established, it is difficult for others to enter unless they are trained by the authoritative figure. This sociological aspect of Biology is by no means unique to Galápagos.) But here I use residents to denote people who are not necessarily aligned with the conservationist cause as defined by the national park and the many foreign NGOs working in the islands. Importantly, I do not rely on these categorizations analytically. I only present them here as shorthand to generally explain whom the actors I engaged with are. These in-depth interviews were further informed by numerous informal conversations and experiences I had while living in the islands. I also conducted twenty quick surveys of tourists as they visited the corral of Lonesome George at the tortoise breeding center to assess how George was used to communicate a conservation message to visitors. The goal of this quick snapshot was not to provide an authoritative account of tourists' views of George, but to test whether a random sample of tourists brought up the same ideas and points that are often attributed to tourists in the Galápagos. (They largely did. More on this in Chapter VI.)

To complete the research, I obtained a research permit from the GNP, although my central sponsor was the Universidad San Francisco de Quito. The affiliation with GNP made it possible for me to volunteer at the breeding center, shadow park guards, and gain credibility with scientists. It was essential for getting close to the tortoises and the relationship between science and conservation. Within these communities, informants were interested in my project and happy to help, although I think they were often perplexed about why I wanted to volunteer and collect data about the processes of conservation and science, rather than the tortoises or ecosystems themselves.

I identified myself to informants inside and outside the Park offices as being affiliated with UNC. I hired an Ecuadorian research assistant during my stay to help me set up meetings with appropriate informants outside the Park offices (such as local government officials, particularly in the highlands communities). She was very helpful for making my research time efficient; after I told her who I was generally interested in talking to, she set up meetings with the appropriate people. She introduced me to six of the people I interviewed. (She accompanied me on only one interview, with her neighbor whose family owns a tortoise tourism farm.) I did not find that my affiliation with the GNPS shaped my interviews, which was something I was concerned about. But I did not wear anything to identify myself as belonging to the park, nor did I make rounds to agricultural zones with park guards. On the contrary, I found informants quite willing to talk about tourism and priorities for the future. Most were less inclined, however, to talk about the tortoises—particularly as political symbols. I think this reflects a genuine ambivalence among many residents to the animals, which they rarely see during their daily lives. (The few fishers I interviewed during research in 2011/2012 about past strikes targeting tortoises either denied the tortoises were a central target or were not interested in discussing tortoises as political symbols, which is contrary to earlier interviews with fishers conducted during 2007. I think this partly reflects a shifting political landscape and partly reflects me introducing the project as focused on tortoises.) This was something I stopped doing in interviews with local residents who were not themselves closely tied to tortoises (because some had a hard time understanding why I wanted to talk with them, so instead I explained that the project was about relationships between science, conservation, and development.)

Overall, I found most informants to be happy to talk with me. In particular, most older and retired park guards were eager to share field stories, although not all wanted to be interviewed. One informant was particularly critical about the number of outsiders who come to Galápagos to collect information to build their careers without helping the islands. (I am sensitive to this critique and feel the best way I can address it is to take my work back in hopes of building long-term relationships.) Park staff and scientists were generally welcoming to me as a woman who wanted to participate in fieldwork, although at times I think they were baffled as to why and concerned about my ability to keep up. I felt sexism most as I had to push to be included in field excursions to other islands that would have meant camping with a group of men for several days (I was set to go on one trip, but it fell through at the last moment because of problems securing fuel for the ship.)

About half the interviews were conducted in English and half in Spanish, depending usually on the native language of the interviewee. (One Ecuadorian interviewee who had spent considerable time working in the United States wanted to talk in English.) I transcribed all the English interviews (using F5 qualitative transcription software). To transcribe the Spanish interviews, I hired an Ecuadorian who is a native Spanish-speaker. I have translated pieces of the Spanish interviews as needed to include as quotes in this dissertation. Otherwise, I analyzed them in Spanish.

In the dissertation, I identify scientists and key conservation figures (for example, the Park Director in Charge of Terrestrial Control) by name. This is done with their written informed consent. Because the community of Galápagos tortoise scientists is small (I have interviewed almost all of them), because I engage with their publications, and because the questions I asked focused on their professional more so than personal identities (to the extent these are possible to distinguish) I have not attempted to anonymize them. I do however extend the cover of anonymity to other informants, whom I identify mainly by their occupation and its relationship to tortoises or tortoise-centered activities (for example, someone who works in a souvenir shop, as a tourist guide, or people who run tortoise tourism farms).

Archives

I visited eleven archives in the United States, the United Kingdom, France, and the Galápagos. During the eighteenth and nineteenth centuries, Galápagos tortoises were a common object of natural history collection. As such, almost all the major museums had—and traded—specimens. Although it may appear otherwise, I did not attempt a comprehensive study of museums with Galápagos tortoises. The archives were chosen based on the strength of their institutional connections to the Galápagos. For example, the California Academy of Sciences launched a major expedition to the Galápagos in 1905-1906; while the team was traveling, the San Francisco fire destroyed the museum—when the ship returned, its trove of Galápagos specimens *was* the museum (see James 2010). The California Academy has since been a major center for Galápagos research. Edward Larson's (2001) meticulously researched history of science in the Galápagos was a great help in steering me to relevant archival collections. John Woram's Galápagos History Web site (http://www.Galápagos.to) was another crucial resource. The particular collections are listed below.

To limit the study, I did not research the extensive archives of Charles Darwin or Louis Agassiz (a staunch anti-evolutionist who traveled to Galápagos to disprove Darwin's theory). Although I would like to work in these collections in the future, I have here relied on previous scholarship (for example, Frank Sulloway's extensive research on Darwin's Galápagos work) as well as select original documents relevant to Galápagos (such as Darwin's *Beagle* journal).

Table 1.3 Archival Collections Researched

Archive	Collections
British Museum (Natural History) & Tring Natural History Museum	In London, my research focused particularly on the collections of Lord Walter Rothschild, an avid amateur natural historian and giant tortoise aficionado who established the world's largest private natural history museum at his family's estate, Tring, at the turn of the twentieth century. Rothschild sponsored several collecting trips to the Galápagos, in an endeavor to bring back all the islands' tortoises to "save them for science."
California Academy of Sciences	In 1905-06, the Cal Academy sponsored a year-long expedition to the Galápagos Islands. Led by Rollo Beck, the team collected 264 tortoise specimens, which became the basis for Herpetologist John VanDenburgh's authoritative natural history of the species, published in 1914. The Cal Academy Archive is also home to the papers of Robert Bowman, an ornithologist who was instrumental in the founding of the Charles Darwin Research Station and Galápagos National Park in 1959.
Bronx Zoo/Wilderness Conservation Society	By the 1920s and 1930s, giant tortoise management shifted from museum preservation to captive breeding in zoos. The WCS Archive houses the papers of Charles H. Townsend, director of the NY Aquarium, and the first to try to establish breeding colonies of Galápagos tortoises across the southern United States.
San Diego Zoological Society & Wild Animal Park	The San Diego Zoo was home to one of the tortoise colonies Townsend established and one of the few that was successful in getting its tortoises to breed. I researched the history of tortoise keeping as well as the story of one particular Galápagos giant who has since been returned to the islands where he is the star stud of the national park's breeding program.
UNESCO	In the 1950s, an international network of scientists and conservationists joined forces under the auspices of UNESCO to found the Charles Darwin Research Station on Santa Cruz Island in the Galápagos. They were also instrumental in convincing the Ecuadorian government to found the Galápagos National Park, the nation's first.
Charles Darwin Research Station	The CDRS Library and Archive houses fascinating papers that detail the challenge of setting up a scientific research station on a remote Pacific Island. Its collections track the history of conservation management and scientific research in the islands over the past half century.
American Museum of Natural History	The AMNH was my first archival trip, where I spent a couple of days looking at records from the Beck 1902 & Chapin 1930 expedition files. I was also able to work in the Herpetology Department archives on accession records, where I also encountered my first stuffed tortoises.
Smithsonian Institution Archives	I spent a week at the Smithsonian Institution Archives in Washington, DC, where I researched the papers of former Secretary S. Dillon Ripley who was a pivotal member of the early Charles Darwin Foundation. I also looked at the Allan Hancock Pacific expedition (1933) files.
Zoological Society of London	I spent one day while in London at the ZSL, where Rothschild housed many of his tortoises. I looked primarily at tortoise accession and health records—tropical animals tended to die quickly in the cool climate—as well as correspondence between Rothschild and the Zoo director.
Muséum national d'histoire naturelle (Paris)	Finally, I spent a quick afternoon at the MNNH, where the archivist kindly allowed me access to several files of its former director, Jean Dorst, who was instrumental in the founding of the Charles Darwin Research Station and served as one of its first directors. The full Dorst collection will not be cataloged and made publicly available for several more years. He died in 1996 (and standard practice is to wait 50 years to release documents to public research).

My method in all of these archives was to work through Galápagos-related documents. I am lucky in that "Galápagos" is a great, unique search term. As described in **Table 1.3**, I expanded the search by tracing particular actors, expeditions, and the formation of the new Charles Darwin Research Station in the Galápagos in the mid-twentieth century. I also researched the broader history of the archival institutions, as well as their directors and curators, and traced correspondence among curators at various institutions, particularly as they coordinated Galápagos conservation efforts in the early twentieth century. Working in multiple archives gave me the opportunity to piece together various sides of conversations—not everyone kept copies of outgoing correspondence, particularly before typed messages were common and for more personal notes.

In the archives, I took photographs of all the documents I found and thought were either directly relevant to tortoise stories or could potentially be relevant either directly or as contextual information for other, broader, Galápagos stories. This amounted to a wide net. I now have a database of 38,455 photographs of documents. I have organized the photos according to the conventions of the archives (by archive, collection, box number, folder) and have tagged eighty percent of them with meta-data to make them searchable. Examples of codes include correspondents' names, the year of publication or correspondence, and a variety of kinds of tortoise projects ("tortoise keeping," "tortoise hunting," "tortoise taxonomy"). I developed these codes iteratively as I visited the archives and read through the documents I found. Thus early categories were sometimes broken down further and sometimes collapsed into broader categories. These codes serve as meta-data, rather than as final analytical categories, and thus help me identify relevant documents for iterative data analysis.

Data Analysis

Not all of this archival work—nor all of the ethnography—has made it into the dissertation. In the interest of delineating a story of reasonable length, I focus analysis on the relationship between evolutionary science and conservation in the Galápagos.[12] Based on this focus, I concentrate primarily on the period 1950-present, when in situ conservation efforts in the islands began. I do look back to earlier historical periods and events—and also look to the future—but I do so primarily by following my actors—tortoise and human—rather than beginning with Darwin's visit to Galápagos or with the islands' discovery by Fray Tomas de Berlanga as do most histories of the islands.

To analyze this trove of data, I iteratively read, sorted, took notes on, and pondered sources. Chapter topics emerged from my experiences and I iteratively followed stories that interested me. A good example is the genetics chapter, which turned out to be a different story than I had initially thought it would be. One of the key themes I was interested in as I conducted research was how technologies for taxonomic classification had changed since the days of natural history and how these changes mattered for conservation management. I was rather dismayed when one informant after another told me that the taxonomy was largely irrelevant to management practices, which had always focused on keeping the tortoises separated by island. For day-to-day management, conservationists did not care whether the biologists called the tortoise populations species or sub-species. However, this long-standing distance became

[12] The combination of my focus on tortoises and the relationship between science and conservation—rather than, say on the relationship between conservation and local populations, as is more typical in the political ecology literature—means that in this dissertation I do not fully engage a range of topics of historical and contemporary significance. Most notably absent are contemporary political debates about development and sustainability in the islands. I did conduct some research on this during my interviews and experiences living in the Galápagos, but have not yet included it in the material discussed here. This is partly for length reasons, partly because I feel the research I have done on this is incomplete, and partly because tortoises do not figure centrally in the debates as I encountered them (Unlike the fishers' strikes of the mid-1990s and early 2000s, when tortoises were targets of protest).

interesting when I saw how genetic studies were reworking basic assumptions about the geographic isolation of tortoise populations. This then became the basis for defining the “alien” tortoises whose story I trace in Chapter V.

For that and other chapters, I went through a process of iterative data collection, review and thematic coding. In Chapter V, I focused on one of the biggest surprises to come out of the genetics work—first described to me in interviews. I followed up in a visit to the lead scientist’s lab at Yale University, and then traced the emergence and resolution of the identity of the “alien” tortoises through her lab team’s publications. As I read these publications, I flagged language to analyze—such as “alien” and “hybrid”—that often came up in other discussions. I then conducted follow-up interviews with conservationists to understand how they read and used this new information. I often looked back at historical events and documentation with my present-day informants—for example following geneticists as they re-read historical sailors’ narratives to hypothesize about how the “alien” tortoises got from one island to a volcano across the archipelago.

To tell a history of the present, many of my chapters grew from ethnographic work. For example, the story of Diego the tortoise (Chapter IV) first emerged as I heard tour guides tell it to tourists and then discussed it with park guards while I was volunteering at the tortoise breeding center. I did further research at the CDRS archives before deciding the story was worth trips both to San Diego and to the Wilderness Conservation Society in the Bronx so that I could trace Diego’s experience over the past century. Thus the stories enfold ethnographic and archival data although some are more historical and some more contemporary.

Chapter Outline

The dissertation is organized into five substantive chapters that trace how evolutionary science—from Darwinian natural history to phylogenetics—has shaped the production and management of conservation territories and development strategies in the islands. The chapters use the giant tortoises to trace a genealogy of recent crisis declarations, situating the islands' current fame as a tourist destination and laboratory for sustainable development in histories of science and empire. They begin with the founding of the GNP and CDRS in 1959 as the pivotal moment in which scientific desire to manage the islands as a "natural laboratory" was institutionalized. The chapters then use the stories of particular tortoises to explore how the goal of "conserving evolution" has guided island management through invasive species eradication, conservation breeding, rewilding projects, and eco-tourism. The chapters track not only a discursive and epistemic shift in the way the islands have been imagined—from a hell on earth to a natural laboratory—but also the material repercussions effected as "conserving evolution" was taken up as a goal for island management. These include a bifurcation between ostensibly natural and social territories, as well as delineations between "endemic" and "invasive" species, the purification of tortoise population lineages, and differentiation between appropriate and inappropriate social and economic development.

Although the chapters begin with the founding of the CDRS and end with discussion of tourism and recent crisis declarations, I have tried to be careful to not tell a straightforward linear story. Instead, I follow the tortoises I encountered in the Galápagos and further afield to tell a series of related genealogies that speak to various aspects of tortoise life in the Galápagos today. In telling the stories that follow, I have tried to follow Timothy Mitchell's approach, to set forth a kind of analysis that “avoids the method of abstraction from the particular...the theory lies in the complexity of the cases” (2002, p. 8).

Chapter Two traces correspondence among networks of American and European naturalists working with UNESCO to found the GNP and CDRS in 1959. I argue they used evolutionary science to make a geopolitical claim to the islands as conservation territories—a form of mid-twentieth century scientific imperialism based on the old maxim that scientific knowledge provides the most rational use of resources.

Chapter Three tells the story of the most famous Galápagos tortoise, Lonesome George, who was the last of his particular species from Pinta Island and became a favorite of tourists during the 40 years he lived in captivity at the park headquarters. It uses George’s story to analyze how and to what effect the GNP and CDRS have taken up “conserving evolution” as a guide for island management. I develop an analytic of nonhuman biopolitics to examine how Darwinian understandings of nature have been applied to govern endangered species. The chapter details four elements of conservation biopolitics, exploring how population surveys, invasive species eradication campaigns, and captive breeding and reintroduction of tortoises are used to reproduce “pristine” ecosystems. It demonstrates that conservation is a productive relationship through which emerge not only populations of desired species, but also human subjects that possess appropriate skills and knowledge to manage species.

Chapter Four goes into more detail on conservation breeding, exploring the production of “prehistoric” life by tracing the story of one tortoise, Diego. In the 1930s, Diego, then unnamed, was collected from Española Island and taken to the San Diego Zoo as part of an experimental breeding colony, where he did not breed, but antagonized other tortoises. In the 1970s, he was returned to the new tortoise breeding center in the Galápagos, where he has sired more than 800 offspring in captivity, making him the star stud of one of the world's most successful conservation breeding and repatriation programs. I argue that breeding a "wild" species demonstrates the co-production of scientific knowledge about tortoises and the species itself, producing hybrid genealogies that blur distinctions between "artificial" and "natural" selection.

Chapter Five traces the rediscovery of an extinct species of giant tortoise through genetic analyses to explore how genetics are shifting the way conservationists imagine and manage pristine nature. The chapter examines the construction of scientific knowledge through which these tortoises were rediscovered and subsequent plans to selectively breed them as part of an island restoration plan. I argue that genetic lineages have become a new frontier of conservation territories as managing genetic purity becomes a key concern.

Chapter Six returns to Lonesome George, analyzing his role as an animate boundary object situated at the nexus of science, conservation, and tourism. The chapter returns to the argument that scientific valuations of Galápagos nature made the islands economically valuable. I examine the "encounter value" (Haraway 2008) of charismatic species at the center of nature tourism as a form of commodification. I argue that the fetishization of encounters with pristine nature sets up social and economic stratifications in the islands that generate conflict and crises.

The **Conclusion** returns to the notion of a critical geography of evolution to draw these chapters together.

CHAPTER II: THE SCRAMBLE FOR CONSERVATION: SCIENCE, EMPIRE, AND THE MAKING OF A NATURAL LABORATORY, 1930-1965

> "Take five-and-twenty heaps of cinders dumped here and there in an outside lot; imagine some of them magnified into mountains and the vacant lot the sea; and you will have a fit idea of the general aspect of the Encantadas, or Enchanted Isles."
>
> – Herman Melville, *Las Encantadas*, 2002 [1854], p. 5

> "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, 1958 (quoted in Eibl-Eibesfeldt, 1958)

Introduction

In November 1957, two young scientists—Austrian ethologist Irenäus Eibl-Eibesfeldt (who went by "Eibl") and Canadian-American ornithologist Robert Bowman—stood on the shore of Tortuga Bay on Santa Cruz Island in the Galápagos Archipelago. After four months "on the trail of Darwin" (Behrman 1957, p. 6) on a "biological reconnaissance" (Bowman 1960) mission sponsored by UNESCO and several American environmental organizations, they found what they had been searching for: the ideal spot for a research station, to be built in memoriam to Charles Darwin. Eibl described the location:

> …from the top of a tall sand-dune, looking eastwards I could see over a whole broad inlet. To the south jutted out a long, picturesque bar of rock, covered with tree-cacti, and serving as a natural breakwater against the fury of the ocean…. (Eibl-Eibesfeldt, 1960, p. 22)

Since Darwin's visit to the islands, naturalists had expressed concern about the fate of the archipelago's unusual endemic species—giant tortoises, marine iguanas, flightless cormorants, and equatorial penguins. Eibl and Bowman's expedition was a turning point for dreams of protecting the islands. The goal of a research station was two-fold: to establish a permanent base for visiting naturalists and to promote conservation of these "treasure islands for science" (Bowman 1960b). For the biologists involved the project was a celebration of evolution and Darwin, for this was the place to which Darwin attributed "the origin of all my views" (1959, p. 7)—a natural wonderland of pristine nature that seemed to hold the key to "that mystery of mysteries… the first appearance of new beings on this earth" (n.d. [1845], p. 359). As one naturalist argued, it was "one of the most amazing natural laboratories of evolutionary processes on earth" (Harry Swarth, quoted in Barrow 2009a, p. 176).

But the Galápagos were not always known as an evolutionary wonderland: in the mid-twentieth century, the stark, isolated landscapes of this remote archipelago 600 miles off the coast of Ecuador in the Pacific Ocean were more often considered cursed than a paradise. In 1841, Herman Melville visited the Galápagos just a few years after Darwin. The islands gave him nightmares. He likened them to heaps of smoldering cinders. Melville wrote of *Las Encantadas* as dry, evilly enchanted isles that seemed to drift in the fog, a curse to becalmed sailors (2002 [1854]). The Ecuadorian state seemed to agree with Melville; until the mid-twentieth century the islands were home to little more than penal colonies and other wayward souls.

This chapter analyzes how networks of naturalists campaigned for the conservation of the archipelago during the period 1930-1965, eventually transforming the image of the islands and succeeding in establishing the Charles Darwin Research Station and Galápagos National Park in

1959. It explores how their efforts recast the islands from a cursed backwater to an icon of science and "pristine" nature. I argue that the conservationists marshaled geographic imaginaries of the islands as a natural laboratory based on Darwinian science to recast the Galápagos as an important site for scientific research and thus a place worth conserving. If read in a broad sweep, this story could be said to mirror common narratives of shifts in the understanding of wilderness from scary no man's lands to places of quiet respite with the spread of scientific rationality (c.f., Nash 2001). But closer attention to the social processes through which this recasting was negotiated reveals a more complex story that intertwines histories of science, exploration, imperialism, nationalism, and the emergence of transnational governance. Exploring the formation and operation of the networks through which northern scientists and conservationists made these territorial claims—particularly through UNESCO and the International Union for the Conservation of Nature (IUCN)—sheds light on the emergence of international environmental governance institutions in the post-war period. But their success in doing so was not a matter of unfolding enlightenment with the spread of scientific rationality, but the result of political negotiations over territorial claims that turned on particular productions of space.

By analyzing how Western scientists used Darwinian imaginaries to claim a conservation territory, the case explores the relationship between mid-century science and imperialism. I argue that science took on a new role in this case as the leading justification for a new form of post-war imperialism through transnational governance. In a post-war moment of new imperialism marked by the rise of international institutions and faith in Science as a means to Progress, scientists made their own claims to manage foreign territory. Instead of accompanying colonial expeditions, as Darwin had, this new generation led their own scientific expeditions to justify their intervention and the creation of a conservation territory.

At the center of this new scientific imperialism was not an ethos of state expansion, but one of the expansion of science as scientists extended their own "civilizing mission" based on the old maxim that scientific knowledge would provide the most rational use of resources (Drayton 2000). In the Galápagos, such rational use of resources meant not extraction for the advancement of capital, but protection for the advancement of evolutionary science. Scientists' success in claiming the Galápagos as a conservation territory, much like the success of earlier colonialism, turned on their ability to reorder nature, in this case from an evil hell on earth to an allegorical place through which to understand the very origins of life. By analyzing how naturalists justified their management of the Galápagos, the case reveals the importance of the environmental movement as a geopolitical endeavor. It also shows that what was at stake in environmental geo-politicking were not only international power negotiations over territorial claims, but also the very the nature of the territory.

The chapter is divided into three main parts: a theoretical framework and social history of the Galápagos prior to conservation efforts; the first wave of *in situ* conservation efforts in the 1930s; and efforts to found a research station in the 1950s and 1960s. The theoretical framework draws on critical histories of science and environmentalism to situate conservation efforts in a history of imperial geopolitics that turned on arguments that science provided the most rational model for government. The following section explores changing valuations of the islands and how they governed different patterns of extractive resource use—from sailors' reliance on the tortoises as food, to U.S. desire to mine guano, to state penal colonies. Natural history collection too constituted an extractive use of natural resources. The chapter then traces the history of calls to protect the archipelago at two historical moments. In the 1930s, naturalists succeeded in lobbying the Ecuadorian state to adopt two protectionist decrees, but failed to institute plans for a research station. In the 1950s, an international coalition under the auspices of UNESCO succeeded in establishing a station and national park in the islands. The evidence the chapter draws on to illustrate this scramble for conservation is itself something of a scramble: published accounts of these efforts as well as bits of gossipy correspondence among networks of naturalists and conservationists in Europe and the United States.

By analyzing the networking during these two historical moments, I compare the reasons for limited success in 1930s with the effective strategies in the 1950s. I argue that success turned on four factors: first, networks of men involved in establishing the research station created an international consortium that reinforced global constructions of the value of the archipelago's nature; second, they reoriented dominant public opinion of the islands—from cursed and inhospitable to an evolutionary laboratory; and third, they offered a vision with the potential to generate economic development for the Ecuadorian state. Each of these three factors relied on a fourth: the scientific credibility of the men who predominately constituted these networks shaped their ability to marshal resources and to present an understanding of the islands that was taken seriously. In addition to these factors, the political climate of these two particular historical conjunctions also conditioned success: the beginning of World War II stymied international involvement in the Galápagos, but the project was revived in the context of post-war interest in establishing transnational governance as a framework for world peace. This paralleled the re-emergence of Darwinian theory with the Modern Synthesis as well as a renewed importance of fieldwork for evolutionary science. These geopolitical and scientific shifts were further complemented by the growing popularity of the conservation movement and national parks and increasing ease of travel following World War II.

The establishment of the Charles Darwin Research Station and Galápagos National Park is an interesting case for thinking through the history of conservation. An extensive literature in environmental history details the politics of national park and wilderness areas in the United States, but too often the "Yellowstone model" park is said to be neatly exported to the rest of the world—either through a process of coercive colonial manipulation or a nebulously undefined spread of popular ideas (see for example, Worster 2007). This chapter details the emerging networks of transnational environmental governance through which national park conservation was first institutionalized in Ecuador. By doing so, it makes two interventions in understanding how they proliferation of national parks in Latin America happened: first, by analyzing international geopolitics involved in the construction of conservation territories, it sheds light on the changing relationships among science, empire and environmental management in the post-war period. Second, it tells a different story of the relationship between productive use of nature and conservation—rather than utilitarian forestry, in this case the revaluation of nature at the center of scientific territorial claims to preserve the islands as pristine nature set the conditions of possibility for the eco-tourism industry in the islands.

Science, Empire, and Conservation

Natural science and empire building share a dense history (Chaplain 2003, Gascoigne 1998). The techniques of visualization and documentation integral to natural history were likewise integral to the spread of empire (Browne 1992, Pratt 1992, Miller and Reill 1995). Through collection and classification, colonial science facilitated the spread of European imperialism by making the world ordered and rational (Mackay 1995, Gascogine 1995). Scientific spatial representations or "geographic imaginations" (Gregory 1994) of foreign lands were geopolitical tools that served to delineate regions (Browne 1992, Greer 2013) and identify useful raw materials (Gascoigne 1998, Braun 2000). In addition to ensuring the profitability of settler agricultural production (Gascogine 1998), science also provided ideological justification for territorial claims based on the idea that efficient, rational use of resources justified their command (Drayton 2000). The scientific revolution provided a vision of nature ordered by laws and subject to those who discovered and understood these laws—rather than to misuse by "profligate natives" (ibid, p. 58). In the quest for colonial improvement, nature was "a necessary ally of policy"—and science was the key for mastering and managing nature (Drayton, 2000, p. 222).

Colonial science was not only focused on geopolitics and extraction—the colonial experience was also pivotal to the emergence of western environmentalism (Grove 1995). Scientific critiques of "improvement" emerged under colonial rule in the tropics, particularly in small island "Edens" where botanists witnessed the ecological impacts of capitalist production (ibid). While scientists' environmental concerns may have emerged in reaction to colonial management, colonial era conservation was not a contradiction of the imperial impulse, as it is often framed in environmental histories that celebrate conservation as a check on the ravages of capitalist colonialism (c.f. Grove 1995, Miller 2007 in regard to Latin America). Rather than standing in contradistinction to the excesses of empire, environmentalist management—particularly in the form of game reserves and later national parks—was enabled by the very structures and ideologies of imperialism, particularly the notion that science would provide the most rational use of resources (Drayton 2000).

This is no less true today than it was in the colonial period. Critical histories of colonial and post-colonial conservation demonstrate the elite Western cultural values—from English landscape aesthetics that separated the observer from the land to American transcendental appreciation of wilderness—that underwrote enclosures of "natural" space (McDermott-Hughes 2006, Neumann 1998, Cronon 1996). Colonial exploration shaped the dominant lasting understandings of Latin American nature as wild, Edenic, and uninhabited that have underwritten contemporary environmentalism (Raffles 2002, Slater 1996, Pratt 1992). Modern environmental management continues to reflect the ideology of imperial manifest destiny, justifying interventionist land grabs with the same moral certitude, faith in improvement, and scientific support that underscored colonialism (Li 2007, Schroeder and Neumann 1995, Cosgrove 1995, Shiva 1993). Indeed, conservation territories, defined as "designated spaces of nature protection and resource management" (Zimmerer 2006, 8), have proliferated over the past twenty years throughout the Global South.

This chapter returns to an earlier phase of globalization to explore the creation of an early conservation territory in Latin America—indeed, Ecuador's first national park. It draws from and extends work on the relationship between science, empire, and environmental management by exploring U.S. and European justifications for conservation in the Galápagos at a transitional historical moment at the close of the imperial age and the beginning of the post-war world order. I argue that the men involved in Galápagos conservation in the early twentieth century used imperial renderings of nature based on Darwinian science to justify transnational environmental management of the islands. In doing so, their work presents an opposite narrative to accounts that situate colonial science as working in the service of empire. Instead of using science to facilitate other geopolitical aims, here science was the central justification for conservationist territorial claims. By successfully campaigning for a Galápagos research station, networks of Western scientists established themselves as managers of this Ecuadorian territory under the leadership of two institutions central to the post-war order: the United Nations Education, Scientific and Cultural Organization (UNESCO) and the International Union for the Conservation of Nature (IUCN).

The close of the world wars marked an end to a certain mode of imperialism, the fall of Pax Britannica and the emergence of a new world order structured around the promise of international cooperation. It was an age of "development" (Escobar 1990), of modernization, of faith in science and technology as the surest route to prosperity and stability. These were the goals taken up by emerging international institutions forging new modes of transnational governance. It was in this context that UNESCO, and later the IUCN, emerged as key institutions promoting science and conservation around the globe. While networked, nongovernmental governance is often considered a hallmark of the neoliberal era of globalization, many of the transnational institutions central to environmental policymaking date to the post-war moment. As colonial governments fell, northern preservationists channeled their efforts through the burgeoning networks of international institutions such as UNESCO (founded in 1946), the IUCN (1948), and the American Committee for International Wildlife Protection (1930). The operation of these networks foreshadows what is today the dominant political organization of environmental governance—dispersed policy networks operating at various scales (Goldman 2007, Fairhead and Leach 2003, Keck and Sikkink 1998).

Working through these institutions, Galápagos conservationists' territorial claims gained legitimacy in terms of credibility and financial support. Following Mark Barrow, I refer to the men involved in these networks (in the early twentieth century they were predominately men) as "bioactivists": "biologists with a strong social, cultural, and political agenda who firmly embraced the practice of engaging in the public sphere" (2009a, p. 269, also Bocking 2012).[13] Today, these men's vision of Galápagos nature as an exemplar of evolution is widely celebrated and institutionalized in designations of the islands as a natural World Heritage Site.[14]

While the Galápagos Islands are prized today for their endemic biodiversity, the notion that they are a "natural laboratory of evolution" is a construct, a particular understanding of nature that is not natural, but has a history (Quiroga 2009). The Galápagos were "naturalized"—made valuable because of their unique nature—by the North through the establishment of the national park and research station (Grenier 2007). In a detailed history of science in the islands, Edward Larson (2001) explores some of the same ground I do in this chapter, as does Mark Barrow (2009) in a chapter on 1930s conservation efforts. I use and extend these histories by showing how scientific framings of the archipelago as a "natural laboratory of evolution" were used to make a territorial claim in the name of conservation. The chapter thus responds to calls to investigate the politics of territorial ordering in Latin American environmental histories (Brannstrom 2004) while also framing the environmental movement as a form of scientific imperialism.

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13. In Latin America, particularly in the early twentieth century, the bioactivists arguing for conservation were often American and European naturalists concerned about resource exploitation (Miller 2007, Sterling 1999). In the region, the mid-twentieth century was a period of growing environmental protection. The first regional conservation parks were established in Chile and Argentina in the 1920s, following the American model of enclosed nature protected from human encroachment; by the 1970s and 1980s national parks had become increasingly common across the region. Regional environmental histories generally recount the rise of Latin American conservation as a counter to histories of tragic environmental pillaging and decline (c.f., Miller 2007). Galápagos bioactivists often framed their work in this way, lobbying for a national park and research station to protect the archipelago's unique landscapes and species from degradation and extirpation. But in this chapter, I draw on critical conservation histories to challenge the declensionist narratives naturalists used to frame their work. Instead, this work pushes us to analyze how "bioactivists" produced the nature they sought to project.

14. Galápagos was among the first cohort of World Heritage Sites when the program started in 1979.

Background

When naturalists first began campaigning to protect the Galápagos Islands in the 1930s, they used histories of scientific exploration in the archipelago to frame it and its species as scientifically valuable, a natural laboratory where nature should be protected and studied. This framing emerged at a particular moment in the history of scientific experimentalism, following a resurgence in the popularity of Darwinian evolution following the Modern Synthesis, an emerging scientific focus on organisms' ecology (Kohler 2003), and growing concern about species extinctions (Barrow 2009). But the laboratory framing, with its connotation of a "pristine" natural environment and emphasis on *in situ* nature protection, contradicted social histories in the islands that had long turned on extractive use of resources. From Darwin's historic visit to the archipelago in 1835 to the founding of the research station in his name in 1959, how the nature of Galápagos Islands was understood and used changed dramatically. Before the islands became famous as a scientifically valuable "natural laboratory" they were considered cursed, a geopolitically significant site for American interests, and a refuge for colonists. This section reviews these different understandings of Galápagos nature and how they governed use of islands resources before the national park was established.

Reframing Enchantment

Today, the Galápagos Islands are widely considered enchanted—a wonderland of pristine nature and a showcase of evolution. The islands are celebrated in conservationist writing as an allegorical space through which to understand the origins of life. In one of his notebooks, Darwin wrote that the Galápagos—a place he spent a short five weeks in 1835 during his five-year *Beagle* voyage—was the "origin…of all my views" (Darwin, 1959, p. 7). Rhetoric that celebrates this Darwinian history presents the Galápagos as an evolutionary Eden, the site of a scientific origin story and even the place where Darwin "discovered" evolution.[15]

But before the Galápagos were famous as Darwin's "little world within itself" (Darwin, n.d. [1845], p. 359), they were thought to be enchanted in a different sense—cursed and inhospitable because of their sharp volcanic terrain and almost total lack of fresh water (Larson 2001). Before the Darwinian revolution, when nature was broadly valued as a resource for supporting human life, the islands' austere landscapes were considered a hell on earth. When Fray Tomas de Berlanga discovered the archipelago in 1535, he wrote that the islands looked like "God had showered stones" down upon them (quoted in Larson 2001, p. 22). Even Darwin wrote in his Beagle journal that "nothing could be less inviting than the first appearance" (Darwin, nd. [1845], p. 354). When Herman Melville visited the Galápagos in 1841, he called the islands "enchanted," although his imagery is a far cry from the enchanted isles that tourism companies promote today. Echoing the account of sixteenth century Spanish captain Diego de Rivadeneira, Melville wrote of *Las Encantadas* as dry, evilly bewitched isles that seemed to drift in the fog, a curse to becalmed sailors (2002 [1854], von Hagen 1940). For Melville, the islands' best-known species, the giant tortoises, were the reincarnated souls of evil ship captains, doomed to an eternity in this remote purgatory.

Extracting Resources

For Melville, Darwin, and thousands of other sailors, the tortoises were also a crucial source of fresh meat for long voyages across the Pacific Ocean. From the seventeenth to

[15.] These ideas are repeated in numerous popular science books on the islands, nature documentaries, and tourism propaganda that pitch the Galápagos as "the islands that changed the world (Stewart, 2007), a "geological and biological Eden" (Dawkins quoted in Stewart, 2007, p. 6), and "an almost perfect natural laboratory of evolution" (ibid.). The rhetoric is also picked up in the way conservation goals for Galápagos have been framed—most notably as an attempt to go "Back to Eden"—to restore the islands' nature to its state in 1534, before their "discovery" by Westerners (Quiroga 2009, CDF and WWF 2001). See Hennessy and McCleary 2011 for discussion.

nineteenth centuries, pirates and whalers frequently stopped in the Galápagos to pick up giant tortoises, which made an excellent source of food. Not only was tortoise meat well-liked, but the animals could stay alive for nearly a year without food or water. Sailors would stack the animals in the hulls of ships before taking off for a voyage across the Pacific. They took as many as 100,000 tortoises during the nineteenth century (Townsend 1925).[16]

During the colonial era, the ready supply of tortoises made the Galápagos a geopolitically significant staging site from which British and American navies secured their rights to the sea. As the whaling industry diminished, new values for the islands emerged. The United States in particular tried several times near the turn of the twentieth century to buy or lease the Galápagos for their supposed guano reserves, to use as a coaling station, and later as a site from which to protect the Panama Canal.

To protect its sovereignty, the Ecuadorian government encouraged colonization of the islands. In the 1800s, the islands were primarily home to Ecuadorian political exiles and a state penal colony. During the twentieth century, the state promoted colonization for economic development through schemes that included a sugar cane plantation and mill, salt mines, a tortoise oil industry, an international tuna industry, attempts to collect orchilla to use as dye, and resettlement of citizens displaced by an earthquake on the continent. During the first half of the twentieth century, the Ecuadorian government even advertised colonization opportunities in European newspapers to entice people to create a *Swiss Family Robinson*-type existence on the islands. Several small groups of Europeans responded to these calls, though their settlements

[16] These early visitors also introduced goats and pigs to several islands, which reproduced abundantly and served as additional food sources for future voyages. These introduced species changed island ecosystems at such a scale that several nineteenth century visitors expressed concern. In 1869, one American collector reported many introduced animals on Floreana (Charles) Island as damaging for the islands' tortoises: "Pigs now roam in their haunts, destined to destroy their eggs and young whenever and wherever they may find them." A year later, a navy expedition found "tortoises to have almost disappeared from Charles Island," replaced by "several thousand head of wild cattle, besides pigs and goats" (both quoted in Larson 2001, p. 94).

were far from a Hollywood dream. Early Galápagos life was notoriously difficult because of the islands' remoteness, lack of fresh water, and rough terrain. Most people at the time lived on small agricultural settlements. During the 1930s, the Galápagos were best known in U.S. and European newspapers for the sordid affairs of a European nudist colony and the murder mystery surrounding the self-proclaimed "Empress of Galápagos" and her male companions.[17] Thus while not heavily populated, the islands were inhabited when conservation efforts started.

Collecting in Darwin's Wake

Sailors' and colonists' use of island species as resources was a cause for concern among scientists who visited in the islands in Darwin's wake. From the late nineteenth century, the Galápagos emerged as a proving (and dis-proving) ground for evolutionary theory (Larson 2001). As one naturalist wrote in 1875, "the ground is classic ground…the natural products of the Galápagos Islands will ever be appealed to" by scientists studying the origin of species (Salvin 1875, quoted in Larson 2001, p. 93). During the century after Darwin's visit (in 1835), the Galápagos were visited by more than twenty scientific expeditions—from staunch anti-Darwinist Louis Agassiz to David Lack, whose work in the late 1930s popularized "Darwin's Finches" as a key example of evolution.[18] But several of these naturalists saw their ability to study evolution as jeopardized by human extirpation of native species. When Georg Baur returned from the archipelago in 1891, he stressed the urgency of scientific research in the

[17] Although I do not deal with their experiences here, several popular histories and a new documentary discuss these colonists' lives in Galápagos. See particularly Latorre 2005 and "The Galápagos Affair: Satan Came to Eden" (http://www.imdb.com/title/tt2960450/). (Site accessed March 18, 2014.)

[18] Agassiz—a die-hard believer in special creation—visited in 1871 during one of two South American expeditions he was convinced would "give me the means of showing that the transmutation theory is wholly without foundation in facts" (quoted in Larson 2001, p. 96). Another opponent of evolution, American paleontologist Georg Baur, visited the islands in 1891. He based his theory that the islands were not oceanic, but the remains of a subsiding land mass, on similarities between continental and island tortoises—a view which, he boasted, was "in direct opposition to the opinion of all authors who have worked on this group of islands" (Larson 2001, p. 113).

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!” (quoted in Larson 2001, p. 126).

Yet like the colonists and sailors, these scientists also practiced an extractive use of nature—bringing home the islands’ unique species to study in natural history museums (James 2010). Much of this natural history collection was motivated by scientists’ mounting concern about the fate of wild species—it was, as one wrote in 1906, a “race with extinction” (Fritts and Fritts 1982). The benefactor of a major expedition in 1897, British amateur natural historian Lord Walter Rothschild (of the banking family), directed his lead collector to bring back all the tortoises he could find on the islands to “save them for science” before they went extinct (Rothschild 1983, p.197).[19]

As biology shifted to being a predominately laboratory science in the early twentieth century, Galápagos expeditions were mostly undertaken by wealthy gentleman naturalists more interested in the yachting life than science. Wealthy naturalist sportsmen offered their yachts as mobile field stations, although they better served sport-fishing than serious scientific observation or collecting.[20] Popular accounts of these trips, such as a best-seller written by celebrity naturalist William Beebe in 1924, brought attention to the islands’ unique species. Members of these trips also commonly brought home live animals for zoo collections.

By 1938, when Ernst Mayr sent Lack to study the finches, the zeal for collecting was turning. Following the Modern Synthesis of genetics and Darwinian evolution in the 1930s, a resurgence of interest in evolutionary theory drove scientists back into the field as well as into

[19] The collector, Rollo Beck, took sixty-five tortoises for Rothschild, but certainly did not clear the islands of the species. Five years later he collected 211 for the California Academy of Sciences.

[20] These included Vincent Astor, William Vanderbilt, Kermit Roosevelt, Templeton Crocker, and G. Allan Hancock, and Harrison Williams, a NYSZ patron who lent his yacht and financed the William Beebe expedition in 1923.

the laboratory. As biologists became increasingly interested in ecology, fieldwork to study animals' behavior and natural habitats was necessary, precipitating the need for a field station on the islands to accommodate research (cf., Kohler 2002). This, combined with concern about species extinctions, created a sense of urgency among scientists and naturalists that something would have to be done to ensure the continued survival of the archipelago's species for future research and enjoyment. It was in this context that naturalists undertook the first efforts to protect Galápagos species in situ through a nature reserve and research station.

In Situ Conservation Efforts

In the mid-1930s, in response to lobbying by American naturalists, the Government of Ecuador issued two decrees—one in 1934 and one in 1936—that laid the groundwork for a nature reserve and research station in the Galápagos. In this section, I trace the networking behind the two decrees, the first of which was led by American Robert T. Moore, a research associate at the California Institute of Technology. The second was spearheaded by American amateur naturalist and travel writer Victor von Hagen, who also campaigned to establish a research station in the islands. These bioactivists framed conservation as a tribute to Darwin and marshaled international support for the cause. But as they quickly found, negotiating the decrees and establishing a research station was a delicate diplomatic undertaking. While they succeeded in securing legislation that opened the door to foreign scientific management of the islands, von Hagen's efforts failed to find enough traction to make a research station a reality. I argue that this failure turned on his lack of scientific credibility, which hurt his ability to gain the support of key international scientific institutions necessary to convince the Ecuadorian government of the legitimacy of conservation plans.

Conservation Decrees: Securing Foreign Intervention

During the first decades of the twentieth century, naturalists' interest in conservation in the islands grew along with their perceived value to evolutionary science. After a 1932 expedition, one 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).[21] Another member of the same expedition called for Ecuador to create a wildlife sanctuary in the islands that would serve as an "out-door biological laboratory" in what he said were "one of the most amazing natural laboratories of evolutionary processes on earth" (quoted in Barrow 2009b, p. 176).[22] This appeal was reiterated in the UK, by an ornithologist for whom Darwin's 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).[23]

To secure their access to the nature necessary to conduct research, naturalists wanted to establish a research station. A field station would also position them as the actors with sufficient knowledge to manage the islands—a rearticulation of the common justification of science in support of empire as providing the most rational use of resources (Drayton 2000). But here, instead of using science to improve agricultural production (c.f. Gascoigne 1998), the central goal was to increase knowledge of evolution. The cause was taken up directly by two naturalists who quickly discovered that securing access to the foreign territory would be a delicate diplomatic issue.

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

[22] Harry Swarth, CAS Curator of Birds

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

The cause was first taken up by American Robert T. Moore following an expedition to the archipelago in 1927. Moore worked closely with V.M. Egas, former Ecuadorian consul in Los Angeles, to draft proposed legislation to protect the islands' fauna. He recruited well-connected naturalists on the American Committee for International Wild Life Protection—including Harold Coolidge, a Harvard primatologist and stalwart of American conservation.[24] In 1934, the American Committee passed a resolution approving the "Scientific Station at the Galápagos Islands Act," which Egas then forwarded to the Ecuadorian Government. The act called 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," the establishment of a Darwin Memorial Zoological Laboratory, and support for wardens to enforce the act (Barrow 2009b, p. 178).

It was approved almost verbatim by Ecuadorian President Abelardo Montalvo who issued an executive decree on August 31, 1934.[25] The primary change Montalvo made was to limit foreign cooperation in the establishment of a biological laboratory—a small setback in what was otherwise a conservation success. Recalling the crafting of this legislation later in life, Coolidge wrote about the delicate negotiation involved with the Ecuadorian government:

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

[25] The decree stated that "reserves or national parks…inviolable refuges for all animal life" may be declared in the archipelago and that "no one shall catch, molest, hurt, capture or kill" many of the threatened species. It required all visiting ships to first call at San Cristobal (Chatham) Island and sign a document agreeing to respect laws protecting the wildlife. Although it did not formally designate the islands as nature reserves, it did lay the groundwork for such a designation when financing for a warden was organized. As Moore reported in a piece in *Science*, while the issue of a warden needed to be solved, the decree also made possible the enforcement of the U.S. Vandegrift Tariff of 1930, which forbade the importation of wild mammals and birds protected by foreign law (Moore, 1935). ("Excerpts from the Official Register, August 31, 1934. Vol. I, No. 257. Articles 74-90-91-92-93-94-95 & 99. Part 3: Hunting in the Galápagos Islands Reserves or National Parks." 4 pp. British Museum (Natural History) Archives (BMNH), DF 206/162: British Association Galápagos Islands Committee: Decrees of the Government of Ecuador Relating to the Galápagos Islands, 1934-1936.)

> "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 [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."[26]

The following year—the centennial of Darwin's visit to the Galápagos—American Darwin aficionado Victor Wolfgang von Hagen organized his own Galápagos project after proposing, but failing to finance, a Darwin Memorial Expedition along the entire South American coast (Barrow 2009b). A century after the *Beagle*'s arrival in Galápagos "precisely to the day, month, and year—on September 21, 1935" von Hagen erected a monument to Charles Darwin at the bay where he first landed on the islands (von Hagen 1949, p. 215).[27] His efforts to protect Darwin's legacy in the archipelago did not stop there. After spending six months in the islands, von Hagen was unsatisfied with seemingly nonexistent protection for wildlife.[28]

He returned to the Ecuadorian continent, where he campaigned to create a wildlife sanctuary and research station. The political stakes of the project soon became apparent. von Hagen "spent… three months writing the legislation, conferring with officials, giving teas and cocktail parties in an endeavor to make matters progress the more quickly," he later reported.[29]

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

[27] The American Museum of Natural History and Darwin's only surviving son, Leonard, supported the effort, although von Hagen later complained that he was forced to fund the statue and expedition from his own pocket. (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)

[28] After reviewing the Moore/Egas decree, he 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

[29] 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

The work was complicated because of the islands' strategic proximity to the Panama Canal. "It is, indeed, a very ticklish political question in Ecuador. My path was full of these diplomatic pitfalls, which I have so far avoided." von Hagen saw himself as a skillful diplomat, working not on behalf of a foreign government, but to further the interests of science. His comment shows the geopolitical stakes of Galápagos conservation as foreign interest in preserving wildlife provoked Ecuadorian fears of challenges to its sovereignty. Following decades of Monroe Doctrine expansionism, including Teddy Roosevelt's seizure of the Panama Canal zone, intimations of American desire for Latin territory were not a hollow threat.

To overcome geopolitical concerns in Ecuador, von Hagen organized local support for his plans, pulling 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).[30] 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.[31] To a foreign naturalist, he wrote 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."[32] von Hagen's statement reflects a

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[30] The official Ecuadorian name for the Galápagos today remains "Archipelago de Colon."

[31] 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

[32] ibid. Indeed, according to the British consul in Quito, lose interest they did: 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

colonial mentality, using the boards as a tactic to win state support for plans that would facilitate the territorial claims of foreign scientists. In another letter that betrays his attitude, he complained to a British naturalist of the difficulty of accomplishing these goals: "I do not know how familiar you are with the manner in which things are accomplished in Latin American countries. Method there certainly is, even although it is akin to madness. Yet these people, in spite of their equivocalness, are semi-sincere; they merely believe that to promise is one thing; to complete it, another."[33]

Despite Ecuadorian method driving him to "madness," von Hagen made fast progress. Chief Executive of the Republic Frederick Paez signed another decree on May 14, 1936, 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.[34] 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."[35] 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

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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)

[33] von Hagen to H. Swarth, June 27, 1935, DF206/158 British Association Galápagos Islands Committee: minutes and circular letters 1935-1937

[34] 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

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

1949, p. 215). Although Moore's legislation had also introduced the notion of foreign management, von Hagen evidently saw himself as having achieved a geopolitical coup on behalf of Galápagos wildlife and natural science.

Limits of Credibility

Having secured the door to foreign intervention, von Hagen began planning for a research station. He found a working farm to purchase and convert to a station on Santa Cruz Island. He wanted to undertake an aerial photographic mapping expedition and install signs marking the islands as animal sanctuaries. These plans, he thought, would be partially financed by a series of Darwin Memorial airmail stamps to be sold in the Galápagos (Barrow 2009b). But von Hagen needed the backing of international scientific institutions. He reached out to leading conservationists in America and England, including Hal Coolidge and evolutionary biologist Julian Huxley, the grandson of Darwin's bulldog T.H. Huxley who was then Secretary of the Zoological Society of London.

von Hagen's legislative triumph soon turned to frustration. While he reached out to all the appropriate contacts in the world of natural science and conservation, his own lack of scientific credibility kept him an outsider to these networks. He was not affiliated with any of the key institutions, nor was his scientific training clear. The well-established naturalists were sympathetic to von Hagen's objectives, but did not trust his methods or motivations (Barrow 2009b). Their skepticism fluttered through the networks of professional science in gossipy letters—artifacts of boundary work (Gieryn 1999) that excluded von Hagen from the support he sought for a biological station.

Chief among von Hagen's perceived faults was his lack of scientific credibility. 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."[36] 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…"[37] Nobel denied him the status of a scientist, differentiating between the professional status of a qualified biologist and that of an amateur naturalist "promoter."[38]

Unaware, 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 was not clear he had the authority to do this.[39] 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

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

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

[38] 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.

[39] C.G. Darwin to J. Huxley, May 27, 1936. BMNH DF206/161 British Association Galápagos Islands Committee: general correspondence 1935-1938

would it come from?"[40] 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 was interested in Galápagos conservation so asked the British Association for the Advancement of Science to set up a "strong committee"… "to look into the whole question of the preservation of the Galápagos fauna."[41]

von Hagen's reputation among these men was further sullied 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 2009b, 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). In England, the Foreign Office reported to the British Association that the "Darwin Memorial Association" von Hagen started to support his efforts in Quito never officially existed:

> "the Centenary Commemoration was undertaken exclusively by Dr. von Hagen and at his own expense. With the object of giving the affair an official character, Dr. von Hagen had a few commemorative medals struck and distributed to the President of the Republic and other public functionaries together with membership diplomas of the "Darwin Memorial Association"; but actually there was no such association."[42]

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

[41] J. Huxley to C.G. Darwin, May 30, 1936. British Association Galápagos Islands Committee: general correspondence 1935-1938

[42] Stephen Gaselee (Foreign Office) to Tate Regan, FRS August 20, 1936. BMNH DF1004/361 Expeditions: Galápagos Islands 1935-1960

Both the Brits and the Americans were troubled by this history—Hal Coolidge wrote to Huxley that von Hagen's activities in Ecuador complicated the American Committee's plans and had "already embarrassed our Government by some of his actions."[43] von Hagen's rogue advocacy threatened the credibility of the institutions whose support he sought.

Despite the boundary work attempting to close von Hagen out of the elite networks of science, he persisted. In 1937, he travelled to England to pitch his plans to the British Association committee, presenting himself as the "Special Commissioner of the Ecuadorean Provisional Committee for the Preservation of the Galápagos Fauna and Flora." von Hagen found in Huxley a crucial ally. Perhaps because he offered a foothold into a territory claimed by Monroe Doctrine Americanism, or perhaps out of British reverence to Darwin, Huxley's committee was more supportive than the Americans. They issued a memorandum at the conclusion of von Hagen's visit voicing unanimous approval of his plans to survey the islands, post signs prohibiting collection, raise funds to support a station, and publicize the islands' conservation.[44]

But the issue of von Hagen's credibility surfaced again in discussions about appointing a warden to monitor the new sanctuary.[45] The committee members were concerned about

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

[44] The committee included representatives of leading British scientific and conservationist organizations: the British Association, the Royal Society, the Zoological Society, the Linnaean Society, the Royal Geographical Society, the Society for the Preservation of the Fauna and Flora of the Empire, and the Society for the Promotion of Nature Reserves. BMNH DF206/158 British Association Galápagos Islands Committee: minutes and circular letters 1935-1937

[45] In 1936, a member of the British Foreign Office reported that while the Ecuadorian government claimed that the law was in force, it had done little if anything to carry it into effect: "It seems clear that the Government must rely on foreign scientific institutions for the protection of the fauna as they have no means of their own for such a task. I understand that there are no guards or patrols of any kind to prevent unauthorised intrusion; but, on the contrary, that the local authorities are the first to capture specimens to sell to visiting ships…" Stephen Gaselee (Foreign Office) to Tate Regan, FRS August 20, 1936. BMNH DF1004/361 Expeditions: Galápagos Islands 1935-1960. This was a practice that had been encouraged by decades of previous naturalist visitors—scientific collectors and sportsmen—who often hired settlers to help them find specimens for their collections.

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.[46] They were convinced that the warden should be a "qualified biologist" who would not only report offenses, but would also be capable of conducting his own research, issuing research permissions, and making recommendations to the government based on such research. This assertion—that the best management of natural resources would be in the hands of a trained scientist—reflected a common argument of colonial government (Drayton 2000). It effectively negated the possibility that von Hagen would run the station.[47] 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…"[48]

Despite the considerable effort von Hagen had put into organizing a station, his lack of credible institutional affiliation and unclear training undermined his plans and his ability to garner the necessary international support to make them a reality.

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[46] 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

[47] A suggestion that warden be 'preferably not a native of Ecuador' was stricken from a draft of the memo. My interpretation is that this was both too obvious and too geopolitically incorrect to warrant official recording. BMNH DF206/158 British Association Galápagos Islands Committee: minutes and circular letters 1935-1937

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

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. The station effort had lost credibility in Ecuador, and without a contact on the ground, British and American naturalists were left in a lurch.[49] von Hagen later lamented that Huxley's Galápagos committee "alone of all scientific institutions the world over" supported his conservation efforts (1949, p. 215). He wrote to Huxley recounting his solitary trials,

> "Frankly, I despair of any solution of the Galápagos conservation plans. The apathy and suspicion of the Government of Ecuador, the absolute indifference of American institutions to the rapidly disappearing fauna of the Galápagos make all my efforts seem hopeless. For four years, alone, I have carried the whole matter. In default of any other interested party I have done all these things out of my own purse. 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."[50]

Although von Hagen was savvy enough to seek the support of the those who had been key players in an earlier era of "rescuing" species for science by preserving specimens, he remained an outsider, unable to harness the stature and credibility of these institutions for his plans. He moved on to a research trip to the Ecuadorian Amazon, his neo-imperial goal of securing foreign conservation management of the islands thwarted because of his status as an amateur scientist. Claiming foreign territory in the name of science would not succeed without the full weight of the mantle of science.

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[49] R. Moore to J. Slevin, July 19, 1937, California Academy of Sciences Archive, Joseph Slevin Papers, Box 3.

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

A Military Base

The station campaign was soon overshadowed by more pressing geopolitical concerns with the outbreak of World War II. The islands became geopolitically significant once again in 1942, when just four days after the Japanese attack on Pearl Harbor, U.S. troops occupied Baltra (Seymour) Island with the "grudging consent of the Ecuadorian government" (Larson 2001, p. 175). The U.S. built an air force base from which to protect the Panama Canal.[51]

With the war taking the geopolitical center stage, the bioactivists shifted their campaign to a familiar alignment of science in the service empire. 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 despite the support, all their efforts garnered was a directive for GIs not to shoot the animals.

Following the war, the Americans tried to gain control of the decommissioned air base, arguing that the archipelago's "barren coasts and islands afford simplified ecological conditions…and provide a veritable field laboratory in themselves" (Coolidge quoted in Larson 2001, p. 181-182). 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 islands. But their efforts were trumped by

[51] Known as "The Rock" because of its desolate landscape, the base was home to about 2,000 servicemen until the end of the war. The Americans built an airport, a pier, 408 buildings, and 32 miles of asphalt-paved roads (the first in the archipelago) to support about 2,000 men stationed there (Harrison 1947).

Ecuadorian sovereignty, as the state requested the abandoned base for its own air force. Another decade of efforts passed unsuccessfully.

UNESCO Takes on a Mission: 1950s

Calls for Galápagos conservation and a research station in this "natural laboratory" were not taken up again until the mid-1950s. As was the case with von Hagen's efforts, this campaign was inspired by the experience of field naturalists in the islands who were concerned about the plight of wildlife. This section details the concerns of this next generation of bioactivists and how they gained support to undertake an official "biological reconnaissance" mission in the archipelago. In the context of emerging transnational governance, the mission was a turning point in efforts to establish a research station in the islands and thus a key moment of environmental geopoliticking as the charge of science led the way for neo-imperial territorial claims.

Traces of Devastation

After the war, two young biologists were at the center of renewed concern about Galápagos conservation: Austrian Irenäus Eibl-Eibesfeldt, and Canadian-American Robert Bowman, who had done his dissertation research on "Darwin finches" in 1952-53.[52] In the early 1950s, the "traces of devastation" left by the military outpost and other island settlers made a profound impression on young Eibl-Eibesfeldt, who visited the Galápagos with a marine biology

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[52] The finches were not considered "Darwin's" until they were made famous by a 1949 book by British ornithologist David Lack.

expedition.[53] He recalled two pivotal memories from the trip: first, he found only a single land iguana on Baltra (Seymour) Island, which thirty years before William Beebe had described as an Eden for the species. Worse still, the one Eibl found had been shot some years before; he concluded it was the work of bored soldiers. The second tragedy was finding the bodies of six dead sea lions whose skulls had been beaten in, but the bodies left and not skinned—another example of ruthless predation (Eibl-Eibesfeldt1960). Following their trips, both Eibl and Bowman wrote to the IUCN in 1955 to voice concern and push for a research station. As Eibl later wrote, "only a permanent biological station could, in my opinion, guarantee real protection" for the archipelago's prized fauna (1960, p. 178).

Their letters reached a receptive audience. 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. In the United States, President Harry Truman's Four Points speech in 1949 ushered in a new age of development and American leadership to advance the progress of the "underdeveloped" world. This "new imperialism" of post-war internationalism put faith in the expansion of capital, science and technology to spread modern Western values and ensure prosperity and peace around the world (Escobar 1990). The IUCN was established in 1948 with the support of UNESCO Director General Julian Huxley and 107 governments around the world. The organization was "envisioned as a meeting ground to create international networks of experts and organizations that would strengthen the nature conservation movement" (IUCN 2010, p. 3). Huxley was a central figure in this new imperialism, to which he added his faith in science as a beacon of progress.

[53] The expedition was led by Dr. Hans Haas onboard the *Xarifa* and sponsored by the International Institute for Submarine Research.

Galápagos conservation fit Huxley's mission for UNESCO. 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). UNESCO should "relate its ethical values to the discernible direction of evolution, using the fact of biological progress as their foundation" (ibid). The educational opportunities, development of science, and cultural exchange programs it sponsored would encourage the evolution of society as a whole (Larson 2001). Premised on the idea that scientific rationality would engender progress, Huxley's rationale framed the new imperial moment of the post-war period as an opportunity to further the interests of science. Nature preservation fit both these missions as a source of "pure wonder and delight"; a Galápagos national park would reflect this and provide "a means for understanding 'the cosmic project of evolution'" (Larson 2001, p. 181) for both scientists and the public. Huxley's goals were to protect wildlife, encourage study of evolution, and educate people about both.

UNESCO and the IUCN, where Hal Coolidge then chaired a special commission to establish national parks, provided the platform for another attempt at a Galápagos National Park and research station. In 1956, the IUCN secured an invitation from the Ecuadorian government for an exploratory mission to Galápagos. With the government's support, UNESCO arranged to send Eibl on a "first mission of reconnaissance" (Bowman 1960a, p.8). The mission quickly became an issue of international wrangling among networks of European and American bioactivists. Not wanting to let the Europeans take sole control, Coolidge and other American conservationists worked their connections to send Bowman on the trip as well.[54] Aware of the

[54] The men were chosen because of their recent experience in the islands. At the time, both Eibl and Bowman were still in their twenties. Bowman had just finished his dissertation at UC Berkeley and started as an Assistant Professor of Biology at San Francisco State University. Eibl was similarly starting his career in animal ethology at the Max Plank Institute for Behavioral Physiology in Westphalia, Germany. Bowman taught at SFSU until he retired in 1988;

importance of publicity in garnering public support for conservation, they arranged for a special feature on the trip to run in *Life Magazine* to celebrate the upcoming 1959 centenary publication of *On the Origin of Species.* Two men from *Life*—famed nature photographer Alfred Eisenstaedt and illustrator Rudolf Freund—also accompanied Eibl and Bowman.

The mission, which adopted the language of military reconnoitering, would involve four months' stay in the archipelago. The men would visit as many islands as possible, documenting the status of native species and shoring up scientific, political and public support for the research station. As Bowman later reported, the main purposes were:

> 1. To determine the practicality of establishing a permanent scientific station on the Galápagos Islands
> 2. To locate a possible site for such a station
> 3. To explore with Ecuadorian officials the possibility of setting aside one or more islands in the Galápagos as an international wildlife refuge
> 4. To check on the distribution, relative abundance, and ecology of certain "vanishing" species
> 5. To obtain adequate photographic documentation of the islands and their biota for publicity purposes (Bowman 1960a, p. 8)

The reconnaissance mission was less about the practice of science and more about the gathering of intelligence necessary to make a research station happen. This included biological, political, and practical information—as well as documentation to argue the case before a public audience.

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he made fifteen research trips to Galápagos during his career and was an active participant in the Charles Darwin Foundation for many years. Eibl-Eibesfeldt went on to found the field of human ethology, was Professor of Zoology at the University of Munich and later headed the Department of Human Ethology at Max Planck IBP.

On the Trail of Darwin

Figure 2.1 The UNESCO/*Life* Team 'On the Trail of Darwin,' 1958

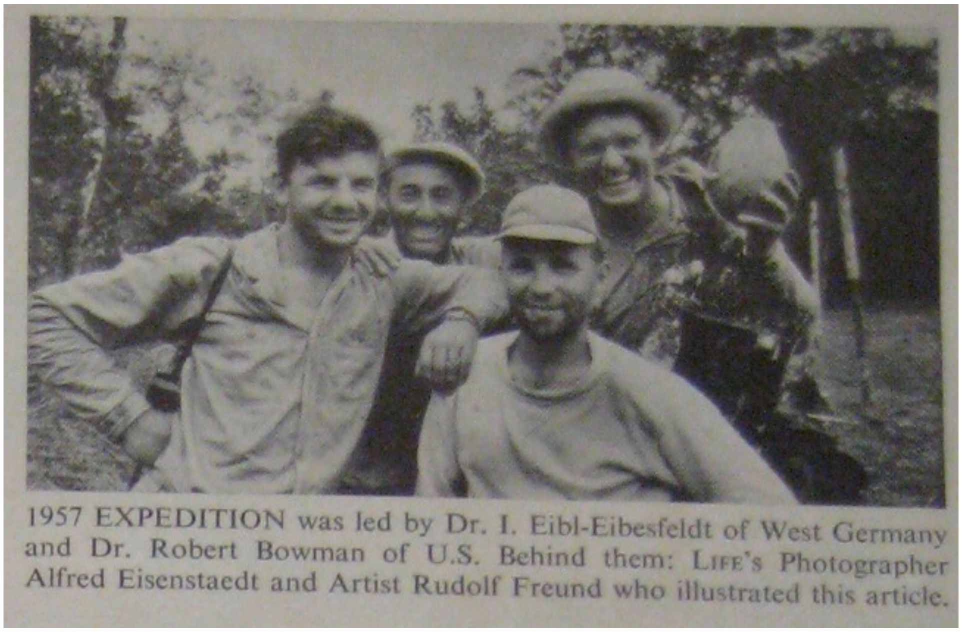

Photo: The UNESCO/*Life* Team: From left to right: In front are Eibl and Bob Bowman; behind them are Alfred Eisenstaedt and Rudolf Freund. Source/ Barnett, 1958, p. 68.

With their mission set, the four men set off "On the Trail of Darwin" (Behrman 1957, p. 6). As *Life* later reported, they found "a trove of evolutionary treasure" (1958). They arrived in the archipelago on July 15, 1957, after several days of meetings with Ecuadorian dignitaries in Quito. The team found local guides in Ecuadorian and European settlers who helped them explore the islands with the aid of a navy patrol boat provided by the Ecuadorian government. They visited nearly every major island in the archipelago and several smaller ones—some sixteen in all (Bowman 1960a). Eibl was enchanted by the experience of roughing it in "virgin" territory:

> "…I was making my way over fields of grey lava and cactus-grown wastes of wild beauty scorched by the equatorial sun. Sometimes I camped in landscapes that were lunar, volcanic, arid. At other times I pitched my tent amid rain-soaked virgin forests, and then, again, I settled down between lava crags where I was surrounded by sea-lions, marine iguanas and penguins" (1960, pp. 21-22).

Bowman later reflected that "We all agreed that the three months spent exploring all but a few of the principal islands of Galápagos were filled with some of the most other-worldly experiences of our lives" (1960b, p. 13). These experiences would become the basis for years of conservation advocacy that framed the islands as a uniquely valuable place.

On Santa Cruz, their first of these other-worldly excursions was a hike to "tortoise country" to see the islands' namesake species. For Eibl, it was "an unforgettable experience." They hiked through the island's distinctive vegetative zones:

> "Setting out with a local guide, we first made our way through the cactus belt. Prickly pears as high as trees and giant cacti bordered our path. Then at 300 feet above sea level the vegetation began to change; the cacti became fewer and fewer and were replaced by trees and shrubs. Finally we came to luxuriant dam woods where there were Scalesia trees with green leafy tops crowning their straight, slender trunks, and Pisonia trees whose reddish trunks were overgrown with ferns." (Eibl-Eibesfeldt 1960, p. 23).

As Bowman recounted, this involved "an all-day hike through fire-ant-infested brush, confusing wild-donkey trails, and slippery substratum. But such inconveniences fade rapidly in one's memory after a first glimpse of these magnificent reptilian monsters plodding through the dense forest underbrush with the ponderous gait of a tank" (1960b, p. 11). For four days, they observed tortoises as they wallowed in shallow muddy pools, hiked down to drier nesting areas, and took measurements of the animals—one of which was so heavy that four of the men could not lift it (ibid). They also observed the machete-ed remains of tortoises killed by local settlers who relied on tortoises for their rich fat—which Bowman reported tasted like roast beef—as well as their liver, "delicious" in Eibl's estimation (1960, p. 22). But while they might have understood the colonists' taste for tortoise, the sight made a lasting impression.

Another excursion to Fernandina (Narborough) Island was one of the most memorable. Upon landing, the team was greeted by huge colonies of marine iguanas that blended into the rocky shore—a unique species of land-dwelling and sea-feeding creatures whose black scales led

Darwin to call them “imps of darkness.” *Life* reused *Beagle* Captain Robert FitzRoy’s description of the “crawling cliffs” of Fernandina as “a fit shore for pandemonium”:

> Of all the animals within the Noah’s Ark of the Enchanted Isles, by far the most conspicuous and bizarre are the iguanas of land and sea….No other creatures of the Galápagos so perfectly embody their environment. The scales that stud their heads and spines are sculptured like volcanic cones. Their black and gray skins reflect the colors of lava and surf…Yet for all their Plutonian appearance, the iguanas are essentially mild and torpid monsters which harm no other living things. The marine iguanas go through life doing nothing more than basking in the sun and munching seaweed at low tide (Barnett 1958, p. 68).

Figure 2.2 ‘A Fit Shore for Pandemonium’ *Life* Illustration of Fernandina Island, 1958

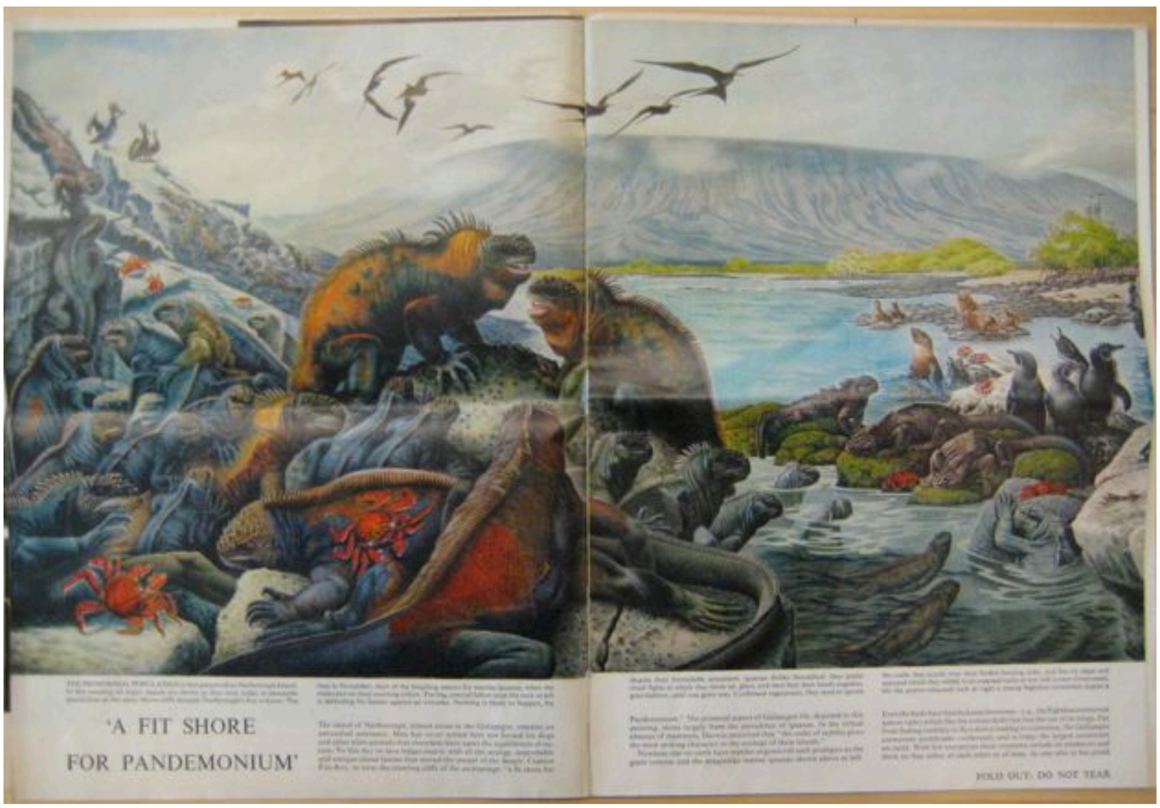

Photo: An illustrated spread by Rudolph Freund depicts the “imps of darkness” and other Fernandina wildlife, published in *Life*, September 8, 1958.

For these men, Fernandina demonstrated Galápagos nature in its most wild, extreme and unusual state.[55] Bowman described it in exotic terms, emphasizing its unique attributes:

> Only after several days of intimate contact with the weird world of Fernandina did I overcome my initial impression that the physical and biotic elements were in temporal and geographic discord with the outside world. Where else on earth can one find enormous herds of ocean-venturing dragon-like iguanas, reminiscent of prehistoric times? Where else does one find a member of the typically Antarctic penguin tribe living in comfort directly on the Equator and feeding on the small fishes that teem in these "tropical" waters, which here are cooler than in any other equatorial region in the world? Where else can one find a giant of the cormorant family of birds with wings so reduced that, in mockery of the evolutionary process, the render the bird flightless? And all these biological productions are staged in a setting one might imagine to be more typical of the cooler parts of Hell or an adolescent planet. (Bowman 1960b, p. 12).

While Bowman might have agreed with Melville's take on the islands as an inhospitable hell on earth, he was awed by the austere beauty of the difficult terrain. The majority of the team's time on Fernandina was spent summiting the cone of the island's central volcano. After two full days climbing to the cone, they reached "a view unsurpassed in all Galápagos" (Bowman 1960b, p. 13). There, "a green-mantled rim, 11 miles in circumference, crowns a steep-walled cauldron containing an enormous lake, almost 2000 feet below. Gusts of warm air whipped these waters into a white-capped frenzy, so that from our position they looked like a boiling sea" (ibid, p. 13). Although nearly out of fresh water, the team descended into the crater where they spent two days camping and living off the lake's warm, sulphorous water. There, Freund and Eisenstaedt built a raft out of empty water tanks and swam to the small volcano in the center of the lake. Bowman and Eibl made collections—attempting to catch small fresh-water fish in the crater lake, and Bowman packing two small snakes into his pack to save as museum

[55] Today, Fernandina, which was never colonized nor much visited by sailors because of its difficult coastline, remains one of the 'most pristine' of the islands, staunchly protected as such by the national park.

specimens. “There is perhaps no more beautiful, or—depending on one’s point of view—more repulsive spot in the Galápagos than Fernandina Island” (Bowman 1960b, p. 12).[56]

In their last week in the islands, the team settled on a site for the proposed biological station in the center of the archipelago on Santa Cruz Island—only some two miles from the town of Puerto Ayora that had served as a pit stop repeatedly during their stay. As Eibl described the “ideal spot” at “Tortuga Bay”:

> 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 (1960, p. 27).

He surmised that with a trail cut, the bay would only be about an hour’s walk from town and the amenities—though few—and camaraderie it offered. Santa Cruz’s central location in the archipelago, proximity to the air base, and relatively pristine condition seemed to provide the perfect environment for scientific study and monitoring.

Reporting Back

In their reports on the trip to UNESCO, Eibl and Bowman reiterated earlier pleas for protection and advocated a research station as the best means to ensure conservation. Bowman warned against “economic encroachment on Galápagos species,” and called for the maintenance of “as much of the Galápagos biota as possible in an undisturbed state” (1960a, pp. 35-36). Eibl

[56] The team did not do extensive scientific work, but they did make several discoveries. To Bowman’s surprise, the snakes he packed out on Fernandina led to the discovery of a new species of fish: the snakes died in his bag, but not before one of them regurgitated one of the fresh water fish Bowman had tried to catch in the lake. The team was the fourth recorded expedition to see the crater lake, and one of the last, for it dried up only a few years later (Eibl-Eibesfeldt, 1960). They also rediscovered populations of land iguanas and finches on islands where they had not been seen for more than a hundred years.

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?"

Table 2.1 Status of Giant Tortoise Populations by Island

Island (English name)	**Species**	**Status, 1914** (Van Denburgh 1914)	**Status, 1957** (Bowman 1960a)	**Status, 2014** (Poulakakis et al 2008; Interviews)
Pinta (Abingdon)	*Chelonoidis abingdoni*	Rare	Very rare	Extinct (Lonesome George); Rediscovered hybrids
Santiago (James)	*C. darwini*	Rare	Very rare or extinct	Fairly numerous
Rábida (Jervis)	*Undescribed*	Very rare	Very rare or extinct	Never existed
Pinzón (Duncan)	*C. ephippium*	Fairly abundant	Rare	Relatively rare
Santa Cruz (Indefatigable)	*C. porteri;* Undescribed	Not rare	Fairly numerous	Numerous; small population
Santa Fe (Barrington)	Undescribed	Extinct	Extinct	Undescribed
San Cristóbal (Chatham)	*C. chathamensis*	Nearly extinct	Very rare or extinct	Rare
Española (Hood)	*C. hoodensis*	Very rare	Very rare	Abundant
Floreana (Charles)	*C. elephantopus*	Extinct	Extinct	Re-discovered hybrids
Fernandina (Narborough)	*C. phantastica*	Very rare	Unknown	Only one animal ever found
Isabela (Albemarle)*		Numerous to rare	Numerous to rare	
Volcan Wolf	*C. becki*			Abundant
Volcan Darwin	*C. microphyes*			Abundant
Volcan Alcedo	*C. vandenburghi*			Abundant
Volcan Sierra Negra	*C. vicina*			Relatively rare
Volan Cerro Azul	*C. guntheri*			Relatively abundant

*Populations now classified by volcano rather than island.

The bulk of the reports discussed evidence for their concerns—biological intelligence they gathered about the status of native fauna and the threats that endangered them, from settler colonies and their introduced goats, pigs, and dogs, to foreign fisheries and nascent state plans for tourism development. Bowman concluded that the tortoises, land iguanas, and fur seals were the animals in "greatest need of protection from further decimation of their numbers by hunters"

(1960a, p. 35). He thought settlers' "poaching" of "tortoises, land iguanas, flamingos, fur seals, and sea lions for food and pelts [was] so serious in some cases to warrant immediate action by the Ecuadorian authorities to put a halt to this" (1960a, p. 35). Tortoises and seals in particular were hunted for food and oil—as Bowman noted, "As long as cooking fat remains in short supply, tortoises are going to be hunted."[57] Poaching was extensive because it was relatively easy in a place where life generally was not: "(1) there is no effective means of enforcing the law, (2) there is little appreciation of wildlife by local residents, and (3) the wild animals are so extremely tame" (Bowman 1960a, p. 36). For Bowman, scientists' protection of these tame, defenseless wild animals was necessary both to enforce the decrees adopted in the 1930s and to educate local settlers so that they would respect nature in the same way the bioactivists did.

Eibl 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" (1960, p. 25).

The argument for a research station in addition to a national park would secure the access of scientists like Bowman and Eibl to work in the islands. 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

[57] Bowman later suggested a charity campaign to sending cheap cooking grease to the islands to obviate the need for tortoise poaching. R. Bowman to A. Eglis, November 26, 1960, CAS Bowman Papers, Box 8.

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. A research station was the central goal of the bioactivsts' efforts because it was through this governmental structure that they would secure their claim to the islands. It was not only a tribute to Darwin, but also would clearly place their research in his legacy. It would also position them as the appropriate actors with sufficient knowledge to manage the islands.

Strategies of Environmental Geopolitics

Having completed the intelligence-gathering mission, the task was then how to make Bowman and Eibl's recommendations a reality. This section details how networks of bioactivists succeeded in establishing the Charles Darwin Research Station with an Ecuadorian executive decree in 1959 and a formal inauguration in 1964.[58] I argue their strategy turned on (1) their scientific credibility and backing by key institutions of environmental governance; (2) the creation of an international consortium that allayed concerns about U.S. imperialism; (3) their ability to reorient dominant public opinion of the islands—from cursed and inhospitable to an evolutionary laboratory; and (4) the translation of their vision into an economic development strategy for the Ecuadorian state. These strategies of environmental geopolitics (Dalby 1996) demonstrate how scientific knowledge was at the forefront of neocolonial claims to establish a

[58] The Galápagos National Park was officially founded in the 1959 decree as well, but the state did not send anyone to the Galápagos to actually institute a park until 1968. In the interim, the CDRS became the environmental authority in the islands; scientists worked closely with Ecuadorian naval officials stationed in the islands to build the station and begin enforcing protection decrees.

new conservation territory. Bioactivists used emerging institutions of environmental governance to implement their scientific and moral imperative to conserve.

'A Delicate Diplomatic Project'

Lack of scientific credibility had undermined von Hagen's efforts; although Bowman and Eibl were still in their twenties, they did not face the same problem. Both were proven field scientists with experience conducting research in the Galápagos who had earned doctorates from respected institutions. By directing their initial appeals to the IUCN, they also demonstrated an understanding that the backing of credible institutions would be essential to achieve environmental protection in the islands. Rather than going directly to Ecuador to push for conservation, they directed their efforts through networks of well-established naturalists and conservationists.

Bowman and Eibl's recommendations were published by UNESCO and formally presented to the International Congress of Zoology in 1958. Their pleas did not fall on deaf ears—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.[59] As the Congress coincided with the Darwin centenary, its support "yielded official scientific recognition" to the project (Dorst and Laurelle 1969, p. 5). 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. Belgian Victor Van

[59] 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.

Straelen, a former vice president of the IUCN, served as president.[60] As scientific leaders, these men evidently felt a moral imperative to not only protect the islands in Darwin's name, but also to ensure that new generations of scientists could continue his work in the "laboratory."

With this backing, IUCN officials set to work on the logistics. 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.[61] Even with credible backing, 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."[62]

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 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.'"[63]

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[60] Also involved were Luis Jaramillo, Ecuadorian delegate to UNESCO, 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.

[61] 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

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

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

These resentments were re-ignited in 1960, when a group of Americans (unaffiliated with research station plans) seeking to establish a settler colony in the Galápagos arrived in Guayaquil on the Ecuadorian coast, "just in time to become an issue in the Presidential race."[64] As an *LA Times* story recounted, a leftist coalition candidate, Parra Velasco, "charged the outgoing administration was not taking proper steps to protect the Galápagos, that the United States was invading the islands." The speech prompted a group of 70 youth to march to the American consulate, throwing rocks and shouting "Americans, get out of Galápagos!" The paper reported that "islanders say a rumor that eventually 500 American families would migrate to the Galápagos resulted in 200 to 400 Ecuadorians – many of them Indians – being brought to Santa Cruz and San Cristobal islands to keep the population in balance in favor of Ecuadoreans."[65] The leftist candidate's charge did not have much of an impact on the election—he lost with less than 10 percent of the vote. Indeed, the article goes on to quote another Ecuadorian official saying the government welcomed colonists looking to develop the islands economically. But the anecdote is illustrative of geopolitical concerns and desire to retain Ecuadorian sovereignty in the islands against encroaching Americans.

Truly International Flavor

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. When Rothman approached Bowman about

[64] They were looking to "establish ourselves on a production-for-use basis, utilizing the natural resources available live off land" (R.E. Moore to J. Slevin, October 12, 1935, CAS Herpetology Department, Box 2 [Correspondence]).; R. Bowman to A. Eglis, November 26, 1960, CAS Bowman Papers, Box 8.

[65] In a letter to a PHS member, Bowman quotes at length from an LA Times article published October 13, 1960. R. Bowman to A. Eglis, November 26, 1960, CAS Bowman Papers, Box 8.

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…[66]

Because of the "many foolish and ill-advised [American] schemes proposed for Galápagos," Bowman felt that the United States could not "take over the drivers' seat."[67] 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 U.S. government grants—they recognized the need for an international appeal. 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 rather than an institutionalization of American power over the eastern Pacific.

Maintaining the international consortium 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 form the planning and developing of the Galápagos Station. The

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

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

> 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 US, 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.[68]

Such "intrigue" was not the only challenge. While Bowman felt sidelined by European-US politicking, his own attitude toward Ecuadorians also became an issue. In a joust of bickering, Eibl 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."[69] 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

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

[69] B. Bowman to H. Coolidge, October 31, 1959, CAS Bowman Papers, Box 6. Bowman may have been particularly sensitive to US/European politics because of his strained relationship with Eibl. Following their joint reconnaissance mission, relations between the two soured. Their plans to write a joint report to UNESCO fell apart after Eibl 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 took his concern that this diplomatic misstep could cost the project to officials at UNESCO, reporting that,

"Dr. Bowman has a quite arrogant attitude toward the Ecuadorians and I think he did not realize yet that Ecuador is going to build a station on Galápagos with international help. 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).

His 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 of plagiarizing his and criticized him for taking full credit for the station plan in his published writings, virtually erasing Bowman's role in the reconnaissance mission. (In letters, Bowman and Rothman discussed a book EE 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.

his ability to return to the islands.[70] 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."[71] Bowman's condescension, while not uncommon, betrays a neo-colonial 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.

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 stepped in and 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, then led by a military junta, 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 which species needed protection and which needed to

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

[71] 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.

be controlled. It also prohibited new colonization in areas determined by the CDRS.[72] With this decree, the committee secured foreign management of the islands—with the cooperation of Ecuadorian military and civil authorities—a victory in environmental geopolitics. 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 on the station.[73]

Over the next several years, a small crew in the Galápagos began building the station—an effort that confronted many difficulties, from clearing a plot to sourcing materials.[74] It was also

[72] 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.)

[73] 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 US 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 twenty years. These funds, while precariously slow-coming at first, allowed them to implement plans decades in the making.

[74] In 1960, UNESCO sent Raymond Lévèque to Galápagos to serve as the first director of CDRS, where he was soon followed by Dr. André Brosset, each serving one-year terms and overseeing construction of the new research station. By 1962, they had nearly completed construction on a laboratory building and workshop. Although the planned site at Tortuga Bay proved inaccessible—the thick underbrush made it impossible to clear a road—they relocated to a plot along the beach on the eastern edge of the settlement at Puerto Ayora. Despite a more convenient location, the work was not easy—everything from negotiations with other settlers to the provision of equipment proved challenging. As Dorst and Laurelle later surmised, "To give an adequate impression in a few words of the innumerable practical problems which the constructors of the buildings of the Darwin Station…had to face would be utterly impossible. Suffice it to say they overcame all difficulties" (1969, p. 5). By 1964, the small crew in the Galápagos included the foreign director as well as a local construction manager, and a local tortoise warden who was tasked with marking animals on Santa Cruz Island. The small station headquarters was operational, having begun receiving visiting scientists in 1962.

met with what the first director, Swiss biologist Raymond Lévèque, considered settlers' gross misperception of their project. He wrote to Bowman,

> "Also, the UNESCO has to pay attention on what they are doing. I think most of the new settlers in the west of Santa Cruz came there on a false reasoning—false for us at least. They simply imagine the UNESCO to be a big commercial company, like "United Fruit" or something like this, they simply moved in, thinking that if one hectare was worth 1 sucre then, it would soon be 100 or 1000 sucres worth! This is the type of thinking of those poor people. Of course the Government is responsible for that awfulness, and especially responsible for the practical extermination of the last tortoises. We can't do much with those irresponsible people in the Government, they don't even know apparently what the Galápagos are! Most of them have never set foot in the Islands!"[75]

The settlers' "misperception"—that the station was a for-profit venture that would increase the value of their land—and Lévèque's comparison to United Fruit, lays bare both the scope of the change the research station brought to the islands as well as its neo-imperial nature. The UNESCO-backed station was the new authority on whose fortunes the future of the islands would come to depend. At the center of this new model of governance was a new understanding, as Lévèque put it, of "what the Galápagos are."

Revaluing Nature

A central part of establishing a research station was bioactivists' redefinition of the value of the archipelago's nature. Melville's vision of Galápagos nature would not convince anyone to protect the islands. The bioactivsts needed to reorient public opinion of the islands from a cursed wasteland to an evolutionary Eden. The scientific value of the islands was something the bioactivists could agree on—both for their Darwinian history and their potential for future research on evolution. Using public media and scientific publications, they translated what was

[75] R. Bowman to H. Coolidge, May 27, 1960, quoting a letter from Leveque, CAS Bowman Papers, Box 6.

for Melville the islands' rough inhospitality into an asset for field scientists—the stark, largely unpopulated landscapes made the Galápagos an ideal "natural laboratory."

Through this geographic re-imagination of the islands as a natural laboratory, the bioactivists reframed the value of the archipelago's nature from an evilly enchanted hell on earth to an allegorical space through which to understand the very origins of life. Von Hagen and other scientists had used rhetoric about the islands' evolutionary value in earlier efforts, but it was not until the late 1950s that it began to gain traction outside circles of Galápagos conservationists. No one's rhetoric more masterfully articulated the Darwinian importance of the Galápagos to modern science than that of the evolutionary humanist himself, Julian Huxley.[76] In the context of the resurgence of Darwinian theory, Huxley used celebrations of the *Origin* to push for Galápagos conservation. In 1959, he argued that:

> "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" (Huxley, quoted in Eibl-Eibesfeldt 1958).

For Huxley, a research station and national park would commemorate the hallowed ground from which Darwin discovered the "origin of species," from which evolutionary theory was born. As he wrote near the centennial celebration of the publication of *On the Origin of Species*:

> "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).

[76] Huxley was a key player in renewed scientific support for Darwin's theory as the "Modern Synthesis" demonstrated that genetics provided the mechanism of inheritance missing from Darwin's theory of natural selection (Huxley 1943).

Huxley's claim springs from Darwin's observation that the Galápagos were the "origin…of all my views" (1959, p. 7). This quote has fueled a popular myth that Darwin "discovered" evolution in a Eureka-like moment as he inspected the beaks of finches and carapaces of tortoises in the islands.[77] Today, the field of island biogeography has demonstrated that island archipelagos often work as "enhanced environments" for the study of evolution (Quammen 1996). Bridging the "lab-field border zone" (Kohler 2002), 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 territories. Like a laboratory environment that allows scientists to isolate and gain control over biologies that escape their vision and grasp in the external world (Latour 1999, Knorr Cetina 1992), the "natural laboratory" of the Galápagos supposedly allowed Darwin to get a clear picture of evolutionary processes. As Jean Dorst explained it in a *UNESCO Courier* article promoting conservation efforts,

> "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)

These articulations of the importance of the nature of the Galápagos reframed the starkness that so repelled Melville into a scientific asset—a simplified, extreme ecology that makes evolution visible. The laboratory framing also positioned the islands as of global value because the nature of the knowledge Darwin produced there—like all scientific laws—was taken

[77] Disproving this myth, and pinpointing exactly when Darwin converted to belief in evolution has become something of a cottage industry in the history of biology. It is now widely accepted that Darwin first wrote of his belief in 'transmutation' after he had returned to England, and developed the theory slowly over twenty years of research, largely on domesticated species, (Sulloway 2009, Browne 2002).

to be universally valid. This global relevance and value supported bioactivists' calls for conservation of the Galápagos as a world patrimony (c.f., Tsing 2005).

These appeals established the Galápagos as the site of a scientific origin story. The laboratory rhetoric reinforced popular conservationist framings of nature as pristine wilderness, suggesting the islands are sites pure nature and controllable isolation. Tropes that celebrated wildlife as "prehistoric creatures" popular in media accounts of the time (Dorst 1961). As Dorst describes, "a visitor setting foot on these shores for the first time feels as though he has gone back to the secondary period, the age of the reptiles." The giant tortoises, he wrote, are "typical of the prehistoric character of so much of the wild life of the Galápagos Islands, which are truly a Noah's Ark for animals that have disappeared from the face of the earth" (1961, p. 28). Framings of the islands as a "Noah's Ark" not only reference notions of pristine, antediluvian nature on which national park conservation was structured, but also position scientists as saviors of nature. Calls for Galápagos conservation were thus legitimized by a geographic imagination of the islands as a natural laboratory. Bioactivists reframed the nature of the islands they sought to conserve though scientific rhetoric about the discovery of evolution and the origins of life.

A Working Laboratory

The research station was not intended to serve only as a museum of Darwinian nature. Bioactivists needed to demonstrate that the islands could serve as a working laboratory valuable to modern science. To this end, Bowman and other bioactivists planned a massive scientific expedition to the islands in 1964. The effort, the Galápagos International Scientific Project (GISP)—was a scientific cruise from San Francisco that included a "floating symposium" as well as five weeks of research in the archipelago. The center point of the trip was the official dedication the Charles Darwin Research Station.

With funding from the United States' National Science Foundation, the GISP was to be an international celebration of the potential of the new station for Galápagos research across a diverse array of fields. Bowman, the trip's co-director under Pacific Science Board president Robert Usinger, an entomologist from UC Berkeley, invited scientific luminaries—Huxley, David Lack, Theodosius Dobzhansky—but in the end, most of the fifty scientists who went were from the Bay area. Huxley gave a send-off address in San Francisco. To ensure publicity, they brought along reporter David Perlman from the *San Francisco Chronicle* who documented the festivities as well as research on the islands' curious flora and fauna.[78]

[78] The trip was a grand affair—they sailed on the 425-foot *Golden Bear*, a ship so large it had to remain anchored at Baltra Island as its hulking presence overwhelmed Academy Bay. The U.S. navy also sent a ship with two helicopters to ferry the researchers about the archipelago, and the NSF had funded the construction of dormitories and lab buildings to add to the CDRS's facilities so it could accommodate all the visitors (Larson 2001).

Figure 2.3 Crowd Gathered for Dedication of Darwin Research Station, 1964

Photo: U.S. and Ecuadorian military officials at the Charles Darwin Station dedication. Source/CDRS Archives.

When the GISP contingent arrived in Puerto Ayora, they were met by a large continent of Ecuadorian officials—107 flown from Quito by the U.S. air force—as well as American and European luminaries who had helped to organize the station.[79] All the townspeople reportedly turned out, bringing the total crowd to about 500 people. The *Golden Bear* brought ten cases of champagne, making the affair, Perlman reported, "the finest social event in Galápagos history" (quoted in Larson 2001, p. 194). A representative of the Junta Government, Marcos Gandera Rodriguez, was bowled over by the pomp and pledged his government's support on the spot. To

[79] Attendees included Harold Coolidge, Victor Van Straelen, Alain Gille of UNESCO, Luis Jaramillo, and even Darwin's grandson.

make it official, junta and station leaders flew to Quito where they negotiated a charter giving the CDRS official responsibilities for the next 25 years. Coolidge, Bowman and Usinger were awarded medals for their efforts (ibid)—a reversal of the situation von Hagen had constructed thirty years before.

With the 1964 dedication, networks of European and American bioactivists succeeded in making their territorial claim. They had convinced the Ecuadorian government to exercise their view of how the islands should be managed—not as penal colonies or strategic military outposts, but as nature preserves. As two CDF members wrote, it "allows us to forecast that we are on the threshold of a settled and fruitful period in which the numerous problems related to the conservation of Nature on the Galápagos Archipelago may reach a solution" (Dorst and Laurelle 1969, p. 6). It was a geopolitical moment in which a private European organization run by scientists was given broad power to manage the island territory as it saw fit. While the specific legal arrangement that established the CDF as an official scientific advisor to the state for a particular territory may be unique, the arrangement was a forerunner of NGO-based environmental governance today. The CDRS case is important because it was among the first such arrangements, emerging along with transnational governance regimes following World War II. It is also crucial for understanding the role of science as a central strategy of legitimating the power of international governance institutions.

Tourism

Redefining the nature of the archipelago allowed bioactivists to translate their vision for management into a new accumulation strategy for the state. More than romantic rhetorical celebrations of Darwinian nature and promises of scientific value, the bioactivists needed to convince the Ecuadorian government of the profitability of their vision. To do this, they appealed to desires for economic development in the islands and nascent interest in tourism. Bowman wrote to Rothman, explaining that the Ecuadorian minister in charge of island colonization's

> "greatest hopes are 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."[80] [emphasis in original text]

As Bowman articulated it, 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.

The CDF bioactivists 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."[81]

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

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

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 <u>means</u> 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."[82] [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. That the Ecuadorian government was convinced by this argument is perhaps obvious today. The potential for Galápagos tourism was first officially acknowledged in the 1964 decree signed with the dedication of the CDRS. The first cruises offered in the islands began in 1969.[83] Eco-tourism provided a solution to the question Eibl posed in his report to UNESCO in 1958 about whether colonization and nature preservation could coexist in the islands. It would not only provide a source of revenue, but would also reinforce a pristine imagination of the islands. The bioactivists had successfully converted the Ecuadorian state to their cause by making the islands economically valuable only if they were protected. This vision is an inversion of the dominant historical relationship between nature and empire in which imperialism rested on the exploitation of natural resources. Instead, in new conservationist imperialism, protection of natural resources

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

[83] Indeed, ecotourism scholar Martha Honey cites the Galápagos as the first modern eco-tourism 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.

is what would make them economically valuable. Nature was made valuable to capital only through its value to science.

Conclusion

The success of tourism and conservation, and scientific research in the islands over the past fifty years demonstrates how thoroughly ingrained bioactivists' geographic imaginations of the Galápagos as a place of evolutionary nature have become. The founding of the Charles Darwin Research Station was a pivotal point in Galápagos history because it recast the value of the islands' nature and thus shaped possibilities for future development.

The creation of this conservation territory in the name of science took years of dedicated effort. Following decades of increasing concern among naturalists about species extinctions, *in situ* conservation of wildlife, rather than preservation of species in natural history museums, became increasingly common, and possible, in the early twentieth century (Barrow, 2009a). But as this case demonstrates, it was not easily achieved. Comparing the efforts of Robert Moore and Victor von Hagen in the 1930s with the UNESCO/IUCN-backed efforts in the 1950s and 1960s demonstrates that conservation efforts turned on several factors, including scientific credibility, the strength of international networks, a recasting of the value of nature, and the articulation of the economic value of conservation. The founding of the CDRS in 1959, and its dedication in 1964, became possible at a particular historical conjuncture with celebrations of the centenary of Darwin's Origin of Species, the rise of transnational governance following World War II, and the increasing ease of travel.

The territorial claims of these scientists turned on a reconstruction of nature. Bioactivists produced the nature they sought to protect, reframing the Galápagos not as an evilly enchanted hell on earth, but as a “natural laboratory” in which to study the origins of life. Highlighting the negotiations that went into this production of nature demonstrates that scientific framings of nature are not a reflection of natural truth, but the outcome of political work. This reframing of the islands as globally important because of their scientific value justified naturalists’ claims to management, allowing them to position themselves as the appropriate responsible authorities. This was a unique achievement at the time for a private foreign NGO as environmental governance transitioned from colonial establishment of nature refuges to the networked policy governance that is a hallmark of current environmentalism.

These two aspects of this case—the reframing of nature and the establishment of international institutional authority—reveal the importance of the environmental movement as a geopolitical endeavor. The bioactivists worked through the networks of transnational environmental governance to reconfigure both the meaning and management of a territory in the name of science. They used the mantle of science to justify governance of a foreign territory. Science was not used to identify natural resources useful to capital, but as a justification for conservation in its own right: Galápagos nature was valuable because of its value to science. This scramble for conservation illustrates the use of scientific knowledge to justify conservation interventions. While the protection of the Galápagos as a natural laboratory of evolution may be a unique case, it is an early exemplar of the centrality of scientific knowledge to modern environmental territorial claims.

CHAPTER III: CONSERVING EVOLUTION

Introduction

Early on a May morning in 2010, the Galápagos National Park Service's flagship work vessel, the *Sierra Negra*, neared the shore of Pinta Island in the northern reaches of the archipelago after a long, choppy night at sea. This was an historic voyage, for on board were thirty-nine giant tortoises that would be the first to set their feet on the island in nearly four decades, since the island's last native tortoise was brought to live in captivity at the GNP headquarters in 1972. Linda Cayot of the Galápagos Conservancy—one of more than fifty scientists, conservations, Park guards and members of the news media who accompanied the tortoises—celebrated the landing in a blog post: "There are now thirty-nine tortoises roaming the slopes of Pinta!! I can't stop smiling and want to shout it to the world."[84] Reintroducing the tortoises to Pinta—or "re-tortoising" as it has become known in the Galápagos—was a pivotal moment in the island's history and in the lives of the released tortoises, many of whom had been born in captivity. The Pinta project was both a continuation of the GNP's tortoise breeding and rewilding work and a departure from business as usual. Because these tortoises were not originally from Pinta sending them to live there contradicted the long-held goal of Galápagos conservation: preserving the evolutionary purity of island nature.

The key tenet of evolutionary understandings of the Galápagos—what makes the archipelago useful for studying evolutionary processes—is that native species evolved separately

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[84] http://retortoisepinta.blogspot.com/ (Accessed November 3, 2013)

on different islands (and volcanoes) through processes of adaptive radiation. Based on the assumption that each island (or volcano) was home to a distinct population of tortoises, the animals have been managed separately by population since conservation efforts started. In captivity, breeding populations and their offspring are housed separately by population before being repatriated to their home islands. The Pinta project was an outlier to this adherence to the evolutionary purity of species lineages because the reintroduced tortoises were not native to the island. Despite concerted effort among conservationists, the last Pinta tortoise, Lonesome George, never reproduced in captivity. (He died in June 2012.) In the intervening years, Lonesome George became an icon of Galápagos conservation, famous around the world because—as his biographer explained—he was a testament to histories of man's destruction of the natural world (Nicholls 2006). What to do with his native island has long been a matter of debate among Galápagos conservationists. How could they restore the ecosystem if the keystone herbivore that evolved there could not reproduce his lineage? Following years of debate, the thirty-nine tortoises reintroduced to Pinta were a temporary compromise solution.

This chapter situates the story of Pinta and Lonesome George in decades of tortoise conservation work aimed at "conserving evolution." This vision for nature protection grew from bioactivists' framings of the islands as a "natural laboratory of evolution" in the early twentieth century (see previous chapter). They established a vision for conservation that combined the islands' Darwinian history with notions of the pristine that have long informed Western nature preservation. This chapter details how this vision has been put into practice through four key areas of work: population surveys, introduced species control, captive breeding, and re-wilding. I adapt Foucault's biopolitics analytic to attend to the government of nonhuman populations of endangered species, exploring how evolutionary understandings of nature have underwritten tortoise management. In doing so, I analyze the human and nonhuman classifications and subjectivities that arise through this work. Examining the labor that goes into nature protection shows that "conserving evolution" is not a matter of letting nature take its course, but involves active management. The chapter shows that conserving evolution is matter of multi-species relations that entangle human and nonhuman agencies in diverse and contradictory ways. Recreating the pristine in this "natural laboratory" involves attempts to untangle some of these relations by forging new enfoldings of nature and culture. Biopower is a productive power through which populations of endangered species are discursively and materially created and populations of unwanted species eliminated. It is a powerful way in which humans engage the nonhuman world. Conservation biopower is productive of both nonhuman and human subjectivities, which I explore through interviews with park guards involved in species surveys and eradication campaigns. Finally, by analyzing the Pinta case as that which complicates biopolitical strategies of conserving evolution, the chapter also explores the limitations of goals to remake nature in the Galápagos. The Pinta case demonstrates the tenacity of the human will to design nature, but also the limitations of attempts to remake evolution.

Conserving a Natural Laboratory

Western nature protection has long revolved around the ideology of protecting "pristine" nature both spatially and temporally separate from human influences (Nash 2001, Cronon 1996, Worster 1994). The remote Galápagos Islands, which had no indigenous human population, are no exception. Indeed, the Galápagos are perhaps the paradigm case of what Steve Hinchliffe sees as a popular "myth of independent nature" that underwrites much of contemporary Western environmentalism. This rendering, in which a pure natural realm is distinct from, and often threatened by, “society,” relies on the spatial imaginary of “an island of natural facts untouched by people” (2007, p. 33). The ideology of the pristine in nature protection was often fueled by landscape aesthetics and American transcendentalism (Neumann 1998, Cronon 1996)—John Muir’s worship of the Yosemite Valley is the paradigm case. If for Muir the wild Nature of Yosemite offered a direct window to a universal God (Tsing 2003), the wilderness of Galápagos could be said to offer a direct glimpse on a secular, scientific origin story. Scientific framings of the archipelago as a natural laboratory suggest that the islands are sites of pure Darwinian nature that unveil the key to understanding life. The laboratory rhetoric also implies that the islands are sites of controllable isolation (Kohler 2002), suggesting a special mission for Galápagos conservation: not only protecting pristine nature, but also preserving the evolutionary processes that produced the laboratory over the past 3-5 million years.

The idea of “conserving evolution” is not an official written policy in the Galápagos, but is the guiding principle on which nature protection work has been organized. Although the focus on maintaining evolutionary processes resonates with Muir’s focus on preserving pristine wilderness, I move away from the terms that structured early twentieth century American debate between preservation and conservation (Nash 2001). I use the term conservation here rather than preservation for two reasons: first, because it is commonly used in the Galápagos; and second, because it speaks to a recognition of the human agency involved in landscape management. Although Galápagos tortoises are not managed as a resource for human consumption as they were once used—they are protected in the strict sense, unlike fisheries resources—they *are* managed. “Restoring the tortoise dynasty” (Merlen 1999), as this chapter shows, depends on an alignment of human and nonhuman labor through captive care and breeding as well as invasive species control to prepare island landscapes for the return of their native denizens.

The idea that Galápagos conservation is a matter of "conserving evolution" was first mentioned to me during an interview with Howard Snell, a University of New Mexico biologist who worked with Galápagos tortoises and land iguanas for more than 20 years and was Director of Science at the Charles Darwin Research Station in the early 2000s. As he explained, the Galápagos were an ideal model for conservation:

> Galápagos had all these things going for it: 95 percent of the biodiversity that was there was still extant. There were some local extirpations, but almost no species expirations whatsoever. And 97 percent was a national park. Small resident population. Not an economic mover and shaker in the country of Ecuador. Six hundred miles off the coast, so theoretically, you could have managed that as a very natural ecosystem, which at one time were the original park goals, which were not only to preserve the biological diversity, but also maintain ecological and evolutionary processes. Which is a very…what always attracted me to Galápagos and made me admire the national park was that at that time they actually explicitly—I don't know if anyone understood what they were saying, or if they understood what they were saying—but…because evolution was such a major thing in Galápagos history, they wanted to maintain evolutionary processes in an unaltered state. That sort of relates to your tortoise taxonomy question…as far as the national park was concerned in its early days, it didn't matter whether a separate island population was a species or a subspecies or not even taxonomically recognized, it was envisioned as first as sacrosanct because it was different or potentially different… I thought that was this wonderful model. In fact when I used to teach conservation modeling—I still teach conservation modeling—but I used to use Galápagos as the ideal model because you had the opportunity to save the islands' natural state and you could do it relatively easily because the numbers of individuals involved that had contrary interests were small. (Interview 1/29/12)

His quote draws together the islands' Darwinian history with understandings of the Galápagos as relatively pristine, isolated islands because of their small human population and few species extirpations. In addition to this unique opportunity to protect islands as a "very natural ecosystem," conservationists were also motivated by desire to preserve the islands' evolutionary history in an "unaltered state."[85] Snell's quote also reveals the politics inherent in

[85] The Galápagos afforded a unique opportunity opposed to Hawai'i, which was often raised in interviews as an example archipelago where conservationists were "too late" to protect the islands' original nature because of widespread species extirpations and a large human population.

conserving evolution as he positioned conservationists as working against those with "contrary interests."

When I subsequently asked other scientists and conservationists about "conserving evolution," they agreed it was an important focus in the archipelago. Linda Cayot, who directed CDRS's Herpetology program during the 1990s and now consults with the Galápagos Conservancy, explained that the focus of Galápagos conservation has always been about "conserving evolution, pristine nature, and species." She explained the link between a natural laboratory and the pristine:

> LC: If you get back to using Galápagos as a natural laboratory of evolution, the more you can return to a pre-human condition, the better that laboratory is…Basically what we do in conservation is to save biodiversity, save regions of the world...part of what makes Galápagos maybe also unique is that we are also saving the evolution. Everywhere in the world does that to a certain extent, and it's possible to do it more because it's islands, and each island is unique.
>
> EH: So is that because there are clear different pieces of evolutionary history to save, or because it's easier to manage isolated islands?
>
> LC: I think it's a combination. Geographic isolation of islands is what makes evolution so interesting on the islands. You could get the same kind of geographic isolation on mountain tops—they are island
>
> EH: —ecosystems—
>
> LC: —yeah. It's just Galápagos, because of the distribution of the islands, the distribution of the species, you already have a laboratory. Because of that same distribution, it makes conservation and management unique by island. (Interview 7/17/13)

As Cayot explains, Galápagos conservation is aimed not only at saving biodiversity, but also at saving evolutionary history. As both she and Snell mention, this is a matter of protecting a particular geography—the archipelago is comprised of individual islands with distinct evolutionary histories. So more than just preserving the evolutionary history encapsulated in measures of species or genetic biodiversity, Galápagos conservation also strives to save the environmental conditions that produced that biodiversity through processes of adaptive radiation among different islands. What they are alluding to are theories of island biogeography, formalized in the 1960s but dating to Darwin, that demonstrate why archipelagos are excellent places to study evolutionary processes. Because of the geographic isolation of islands, archipelagos provide ideal examples of allopatric speciation—the evolutionary process of the diversification of species due to spatial isolation (Quammen 1996, MacArthur 1967). The Galápagos giant tortoises are an excellent example. As shown in Figure 1, biologists have long thought that each major island in the Galápagos archipelago, and each of the five volcanoes on the largest island, Isabela, was home to a distinct population of tortoises (Van Denburgh 1914).[86] As Cayot and Snell both mentioned, this evolutionary theory of species diversification between islands was the rationale for always doing conservation island by island—this island-scale management of native species constitutes the basis of "conserving evolution."

As Cayot and Snell mentioned, the idea of conserving evolution is historically driven. By using evolutionary theory as a guide for nature protection, Galápagos conservation turns on a scientific rationale as well as cultural appreciation of wilderness to justify a "return" to pristine ecosystems. In the Galápagos, as elsewhere, restoration biology has become a major focus of conservation work (Fraser 2009). As Cayot explained, the goal of Galápagos restoration is to

[86] This belief goes back to Darwin—although he did not label the specimens he collected geographically, John Gould (who did the taxonomy of Darwin's Galápagos birds) and Thomas Bell (who worked on the few tortoises Darwin brought back) both pointed to the probability of diversification among island populations (Sulloway 2009). As Darwin later wrote in his published Beagle journal "I have not as yet noticed by far the most remarkable feature in the natural history of this archipelago; it is, that the different islands to a considerable extent are inhabited by a different set of beings. My attention was first called to this fact by the Vice-Governor, Mr. Lawson, declaring that the tortoises differed from the different islands, and that he could with certainly tell from which island any one was brought. I did not for some time pay sufficient attention to this statement, and I had already partially mingled together the collections from two of the islands. 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 nearly equal height, would have been differently tenanted; but we shall soon see that this is the case." ([nd, 1845, p. 373-374).

return the islands to their "pre-human condition" as much as possible. Although there are a variety of interpretations, technologies, and methods for doing restoration work, this broad goal has surfaced in official policy documents with a specific target date. In 2002, scientists and conservationists working with the CDF published a Biodiversity Vision for Galápagos that outlined the goal of going "Back to Eden":

> [The] ultimate goal is the restoration of the populations and distributions of all extant native biodiversity and of natural ecological/evolutionary processes to the conditions prior to human settlement. If this extremely ambitious goal were one day to be achieved, it would represent the pinnacle of accomplishment in conservation biology—the restoration of the biological nature of the Galápagos Islands almost to the conditions of 1534" (CDF and WWF 2002, p. 48).

Through this vision, the goal of conserving the "natural" evolutionary history of the islands is tied to the islands' prehistoric past. The year 1534 serves as a baseline for this vision because it was the following year that the islands were officially discovered by Fray Tomas de Berlanga, Spanish Bishop to Panama, who was becalmed in the archipelago while trying to sail to what is now Peru. This vision situates human influences in the archipelago as unnatural intrusions—no indigenous population evolved in the islands, so their natural history is not a peopled history. As the quote above explains, the complete restoration of the Galápagos to their natural, prehuman ecological and evolutionary conditions is "extremely ambitious," but nonetheless the motivation behind island conservation work.[87] When I asked Cayot how much it was possible to go back to a previous state, she said:

> I would say we go backwards...as much as we can...Those of us who work in conservation, our goals are to minimize the impact of humans on natural ecosystems where humans—in Galápagos it's easy, you can say pre-human

[87] This vision has been much criticized in the Galápagos because it failed to address any social issues in the islands (Hennessy and McCleary 2011); indeed, the accomplishment of this vision would in principle mean removing all human populations from the islands. This is something that has actually been suggested, but which many conservationists now distance themselves from. Subsequent visioning documents released by the Galápagos National Park Service and local government and NGOs all explicitly address social issues and call for management paradigms that stress sustainable socio-ecological futures.

> because humans only got there in the last few hundred years. In other places, it gets more complicated because you have to look at indigenous human populations, and they are part of the system. But in Galápagos it's crystal clear because humans weren't even there.

The idea of "conserving evolution" in the Galápagos combines both a pristine past and a scientific theory. Because science is understood as a direct representation of nature, the natural laboratory discourse justifies conservation as a return to the "natural truth" of the islands. The laboratory discourse further supports restoration efforts that aim to remove unnatural human influences that interfere natural processes of evolution, distorting the results of nature's experiments. To do this, however, requires the paradoxical situation in which human intervention is necessary to return to a prehistoric past. This requires a particular understanding of evolution and an exceptional view of conservationist agency as uniquely aligning with "natural" agency to mitigate the degradation caused by other human agency. The notion that evolutionary time could be refolded such as to return to a past state also reflects a particular interpretation of evolution—one that was frozen five hundred years ago and becomes less "natural" as humans are involved. This scientific framing is a cultural, moral, and political endeavor. This chapter examines how this scientific interpretation is applied to manage the islands, attempting to return them to their prehistoric state. I argue that through management efforts such as breeding tortoises and eliminating introduced species, this particular understanding of evolution is used not to restore, but to *produce* natures that fit the natural laboratory framework.

Evolutionary Biopolitics

> "…population will appear above all as the final end of government. What can the end of government be? Certainly not just to govern, but to improve the condition of the population, to increase its wealth, its longevity and its health. And the instruments that government will use to obtain these ends are, in a way, immanent to the field of population; it will be by acting directly on the population itself through campaigns, or indirectly, by, for example, techniques that, without people

being aware of it, stimulate the birth rate, or direct the flows of populations to this or that region or activity." (Foucault, 2007 [1978], p. 105)

To explain how scientific theories of evolution and island biogeography were operationalized as a rationale for conservation management, I turn to an emerging literature that frames conservation as a form of nonhuman biopolitics (Biermann and Mansfield 2014, Lorimer and Driessen 2013, Buller 2008, Whatmore 2002). This work builds on Foucault's work on the "art of government," which he explained as transitioning in the eighteenth century from the sovereign power of the monarch over territory, to the task of securing a population and its particular attributes. Scientific knowledge was central to this transition—particularly emerging biological understandings of life and the production of national statistics. This is what Foucault terms "biopolitics"—the "means by which the group of living beings understood as a population is measured in order to be governed" (Elden 2007, p. 573, Foucault 1984, 1994 [1970]).

Although Foucault was concerned with formations of social power, here I extend his analytic to attend to the role of natural science as a tool for producing knowledge to manage natural resources (also, Braun 2000). Reworkings of biopolitics to analyze the management of endangered nonhuman life explore how conservation practices order animal and plant life. This work examines the taxonomic technologies of treaties, databases, and practices of scientific knowledge production through which endangered species are defined, enumerated, and managed (Thompson 2004, Whatmore 2002). The enumeration and categorization of wildlife through technologies such as population surveys, endangered species listings, and stud books are a central element of conservation management, the strategies through which "nonhuman biopolitics" operate (Lorimer and Driessen 2013, Whatmore and Thorne 2000).

I use Foucauldian analytics to show how scientific frameworks for studying evolution were used as the basis for conservation management of giant tortoises. As referenced in the quote above, the basic unit of biopolitics is the population. In the Galápagos, the aim of conservationist government is to secure the health of populations of native and endemic species, their habitats, and the ecological and evolutionary processes that shape them. For the Galápagos tortoises—which are endemic, meaning they evolved on the islands and exist only there—the foundation of "conserving evolution" is that tortoises are managed by population, rather than by formal species taxonomies, which have remained in flux over the past century.[88] Linda Cayot explained that tortoise conservation has always been organized by the geographic distribution of species, rather than by taxonomy:

> LC: When I worked in Galápagos, I never worried about taxonomy because while everyone else was arguing, we did conservation more conservatively than the taxonomy.
>
> EH: Because you managed by populations?
>
> LC: Yes. And that is related to the question of conserving evolution. So, basically if you're looking at tortoises, what we try to do is make sure that the evolution of tortoises continues as close to historically natural as possible. So that means not mixing populations… Not mixing subpopulations… I think the way management is done in Galápagos is very focused on conservation of evolution…what we did with tortoises, because they are not like birds that fly all over the place—they have a restricted range, which is often determined by topography. We just managed at that level. (Interview 9/24/12)

To conserve the evolution of giant tortoises is at its most basic to manage the tortoises according to the geographical distribution of populations across different islands and volcanoes. This focus on populations makes a biopolitical analytic useful for understanding how pristine nature is managed. In the following sections, I analyze the technologies through which tortoise populations have been defined and managed, including: (1) surveys focused on estimating populations and observing ecological behavior; (2) nonnative species control and eradication

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[88] Formal taxonomies have remained in flux about whether Galápagos tortoises constitute fifteen distinct species or one species with several subspecies (Le, Raxworthy, McCord, and Mertz 2006).

campaigns; (3) captive breeding to boost tortoise population numbers; and (4) reintroduction of captive bred tortoises to the wild.

In doing so, I expand the emerging literature on conservation biopolitics by detailing not only these varied strategies for managing populations, but also the concomitant delineation of conservation territories, defined as “designated spaces of nature protection and resource management” (Zimmerer 2006, p. 8). Although Foucault was notably inattentive to issues of geography (Gordon 1980), the same methods he used to analyze the production of populations can be applied to understand the construction of governable territories (Elden 2007). As Elden explains, “the same kinds of mechanisms that Foucault looks at in relation to population are used to understand and control territory” (2007, p. 578). “We can therefore read the strategies applied to territory in terms of its mapping, ordering, measuring, and demarcation, and the way it is normalised, circulation allowed, and internally regulated as themselves calculative” (ibid). The Galápagos tortoises are an excellent case to think through the relationship between population and territory because the two concepts are inseparably linked in evolutionary theory. As Foucault noted, “Darwin found that population was the medium between the milieu and the organism” (2007 [1978], p. 78)—that is, environmental influences impact evolution by acting on the population rather than individual organisms.[89] The population and environmental territory—or species niche in ecological parlance—emerge in relation. For tortoises, niches have been defined in accordance with theories of island biogeography, as entire islands or volcanoes—because of the animals’ inability to migrate between islands or volcanoes, tortoise populations have limited

[89] This is in contrast to Lamarck, who posited that environments work directly on individuals, who are able to pass on acquired traits to their offspring. This thesis has been much ridiculed over the past century but is gaining new traction as scientists are now able to trace direct environmental impacts on gene regulation.

ranges and have evolved separately.[90] Through work focused on protecting the historical isolation of these species, conservationists have produced territories managed with the goal of restoring pristine nature—from entire remote islands like Pinta uninhabited by humans to the reserve created to differentiate "tortoise country" from agricultural land in the highlands of Santa Cruz Island.

In addition to highlighting the co-production of conservation objects and territories, a biopolitical lens also points to the human subjectivities that emerge through orderings of nonhuman life (Lowe 2004). By analyzing the labor and politics of conserving tortoises, the chapter explores these human subjectivities—from classifications of local settlers as threatening to wildlife to the politics of knowledge production that differentiate foreign scientists from Ecuadorian and Galapagueño conservationists.

In the following sections, I explore the coproduction of human and nonhuman populations and conservation territories by analyzing four components of tortoise work in the Galápagos: population surveys, invasive species eradication, tortoise breeding and reintroduction. I detail the various forms of biopower used in these methods—from the power to make certain species populations live through breeding and pastoral care to the sovereign power of eradication programs that take the life of other species. Exploring the co-evolution of natural categories, territories, and subjectivities points to what Stefan Helmreich terms "symbiopolitics"—the "governance of relations among entangled living things" or more specifically, how microbial ecology shapes biopolitical strategies for understanding and managing life (2009, p. 15). But rather than build off theories of microbial co-becoming, I

[90] Recent telemetry monitoring and genetic work is redefining species ranges, however, by showing that they are both limited to certain areas on particular islands and that tortoises in other areas are able to move among volcanoes.

explore the politics that emerge through attempts to bifurcate nature and culture, to conserve past evolution rather than let nature and culture co-become in new and unpredictable ways.

Population Surveys

When conservation efforts in the Galápagos began in the early 1960s, protecting giant tortoises was a primary concern. With *in situ* conservation efforts, the dominant form of human power over the life of the species shifted following centuries of natural history collection and predation by sailors. By collecting tortoises, naturalists exercised a sovereign power over nature by killing and taxidermying prized species—a form of what Foucault described as the sovereign power to "take life or let live" (1984, p.136). Rather than preserving species in museums, conservationists wanted to see them thrive in their natural habitats. What is at stake in this new form of power is "the biological existence of a population…power is situated and exercised at the level of life, the species, the race, and the large-scale phenomena of population" (1978 [1990], p. 137). Protecting tortoises was a pastoral form of biopower that positioned conservationists as shepherds taking care of their herds (Foucault 2007). To exercise power at this species level required knowledge not only about where populations still existed and how many animals were there, but also what was threatening their ability to survive.

Scientists and conservationists spent months in the field surveying populations of giant tortoises—the most detailed fieldwork conducted since turn-of-the century collecting trips. In the 1890s, dire reports from naturalists about the fate of tortoises after centuries of predation by whalers and pirates spurred Lord Walter Rothschild to commission two expeditions to the Galápagos to collect endangered fauna. In 1905-1906, Rothschild's lead collector, Rollo Beck, led another Galápagos expedition, this time for the California Academy of Sciences. His crew visited almost every island, collecting tortoises wherever possible. They brought 264 tortoises back to San Francisco, where CAS herpetologist John Van Denburgh used the collection to issue the definitive report on the species in 1914. Van Denburgh—and others after him—reported that several of the tortoise species were extinct or in immediate threat of extinction (1914, Townsend1925).

In the 1960s, survey trips revealed that the status of the tortoise populations was not as grim as earlier proclamations made them sound. When in situ conservation began in the 1960s, conservationists set about accumulating the statistics on tortoises through which the health of populations could be judged and managed. During the early years of the CDRS and GNP, conservationists spent considerable time in the field conducting surveys to estimate the status of the endangered species they had taken on the mission of protecting. One of the first directors of the CDRS, an Englishman named Roger Perry, hired Miguel Castro, an Ecuadorian resident of the Galápagos, to do much of the fieldwork. Castro would go out with local fishers who dropped him on different islands as they worked. When the first two Galápagos National Park Service guards, Juan Black and José "Pepe" Villa, arrived from a forestry school on the Ecuadorian continent in 1968, Castro spent nearly two years training them in the field (Villa Interview 9/27/11). As Villa explained,

> JV: Miguel Castro is probably the most important person speaking about the tortoises of the Galápagos. He took us to the field. We were visiting all the islands with Miguel. We went to see the situation with Miguel. He trained us in field work… The tortoises were our main focus. I was living on James [Santiago] for 5 months, behind the tortoises. The same of the volcanoes on Isabela, I was living on each of them.
>
> EH: What kind of work did you do?
>
> JV: Trying to have the first map of where they are, what are they doing? What were the trails they were following? Where are the nesting zones? How successful is the hatching of these animals? What are the difficulties, the enemies they have? Rats in some places, pigs in some places.

Villa, Black, and Castro were among several people who collected basic information about tortoise reproduction and ecology. The work was often harrowingly difficult as the men spent months at a time living on remote islands. As Villa recounted, “the conditions were very bad, we didn't have any equipment, we didn't have any communication. Sometimes we didn't even know when we were going to come back” (Interview 9/27/11).

In 1968, a young American ecologist, Craig MacFarland, began a long career in the Galápagos by studying tortoises (he would later direct the CDRS). Working closely with Castro, MacFarland spent two years living in the field collecting this information as part of his dissertation research. When MacFarland started out in the field, he had planned to do “pure” ecological research comparing two sample populations, but soon realized these studies were not working well both because of the difficulty of fieldwork and because conservation concerns were more pressing. He told me that instead of his original plans,

> CM: I thought—I want to do core things. I want to see as many of the populations as possible on all the different islands… I mean, I wanted to do some of this ecological stuff, but I also want to begin to see what status are the different populations in? Which populations—some rough idea of how many there are, and, second, are they reproducing? If they're copulating and reproducing, are the babies—some reasonable percentage surviving? I know the majority die because that is a normal thing when anything is produced. Get some idea that there is survival so that when the older ones die the younger ones are building up. When I look at the populations I want to get some sense of full size adults—males and females and then juveniles and all the way down to young ones coming out of the nests. I want to find nests and see how they operate. So I said, I want to do some stuff on basic natural history: How does a population work and what does it do? Where do they nest? How do they make the nests? How long does it take from the time the females put the eggs in and create the nests? On different islands does it happen in different parts of the year or the same seasons? Does it take a longer period of time on a drier island or a higher island? Where do the ones on a higher island go to make their nests—do they go down to where there is more sun? Those kinds of questions. (Interview 5/25/12)

This ecological and reproductive knowledge about the health of tortoise populations was the basis for the pastoral project of conservation aimed, in Foucault's words, at "the salvation of the flock" (1978 [2007], p. 126). To keep tortoise populations healthy and reproducing, conservationists needed to understand their reproductive behavior as well as what habits tortoises preferred, what plants they ate, and how these processes interacted with other species—not only predatory Galápagos hawks, but also introduced goats, wild boar, rats, and feral cats and dogs.

To monitor tortoise populations, conservationists established a surveillance system. To estimate population sizes, scientists and park staff would mark tortoises with individual numbers by making a series of notches in their carapaces. The system allowed conservationists to classify tortoises according to threat levels. After his reconnaissance of the islands with Castro, Villa, and other park guards—the most thorough work on tortoises since Rollo Beck lead the CAS team in 1905-06—MacFarland reported in 1974 that the dire reports about the species that had spurred conservation efforts had been overblown: "The giant tortoises demonstrate in many ways the numerous actual and potential threats to the Galápagos ecosystem. However, the seriousness of the situation in the Galápagos has been somewhat overstated" (1974, p. 118). Eleven of fifteen original species survived, three of which seemed to be healthy in the wild. The other eight, MacFarland concluded, were threatened with extinction "by one or more of the following: (1) greatly decreased population size; (2) predation on nests and/or young by introduced pigs, dogs, cats, or black rats; and (3) competition for food resources with feral populations of goats or donkeys."

MacFarland also mapped zones of existing tortoise populations, delineating areas of future research and conservationist intervention. These population surveys mapped tortoise populations to particular places, thus producing the islands as management territories.

Tortoise Discoveries and the Politics of Knowledge

Through these population surveys conservationists made two major tortoise discoveries. The first was that the tortoise population on San Cristobal—which had long been home to settler colonies—was not extinct as had been thought. Pepe Villa recounted how he and another park guard found the animals after talking with local fishers (who spent long stretches of time in remote corners of the archipelago) who mentioned seeing the animals there. As the second park guard recounted,

> When we went to San Cristobal, there the tortoises were definitively gone… We had searched for a day and nothing. Two days and nothing. Miguel had told me that for each tortoise we encountered, he would give me 100 sucres. The third day, nothing. The fourth day, I was on a little peak—we always changed our routes for searching—there was nothing, but then there was a little peak with a small crater. About 1pm we were eating lunch. I was eating and I saw below us that there were some little shade trees that looked very nice, so I went to see what was below them. There was a little lake. I walked a little and found an excrement, but I didn't say anything to Miguel because he was still eating. But I went down to the open part, it was very green, and there was a tortoise. Then I said, "Venga, aqui hay una tortuga!" [Come here! There's a tortoise!] We walked further and found another. We found nine that day. (Interview 3/1/12, my translation from original Spanish)

Finding these tortoises isolated on the dry terrain of northern San Cristobal was an important conservation discovery. Because the three guards witnessed the existence of the tortoises the animals became recognizable to conservation. While these men took fishers' earlier reports of the tortoises seriously, the fishers' knowledge had to be verified. But the discoveries these Ecuadorian park guards made in the field were not always taken seriously by foreign scientists. Pepe Villa told me of a trip to San Cristobal in 1970 in which he saw 500 tortoises. When he returned, he said, "Everybody looked at me and said, what are you speaking about?" The production of knowledge about tortoise populations was a point of tension between the Ecuadorian park guards and foreign scientists. Villa explained, "This was a problem for us—

trying to explain to foreign people that we were in the field and found several things…They never believed us because we were Ecuadorians. This was a very difficult situation for us" (Interview 9/27/11). Villa continued, explaining that the park guards had close working relationships with foreign scientists who lived on the islands and ran the CDRS. The problem, he said, was working with visiting foreign scientists:

> Visitors were the problem...It was a like a hotel. They always were coming here looking for rights. What are the rights? Most of them came from some organization…they gave some money to the foundation annually. And these scientists came here and they had the right to be here. And we had to say, ok, you have to do this, this [explaining field protocols]. And everybody is working for you. That was terrible. The visitors. You think about the colonization, it's terrible. We were living somewhere special. Special histories. They came and everybody is working for them and everyone has to prioritize information. We were working on tortoises, and it was difficult, working on tortoises. To see the temperature on the equator, to weigh the eggs. They came here and they took all the information. We put all the information. That's what they were doing all the time. They want to go to the field, we have to go to the field. We have to take the water. And they were just like the films you see about Africa… That was Galápagos. They thought that it was something, that the information belongs to them. It wasn't for us.

From Villa's perspective, visiting scientists felt entitled to work in the islands and extract knowledge to benefit their careers, while often treating Ecuadorian conservation workers poorly as field hands rather than respecting their role in knowledge production—a subjugation he compared to African colonization. Villa and other park guards were valuable in the field because of the extensive knowledge of the different islands they had gained during years of survey work. But because they were not trained scientists and did not collect data in what was considered an appropriately systematic scientific way, their work often went unrecognized and their claims about finding new tortoise populations were at times met with disbelief.

The park guards also had a different perspective on discoveries because their field experience had conditioned them to finding numerous tortoises even in areas where they were thought to have gone extinct. The case of Lonesome George, the last Pinta tortoise, is telling. In 1971, several guards working with a Hungarian-American macologist, Joseph Vagvolgyi, on Pinta came across a giant tortoise on the island. As Pepe Villa told me, Vagvolgyi—who did not know the islands' tortoises were supposedly extinct—mentioned seeing the tortoise, so the guards went to check it out:

> We saw the animal there and said, ok, that's ok. We have to go inside to sleep, but surely there are some others… for us it was very natural. We were just doing these explorations and that's what we found. After there was a person who was interested in going there and he had money—now there was money to get a boat—so they went there about a year later and brought [George] back.

As Villa explains, finding the tortoise that would become world-renown as Lonesome George was not particularly striking to them because they thought that where there was one tortoise, there were bound to be more as there had been on other islands. But when the person Villa mentioned—Peter Pritchard—organized a return trip to Pinta, George was the only tortoise the park guards found. In a narrative of the experience, Prichard wrote of the personal significance of finding the tortoise:

> The Pinta tortoise was not just one of about fifteen subspecies of giant tortoise in the Galápagos Islands; to me, it was the focus of a boyhood dream. Thirteen years earlier, when I was a turtle-obsessed teen-ager in, of all places, Northern Ireland, my parents had given me a copy of Albert Gunther's classic monograph *Gigantic Land Tortoises*, published by the British Museum in 1887. This ponderous Victorian work was liberally illustrated with enormously detailed engravings of various giant tortoises and their bones. But the one that caught my attention showed a peculiar beast whose shell looked more like a wrinkled, leathery mantel than a true carapace, and whose long, stout neck, raised straight up, carried a tiny head with expressionless eyes…I resolved that some day I would lead an expedition to try and find any survivors of this prehistoric-looking creature. (1977, p. 91)

Inspired by past centuries of British natural history exploration, Pritchard, who is today a world-renown advocate for turtle conservation, felt compelled to visit the Galápagos. As he explained to me:

> The Pinta tortoise is very distinctive. Gunther's engravings of it made me think this is something I need to go and find. When I first went to Galápagos no one was thinking about Pinta at all because it was far away and there was too much to do close at hand. It was a year after I first went that the animal was found. I had thought for some years, why don't we at least go and look and see if there were any tortoises there? I got there a bit late because there was only one left by the time I got there …The bad guys had been there. (Interview 6/12/12)

When Pritchard first arrived in 1970, conservationists had been surveying the islands for tortoises and eradicating introduced goats—including on Pinta—for several years. In his account above, published in *Natural History*, he becomes the hero who "saved" Lonesome George by having him brought into captivity. The park guards who found George a year after Vagvolgyi's sighting are barely mentioned. In the article, Pritchard recounts the history of Western scientists' work on Pinta tortoises, positioning himself as part of this cannon. The role of Ecuadorian park guards, who had been on Pinta hunting goats, is marginalized into the shadows of introduced species control work, rather memorialized in the annals of scientific exploration. But it was the park guards' hunting and survey work that enabled the production of much of the era's scientific knowledge of tortoises. In the next section, I explore their work on introduced species control and eradication.

Introduced Species Control

Since the Galápagos National Park and Charles Darwin Research Station were founded, introduced species control across the archipelago has been one of the major, and most labor-intensive, forms of conservation work. From the 1960s through the 2000s, a cadre of park guards spent the majority of their time in the field. As they surveyed endemic populations, they also hunted introduced mammals. To protect the health of prized tortoise populations, conservationists implemented a two-faceted approach: controlling competing and predatory introduced species and breeding tortoises in captivity to help ensure the survival of young hatchlings. These strategies used evolutionary interpretations of the "naturalness" of different animal populations to judge which animals should be saved and which were to be made killable. Biosecurity in the Galápagos is a matter of protecting native biodiversity. Conservationists contrasted the endemic tortoise species, which, as Darwin wrote in his *Beagle* journal, must have evolved their differences on the different islands[91], with internationally ubiquitous goat and rat populations that were "unnatural" because they did not evolve in the islands, but were introduced, intentionally or not, by sailors and settlers.

Distinctions between endemic and introduced species, or native and alien biodiversity, reflect a division between nature and culture—as Stefan Helmreich writes, the categories of native and alien species are defined relationally—that which is alien is anything that is not native. In this framework, native species are aligned with nature and alien species are associated with culture (2009, p. 149). In the Galápagos, conserving evolution turns on controlling the biological threat of alien species to allow pristine nature to thrive. Nature is to be purified of culture. But these are not stable nor easily distinguished categories—the work of producing pristine nature by controlling introduced species requires new entanglements of natures and cultures—from the labor of hunting to the manipulation of animal biology. In this section, I analyze the classifications, moral judgments, and labor involved in the sovereign power to take the life of alien biodiversity.

When MacFarland published his tortoise survey and ecological studies, he included information on the key threats to the populations. As shown in Figure 5, below, he also surveyed introduced species populations on each island and how they interacted with tortoise populations.

[91] Endemic means the species is found no where else on earth. Galápagos tortoises are considered a different species family than the giant tortoises in the Aldabra Atoll in the Indian Ocean—making them endemic to the islands. In contrast, blue footed boobies, while often associated with the Galápagos, also occur on the Ecuadorian coast, making the Galápagos resident populations native, but not endemic to the islands.

He wrote that “exotic predators and competitors are now the greatest threat to the tortoise populations. It is difficult to quantify the population sizes of these species, but their distributions are now well known; one or more occurs in every area inhabited by tortoises” (1974a, p. 122).

Table 3.1 Introduced Species/ Tortoises

Island (English name)	Tortoise Species	Pigs	Dogs	Cats	Black rats	Goats	Donkeys	Cattle
Pinta (Abingdon)	*Chelonoidis abingdoni*					*x*		
Santiago (James)	*C. darwini*	*x*			*x*	*x*	*x*	
Pinzón (Duncan)	*C. ephippium*				*x*			
Santa Cruz (Indefatigable)	*C. porteri*	*x*		*x*	*x*	*x*	*x*	*x*
Santa Fe (Barrington)	Undescribed							
San Cristóbal (Chatham)	*C. chathamensis*		*x*	*x*		*x**	*x*	
Española (Hood)	*C. hoodensis*					*x*		
Isabela (Albemarle)								
Volcan Wolf	*C. becki*			*x*	*x*			
Volcan Darwin	*C. microphyes*			*x*	*x*			
Volcan Alcedo	*C. vandenburghi*			*x*	*x*		*x*	
Volcan Sierra Negra	*C. vicina*	*x*	*x*	*x*	*x*			*x*
Volan Cerro Azul	*C. guntheri*	*x*	*x*	*x*	*x*	*x*	*x*	*x*

*very small population
Source: Adapted from MacFarland, Villa and Toro, 1974a

He estimated some introduced population sizes to be quite large—30,000 to 40,000 goats on Pinta Island and 4,000 to 8,000 pigs on Santiago. MacFarland published a series of photos of tortoise nests destroyed and young tortoises eaten by pigs, rats, and feral dogs.[92] The sheer numbers of goats threatened the health of island vegetation through over-grazing—leaving little for shorter, less mobile tortoises to eat. Goat populations often grew rapidly with plenty of vegetation and no natural predators—becoming invasive and overtaking other species’ ability to

[92] Such photos are a common trope of conservationist publications in the islands.

survive. In the early 1970s, CDRS Director Peter Kramer presented a paper at the AAAS that laid out the goat problem on Pinta Island:

> The alarming proportions of the goat problem can be judged from the example of Pinta. Three goats were introduced to this island as recently as 1957, shortly before the Darwin Station was set up; yet, since 1971, the Park Service has shot no less than 30,000. There are still far too many left but thanks to this policy the vegetation is recovering very well considering the severe degradation; at least danger of erosion on Pinta's steep slopes seems to have been averted. The case of Pinta demonstrates dramatically the importance of the time fact. Measures to control introduced organisms and to prevent further introduction must be given the highest and most immediate priorities (1974).

Kramer alludes to the belief that goats were introduced to Pinta by sailors who would return to the islands and relied on growing populations as food.[93] In becoming "invasive," the passive agency of species "introduced" by people transforms through hyper-fecundity into a natural threat to "fragile" island ecosystems. By adapting too well to island ecosystems, these alien species threatened the "natural balance" attained through hundreds of thousands of years of evolutionary history. The problem of invasion does not fit neatly into classifications of culture or nature, but emerges only as they are intertwined.

Although MacFarland did not consider local populations to be a considerable threat by the early 1970s, other conservation reports classified settlers as an additional population to be controlled and educated. Island residents were also classified as threatening to native fauna. As one early CDRS progress report explained:

> "Local Population. The population of the islands has tripled since 1960, and now numbers approximately 5,500. Immigration was heavy from the late 1950s until recently, and, as pressure for land ownership increases in continental Ecuador, this factor could become important again. At present a strong population growth

[93] This was common practice throughout the eighteenth and nineteenth centuries and continued by Galápagos settlers and fishers—during the nineteenth century about 200 people lived on Santiago, supported by a small salt mine. Local fishers stopped on Pinta during long trips in the north of the archipelago—sometimes relying on tortoises for food, as was common practice among settler colonies.

> results from a very high birth rate coupled with a decreasing death rate due to improved medical care. The lack of natural resources would eventually restrict the spread of population, but several uninhabited islands and areas on the inhabited ones are arable and have been threatened recently. This situation will rapidly worsen if the population is not controlled." Peter Kramer, Galápagos Conservation: Present Position and Future Outlook Reprint of paper read at American Association for the Advancement of Science. (Director CDRS 1971-1973)

When Villa and other conservationists first arrived in the islands, they had to convince local settlers not to eat tortoises. On Santa Cruz Island, where the CDRS headquarters is, conservationists collected the tortoises settlers kept as "pets" and protected a large reserve of "tortoise country" near land where settlers farmed. Creating the boundary between social and natural spaces was a contested practice. Tasked with demarcating the park boundary on Santa Cruz, Pepe Villa spent months hiking and camping while he negotiated with farmers, one of whom, he said even shot at him. For Villa, working with the fishers was easier: One aspect of this was teaching local residents not to kill tortoises.

> PV: It's like with any social problems, we have to go with…baby steps. You have to convince them. Discuss with them. I was in the field and I know how it is. That happened to me -- I was in the afternoon and I don't have nothing to eat. All I have is some terrible water. Nothing to eat. They [fishers] decided OK, after being there too many days, hungry, they kill these animals to eat. We never did it. But when you are in the field working like this and you have nothing, and the only thing moving to eat is a tortoise. But when I was discussing with them, these fishermen, …in that time, the fishers were people from the Galápagos and were very nice people. They explained to me, look, I have this problem: I can see 20 tortoises. If I kill one, there is no problem. That's explained to me. I said no, we can't kill any of theses animals. And they say ok, I know I can't kill any. I try to avoid. But, sometimes I kill one. That is more or less. I can accept, but we have to avoid, avoid, avoid. How to do this? …Think about it, in that time, you can't go to the market to have some other food to take with you. They didn't have that. Cookies, they didn't have cookies. They need to eat something. They don't have fresh fruit. That was the problem. … But nobody understands. In all the [scientific] papers, I found 'they killed an animal here.' But what is behind this? That's how the school taught me to handle conservation. It's necessary to work with people. Nobody knows how to work with people [today]. Rules, rules are

> nothing. Here you have to work with people and there were very nice people here in the Galápagos at that time. (Interview 9/27/11)

To carry out the charge to control introduced species, park guards conducted long-term hunting campaigns, particularly targeting goats and wild boars. For example, for seven years during the 1990s, Linda Cayot, as director of herpetology at CDRS, directed a team of guards who spent the majority of their time on Santiago hunting pigs. As one of these guards explained to me, they would go out on campaigns that usually lasted about 20 days, setting up camp at different *casetas*—small field houses—usually three men in each of eight camps. The guard told me he loved hunting, loved being out in the field. The men hunted at night, when the boars were out, with dogs who would sniff out the boars and chase them. It was difficult work in the beginning, without much gear besides boots and knives, and dogs who were scared of the boars' tusks. But on a good night, the small group might kill six or seven boars.

While some park guards enjoyed the camaraderie and simplicity of field life, the work was difficult for others. Pepe Villa described the extent of his fieldwork hunting in the late 1960s and early 1970s, naming the many sites he visited:

> We extended to James. To the South of Isabela. To the north of Isabela, Piedras Blancas. We were killing animals, goats. Most of the travel was killing goats. We eradicated them totally from the small islands -- Barrington, Rabida, Marchena. We killed all the animals there. That was terrible. At the beginning it was difficult, absolutely difficult to kill the animals. But after some travels we killed more than 100 in a day.
>
> EH: Why was it difficult? Was it hard to find them? To catch them?
>
> No, it's difficult to kill an animal. To see blood, that stuff. We killed most of the animals only with a knife… We were killing animals all the time. That was our profession. To kill animals. At the beginning it was difficult, really because we'd just come from school. Probably I couldn't do it now. But in that time we killed all the animals. In Pinta we killed thousands of animals. When I was living in James [Santiago] we killed pigs. We started shooting them, then we started using machetes. Then finally we killed them with a stone. That was an exercise, very interesting exercise. To teach the other people was difficult. They avoid to kill

> animals. They don't like. Most people were from rural areas and they love animals. So I remember in the training how to kill these animals because he had to kill them. I remember I took some cats and small animals and I had my knife waiting so they have to learn that we have to kill. People from rural areas don't like to kill animals. I wrote a lot about this in that time, how to kill animals, why to kill animals. It's not easy. It's only for scientists, botanists saying that these animals destroy all the vegetation. But for us it's not the same. People living in rural areas, we love all these kinds of animals. We raise these animals. We didn't want to kill them. It's difficult to understand the business. We have to kill them. We were doing this. Nobody wanted to hear about this when we went for vacation. I avoided to speak about this, only with my friends, when we were drinking would we talk about how we kill animals. (Interview 9/27/11)

Killing animals at this scale was not the kind of conservation work Villa's forestry school prepared him for, but it was something he had to train other park guards to do. By describing his personal discomfort with the slaughter, he points to different understandings and engagements with nature between the "rural people" he identified with and the scientists who were directing conservation efforts. For Villa, the willingness to frame species commonly kept by rural households as killable en masse as an invasive threat, rather than for consumption, distinguished foreign scientists from local Ecuadoreans. His quote demonstrates his uneasiness with being forced to shift his conception of nature when the majority of his job was not about teaching people to manage their use of scarce resources, for which the forestry school had prepared him, but teaching fellow conservationists to kill in the name of protecting wild nature.

Killing nonnative species was central to the production of pristine islands. To restore the Galápagos to its "natural state" required removing species that did not evolve there. On small islands, Villa and other guards were able to eradicate goats completely in the early years. But on larger islands where introduced populations were much more difficult to eliminate, conservation efforts focused on control rather than complete eradication. This was an unending, Sisyphean task, and kept park guards employed during more than 30 years of hunting campaigns. The production of “pristine” evolutionary nature necessitated thousands of hours of continual human labor (all of which was to be kept out of site of tourists).

When Linda Cayot and I discussed the human role in producing Galápagos landscapes, she told me of a “heckler” who questioned her about the ethics of goat campaigns during a lecture she gave in California:

> The heckler was sitting way back in the auditorium and kept asking questions about killing goats and why we would do that, the whole right to life for goats. And basically, they would say, aren't humans part of the ecosystem and we put the goats there, so if we're part of the ecosystem then that is a natural thing. My argument is that we are part of the ecosystem, and as much as the people who put the goats there, the people who do conservation work are part of the ecosystem too. It all depends on what your goals are. Those of us who work in conservation, our goals are to minimize the impact of humans on natural ecosystems where humans—in Galápagos it's easy, you can say pre-human because humans only got there in the last few hundred years. In other places, it gets more complicated because you have to look at indigenous human populations, and they are part of the system. But in Galápagos it's crystal clear because humans weren't even there. (Interview 7/17/13)

For Cayot, the appropriate role of people in the ecosystem is a question of moral goals. For her, conservationist intervention in an ecosystem to return it to a previous, unpeopled state is justified. The wholesale slaughter of goats is also justified because of their social history as a species humans introduced to the islands. They are not endemic nor native, but exterior to the project of conserving “natural” evolution, thus making them not only dispensable, but a menace that had to be eliminated. Nature-culture entanglements are necessary to the goal of restoring the pristine.

Goats have earned the ire of conservationists not only through their relationship to human agency, but also because of their own agency. Goat grazing has had devastating effects on Galápagos landscapes—in places, particularly on Volcan Alcedo on northern Isabela, nearly denuding all vegetation. This destructive behavior coupled with prolific reproduction made goats threatening targets that conservationists sought not only to control, but to eradicate completely. In the early 2000s, the nature of introduced mammal control in the Galápagos changed dramatically as the Global Environmental Facility supported this conservation mission. Spurred by a series of photographs comparing Alcedo "before goats" and "after goats"—which showed grassy fields transformed in to a bald, over-mowed lawn—the Global Environment Facility (GEF) granted the CDRS $15 million for a large-scale mammal eradication project.

Project Isabela

"Project Isabela," as the eradication campaign was called, ran from 1998 to 2006. With GEF funds, conservationists eradicated goats and pigs on Alcedo and the other northern volcanoes of Isabela and also cleared Pinta and Santiago of remaining mammal populations. A Galapagueño conservationist explained the significance of island eradication programs:

> They were believing that it was impossible to get rid of pigs, it had never been done before on an island that size. And we did it. After we did the pigs, we started on the goats on Santiago. Then we also started on the goats on Pinta. Pinta has a small remnant population that hadn't been able to be eradicated. So we started implementing the Judas goats program and training the hunters, because they had been hunting in a very folkloric way, to say the least.
>
> EH: Why do you say that?
>
> They didn't have proper equipment, they didn't have any strategy. They were just going and shooting whatever moved, without doing anything in a systematic way. We changed that, started doing it in a very systematic way. We got rid of the pigs on Santiago, the goats on Pinta, and then we started on the goats on Santiago. Why we were doing that is because for once we were developing at the same time the GEF project, which was the funding for the larger part of the campaign. But the GEF didn't want to give us the money only for goats, so we needed a more comprehensive project. So it became a $15 million project for invasive species in general in Galápagos. (Interview 10/31/11)

The GEF program fundamentally changed the labor practices of mammal eradication in the islands—instead of "folkloric" hunting methods, three park guards were sent to New Zealand to train with sharp-shooting experts. One of these guards, Washington Tapia, who now directs the PNGS's conservation efforts, explained:

> EH: The hunting on Project Isabela was different than normal?
>
> WT: Yes, of course, it had to be because one of the things I understood when I was working with the hunting group [on Santiago] is that by land we were never going to succeed—it was impossible. Every month we killed 3,000 or 4,000 goats, and we when we came back it was like nothing had happened. So from this is when we began thinking that we needed a large project and that the objective would be eradication [rather than control]. We looked for other methods and through some publications found out that in New Zealand were specialists in hunting with helicopters. So three people went to receive training to understand how it functioned and once we were there we said yes, this is what we need.[94]

The hunters were trained to use automatic rifles to shoot out of helicopters, which sped the process and allowed them quick access to difficult terrain. All the kills were geo-located with GPS units and mapped. The team used trained dogs to locate goats. To find difficult-to-reach populations, the team used "Judas goats" tagged with radio telemetry devices which would seek out a pack, leading the hunters to a group to kill. They also used "Mata Hari" goats—females tagged and manipulated into permanent estrus to attract males. A total of 152,292 goats were eradicated on Isabela and Santiago islands. On Isabela, with a large number of goats, the cost per kill was $47.91. On much smaller Pinta, with fewer goats, it was $1,290.63 per goat (Lavoie, Cruz, Carrion et al., 2007). Hunters also killed 1,235 donkeys on the two islands. These methods not only introduced highly technical, and expensive, hunting methods that reshaped park guard labor practices. They also manipulated the biology of invasive species, turning the nature of the species against itself.

[94] Interview 2/22/12. My translation from original Spanish.

The project sparked controversy among local goat hunters in the islands who provide meat for the residents; they were upset that they had not been employed to help kill or process slaughtered animals to sell as food. I asked Cayot why most local hunters had not been involved:

> EH: I've done interviews on Isabela and people grumble about why more hunters there weren't used. Why was the meat all left?
>
> LC: Yeah, the meat one is a pretty easy one. In the hot season, meat rots within two hours. This gets back to the thing I was saying about pigs—if your goal is eradication, you don't have time for anything. If you were going to kill 100,000 goats and take the meat off and have a refrigerator ship down at the coast, your helicopters would be—
>
> EH: —doing that constantly.
>
> LC: Yeah. And the ecological argument is that everything the goats are came from Alcedo. They should stay there. All the chemicals, everything….what I'm saying is the nutrition—the nutrients should go back into the system. If you take out 100,000 goats, I don't know what you're taking out of that system, but it was in there before. But the main reason is that you can't do that with eradication. We had hunting groups—we had so many people who wanted to do this for us 'oh, just give me…' and nobody got it. Nobody got the difference between killing the first 90 percent and the final 10 percent. Everybody could kill the first 90 percent, that's easy. It's the final 10 percent that's really hard. And you can only get there if you kill the first 90 percent really, really fast. (Interview 9/28/11)

Local hunters lacked technical training in "precision hunting" methods. Cayot said they also did not understand the need to completely eradicate the species—the difficult "10 percent" that made hunting with helicopters and Judas and Mata Hari goats necessary. In response to questions about why goat carcasses were left on the islands, Cayot said it was partially a logistical problem about removing them from hard-to-reach places in a timely manner. But she also made an ecological argument that the nutrients from the goats' bodies should be left in the ecosystem. While alive and grazing, the goats were considered a dangerous, unnatural threat to island ecosystems. But in death, their "unnaturalness" changed as the nutrients in their decomposing bodies was deemed a resource that should remain in the ecosystem.

As these projects demonstrate, goals to conserve natural evolution in the Galápagos have long rendered unnatural animal populations killable. The morality of doing this labor, as well as the technical training involved in Project Isabela, have become further axes that distinguish the subjectivities of conservation workers—both from scientists and local hunters, but also from each other as some were trained in high-tech eradication methods and others were not. Attention to the work of introduced species control highlights the labor and politics involved in the conservation of pristine landscapes. Even in this isolated archipelago, the pristine is produced only through dense entanglements of nature and culture.

Breeding

While considerable labor has been directed at taking the life of introduced species to purify landscapes, "making live" endemic tortoise populations has also involved dedicated labor over the past half century. Since shortly after the CDRS was dedicated in 1964, scientists and conservationists have bred tortoise populations in captivity at the Santa Cruz headquarters. In 1965, the giant tortoise breeding project began when CDRS staff brought Pinzon eggs back to headquarters following a survey trip because eggs and juveniles were susceptible to rats that had invaded the island. They incubated the eggs and then raised hatchlings until they were large enough to withstand the rats. In 1966, CDRS staff brought the first adult tortoises to headquarters to breed—they were from Española Island, where there were so few remaining tortoises that scientists feared the remaining animals would not find each other in order to mate. Over the next decade, with substantial funding from the World Wildlife Fund (WWF, now the World Wide Fund for the Conservation of Nature), the *Centro de Crianza de Tortugas Gigantes* [Giant Tortoise Breeding Center] expanded to captive breeding of eight different populations of Galápagos tortoises. Today, in addition to the original center on Santa Cruz Island, two others have been built to raise tortoises on Isabela and San Cristobal Islands. Over the past forty-five years, the Galápagos giant tortoise program has become one of the most successful captive breeding and reintroduction projects in the world. Nearly 6,500 juvenile tortoises have been raised in the centers and returned to their home populations. On Santa Cruz and other accessible islands, park guards also protect nests in the wild so boars cannot get the eggs, returning months later to "liberate" baby tortoises. Today the national park estimates there are some 20,000 giant tortoises living in the wild and reproducing *in situ* in Galápagos.

As Chapter IV shows, this breeding success emerged through decades of experimentation as scientists struggled to assemble the conditions that would allow tortoise reproduction to thrive. James Gibbs attributed this success, in part, to the hardiness of tortoises:

> These tortoises are pretty tough. I would be concerned about bringing Champion Island mockingbirds into captivity—all kinds of things can go wrong. But tortoises are utterly different. It may do them a lot of good to come in out of the field.
>
> EH: [laughing] have the easy life for a little while…
>
> JG: That is the liabilities and opportunities with tortoises. They let you make mistakes. Many other animals do not. You can get it right. (Interview 10/2/11)

The tortoises have been at the center of Galápagos conservation efforts not only because they are the species most identified with the islands, but also because their biology allows it.[95] I examine the labor and experimentation that has gone into producing prehistoric life in detail in the following chapter. Here, rather than focus on the success of the breeding program, I investigate its failures—specifically efforts to breed Lonesome George in captivity. As the next chapter shows, the pastoral project of breeding and raising tortoises has become a standardized

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[95] In the 1980s, CDRS staff starting breeding land iguanas in captivity—the project was also successful, but as Howard Snell, who started it, told me, it was also much more difficult, in part because of the animals' aggressive behavior, and also because their eggs are not encapsulated in hard shells like tortoise eggs, making them difficult to move without damaging.

routine in the Galápagos. But George, as his nickname suggests, remained lonesome throughout his life—never breeding in captivity.[96] In this section, I analyze the various strategies through which conservationists attempted to make George fit into their plan to make the Pinta lineage thrive once again. While the labor of the breeding program demonstrates the entanglements of natures and cultures involved in producing prehistoric life, George's recalcitrance demonstrates the limits of human plans to design nature.

George is often said to be an icon of conservation, an animal whose plight sounds a clarion call about species extinctions. With that fame has come a host of attempts to try to save his species. When he was first brought to the Park headquarters after being found on Pinta in 1972, he was resolutely anti-social and would flee from human visitors. Until 1988, he lived in a corral at the breeding center tucked behind the CDRS Director's house—out of sight and away from the traffic of tourists who routinely came through the breeding center to see the tortoises. When Linda Cayot became Director of Herpetology in 1988, she moved George to a centrally located corral because she so frequently got requests from visitors to see him.

With George safely in captivity, the conservation community searched for a mate for George on repeated trips to Pinta and in zoos around the world through letter-writing campaigns that offered a $10,000 reward for the return of a female Pinta tortoise. Park guards repeatedly combed Pinta for a trace of other living tortoises—in 1991, Cayot found a tortoise scat on the island, but no one found the tortoise who made it. In the early 1990s, the CDRS began trying to get George to mate with females from a nearby population on Volcan Wolf at the northern tip of Isabela Island, which they thought was the closest related species because they looked

[96] According to his biographer, George was named after a character on an American sitcom from the 1950s (Nicholls 2006). Originally taken to be 'lonesome' as the last of his species, the moniker has come over the years to also represent George's lack of interest in mating.

morphologically very similar to George.[97] Linda Cayot told me about why they decided to mate George:

> The original decision to put females with him – well he had had a female with him once. And apparently there was one that he liked – years ago, but apparently she died. But it was like, we have this tortoise in captivity, nobody's found another, at least let's get a hybrid. Because then we can decide what to do. If we still don't get a hybrid… So the idea was, let's get some females with him because even if we eventually find Pinta females, he needs to be socialized a bit. He's a very anti-social tortoise. (Interview 9/28/11)

In lieu of Pinta females, the hope was that George would breed with the two Wolf Volcano tortoises to produce hybrid offspring, which could potentially be back-bred if they were healthy (more on back-breeding in Chapter V). But George showed little interest in the females, prompting speculation about his health and sexuality. Cayot continued,

> Females were there for years and he never paid any attention to them. He started getting more interested in the females after Sveva was working with him. Again, it's decisions you make in a management process. If you want to put tortoises back on Pinta, they could either be totally nonPinta tortoises, or if we could get George to breed at least his genes could be out there. (Interview 9/28/11)

Speculation about what was wrong with George ran high—in tortoise workshops and newsletter articles, Galápagos conservationists debated how to best to handle this tortoise. Perhaps after years alone on Pinta, he needed to be taught reproductive behavior. To do that, several people advised putting him with another male tortoise who could demonstrate mating behavior (Fritts Interview, 1/29/12). But others worried about the potential psychological damage of introducing a competitive male into the corral of an already anti-social tortoise (Grigioni, 1993). Perhaps there was a biological problem—George became obese during his stay

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[97] There are two dominant tortoise morpho-types in the Galápagos: large tortoises with domed carapaces, which are prevalent on larger islands with humid climate and considerable vegetation and smaller tortoises with saddle-shaped carapaces that curve up at the back of the neck, allowing the tortoises to reach up to get vegetation from short trees on drier islands where there is little grass and edible ground cover.

in captivity and his daily ration of papaya had to be eliminated in the late 1990s, replaced with more nutritious greens.

If George would not breed with his carefully selected mates, conservationists suggested more direct artificial help. In 1993, a Swiss biology student, Sveva Grigioni, volunteered with the CDRS for three months. Her task was to get a sperm sample from George. She practiced with other tortoises—approaching carefully and covering her hands with cloacal fluid from female tortoises. After the tortoises became accustomed to her presence, she could get a sperm sample from some of the males in 15 minutes. She worked with George no fewer than 32 times, but never got a sperm sample. She did report, however, that during her stay George became more active and interested in the females—she observed several unsuccessful mating attempts.[98] Following the failed manual stimulation project, others suggested electro-ejaculation (Pritchard, 1984)—a technique commonly used for captive breeding of large mammals. But Grigioni warned against this—the technique is rarely used on tortoises and could potentially cause George serious damage or kill him, a risk no one in Galápagos was willing to take.

After decades of not breeding, conservationists held their breath in 2009, when the females living with George laid two clutches of eggs—would they hatch, and would George, at last, reproduce the Pinta lineage? To much disappointment, the eggs did not hatch, further contributing to speculation that George was sterile or otherwise in poor health. But conservation interventions did not end. Genetic studies of the tortoise populations (discussed in Chapter 5), showed that George was not most closely related to the Volcan Wolf tortoises he had been living with. Instead, his closest genetic relatives were the Española Island tortoises, which had been

[98] George also apparently became fond of Sveva. As Cayot told me, "He knew her voice. I had a little sign that explained what she was doing that before she went in she would have to go up on the platform and hang it, so that if tourists saw her goosing him they would know what she was doing. She discovered that when she was up on the platform if tourists came up and she started talking to them his head would pick up like, 'there's Sveva!' " (Interview 9/28/11).

breeding in captivity for decades. The GNPS switched the two females in his corral with two first-generation offspring from the Española breeding program that had been repatriated to the island. But genetic similarity did not prove a tortoise aphrodisiac—George showed little interest in the new females.

In June 2012, Fausto Llerena, a park guard who has run the Centro de Crianza for 30 years, went to check on George early one Sunday morning and found him dead. A necropsy did not reveal any immediate cause. Nearly 40 years after he was first brought into captivity, the tortoise, thought to be about 100 years old, passed without leaving an heir. But speculation about future possibilities for reincarnating George and the Pinta lineage remain. A sample of George's blood is stored in the "Frozen Zoo" at the San Diego Zoo and Wild Animal Park and another American scientist is sequencing his genome. Since the early 1980s, conservationists have talked about cloning George, although most dismiss the idea as far-fetched. Cayot explained that even as cloning has become a real possibility for mammals, cloning a reptile remains a different story:

> We went through Lonesome George and what would it take to do anything serious with him? And the first thing is, most things you would do, cloning…. none of that has been done on tortoises. None of it. So you couldn't start on Lonesome George. You'd have to start with decades of research on other tortoises to even get to Lonesome George. The amount of money you would spend on doing something with an unknown outcome – because it could be that he just doesn't have any sperm, or it has atrophied, or whatever … there is so much in need in Galápagos that we don't want to spend $500,000 or $1 million on one tortoise that we may get nothing out of. So I liken management with the research part that is connected to it to triage in Galápagos …. You look at your problems, and if one is so far gone, you let it go because you could do so much more with the money. I mean, George is one male. That is different than one population of mangrove finches. You still have a population. They are still in the wild. They are still nesting. Maybe you can do something. But one male tortoise who doesn't even like tortoises and you can't get sperm out of? I mean… (Interview 9/28/11)

Despite his being the world's most famous tortoise, George is, Cayot says, still just one male animal in an archipelago with multiple conservation priorities. For her, the investment in cloning is not a realistic use of scarce conservation dollars. Washington Tapia agreed in an interview before George died:

> I think in practical terms, as an individual who contributes to the salvation of the species, there are very few possibilities that remain—there isn't much more we can do. His genome is the last effort… From a scientific point of view, cloning doesn't help—basically what we would have would be photocopies of him, perhaps including the same reproductive problems. On the other hand, the technology to clone tortoises doesn't exist, and if it did, it would be very expensive. We do not have the luxury of investing what it would cost for something for which success is not guaranteed, so for us it is not an option, unless an eccentric millionaire appears who wants to donate all the resources to develop the technology and do the program. (Interview 2/22/12, my translation from original Spanish)

For an animal as famous as George—beloved by thousands of tourists who have taken his photo from the promenade Cayot had built overlooking his corral, and eulogized in major media outlets across the Western world—speculation about the possibilities of biotechnological developments to reinvigorate his lineage seem likely to continue, despite the expense and current lack of technical ability. That George has resisted conservationists' attempts to save his species over the past decade speaks to human inability to design nature as we see fit. It has also helped make him so famous. George's shy passivity lends him charisma as a conservation icon—people seem compelled to care about his plight. That he has been exhibited for the past 20 years as a testament to man's past misdeeds to the natural world inspires guilt at the scale of humanity. As a charismatic icon, George sits at the nexus of human desire to connect with the nonhuman world, to amend for past wrongs, and seemingly indefatigable faith in the promise of technology and ingenuity to control nature. While his experience points to the limits of the pastoral project of breeding, it also highlights faith in the sovereign desire to make nature perform according to human will.

Re-tortoising

The final step in the pastoral project of raising tortoises is returning captive bred juveniles to the wild on their home islands. After four to five years at the breeding center, the young tortoises are large enough to withstand predation from Galápagos hawks and introduced rats. Park guards make "repatriation" trips every couple of years to return young tortoises, "liberating" them into the wild. The nationalist language of returning tortoises to their natural patrimony speaks to the co-production of bodies and territories. The tortoises' evolutionary genealogy places populations as belonging to particular islands. Rewilding according to this ancestral geography—rather than allowing tortoise diasporas to interbreed—is central to the project of conserving evolution.

> Around the world, rewilding projects are an increasingly common form of wildlife management. The Galápagos tortoise project has been one of the most successful. On Española Island, where the last 12 tortoises were brought into captivity in the late 1960s, scientists estimate around 800 tortoises now live in the wild. Over the past 40 years, nearly 1,900 tortoises have been repatriated to Española—meaning that survival is about 50 percent. Although this statistic sounds dismal, it is actually quite good for rewilding projects, which often see very high mortality rates (Gibbs Interview 10/2/11).

Building off the success of the Española program, conservationists have long discussed whether to try to put tortoises back on Pinta. The Pinta Project that put 39 tortoises on the island in 2010 came only after a long history of debate. As hopes that George would reproduce dwindled over the years, conservationists debated putting tortoises from other populations on Pinta. The intervention was controversial because it would contradict goals of "conserving evolution"—those tortoises would not originally have evolved on the island. But returning the island's historically dominant herbivore was in another sense a restoration of natural processes at the ecosystem scale. Linda Cayot explained to me the long-running debate between scientists interested in maintaining the evolutionary purity of the different islands and those who argued the health of the island's total ecosystem mattered more than the lineage:

> I would say ever since I first came here there has been sort of the purists that are species purists and the island ecologists. The island ecologists have always wanted tortoises there [on Pinta] because tortoises are part of the ecosystem and if we are going to restore Galápagos islands then we need to restore the ecosystems. The purists thought if we can't put a Pinta tortoise there, we shouldn't put anything there. And this sort of went on. The botanists are on the ecosystem side. Ole Hamman [a botanist] has been arguing to put tortoises there forever – one of the most vocal non-tortoise people. .. So that argument stimulated the whole part of Eddie Lewis's study of zoos, looking for Pinta tortoises. It also stimulated some of the searches of Pinta that Peter Pritchard did…And then the goat eradication that was part of Project Isabela opened the island enough to know that there were no tortoises. That was the point when people were walking the island enough to know there were no tortoises. So coinciding with that, Tom Fritts and Howard Snell's participation waned, and they were the only strong voices against it.

Howard Snell, who was CDRS Director of Science in the early 2000s told me he felt putting nonnative Pinta tortoises on the island would be a mistake because it would not be true to histories of adaptive radiation in the islands:

> [The idea that] a tortoise is a tortoise, so I'll take this one from over here and plop it over there—it's the designer ecosystem model, it's the Disneyland model that I personally feel is a convenient model, an easy model, but it is a fundamentally flawed model if you really value natural systems, because it's not a natural system. (Interview 1/30/12)

Snell used the island's evolutionary history to define what he considered a "natural system"—one untrammeled by man and introduced goats. Snell told me he thought the island should be left without tortoises as a reminder of man's past destruction—these sins should not be papered over by using nonnative tortoises to restore the ecosystem. Others Cayot described, including herself and the botanists, were less fixated on historically pure nature and more concerned about the health of the ecosystem. Pinta has undergone a shift in vegetation cover over the past 30 years. When it was inhabited by tens of thousands of goats, one scientist told me his assistant said it looked like the island had been cleared by a fire—all the vegetation below one meter was gone. Today, without goats the island is heavily vegetated—although much of the new growth is dense woody shrubs rather than grasses which tortoises eat and which are easy for them to move through.

Faced with this shift in the ecosystem, conservationists and scientists debated how to proceed. The decision was the choice of the GNPS. Over the past 10-15 years, authority over the direction of Galápagos conservation, which was long dominated by foreign scientists working with the CDRS, has transferred to the Park Service as it has grown in size and technical capacity. James Gibbs, who with Cayot is now one of the key advisers to the GNPS on tortoise issues, explained that park conservationists engage in debate with scientists, then tend to make their own decisions:

> There are people in the world who say, let's get on with it—the world is so screwed up, forget about biological purity and invasive species are fine unless they are just running amuck. But there are other people who are sticking to 'remove them at any cost because they don't belong' and keep these ecosystems sacrosanct—it's a big debate. And it is playing out right here in Galápagos… It's actually a nice healthy debate. Everyone talks and interacts and the Park makes decisions the best they can given the circumstances they have. I think it's wonderful—everyone is waiting to get the definitive results from the geneticists to think about it, but they also know they need to do some action-oriented things, like get some tortoises on Pinta. (Interview 10/2/11)

Wacho Tapia, head of protection for the Park, told me he knew something needed to be done on Pinta after a winter of particularly heavy rains:

> The restoration of Pinta began when I visited the island—I had been visiting while it had goats and later I visited about six months after the eradication. I saw that there had been a change that was not normal, because clearly there had been the eradication and a strong winter—I started to notice changes that were not normal for the island—much more green than before and species that need open areas that were not recuperating, and other plants creeping into areas where they should not be. So from that we decided that the Park should complete an ecological restoration of the island. Part was the eradication of goats, but then we had two options: wait and only monitor the changes and document what

> happened, or really do a process of active restoration and put back on the island its herbivore. (Interview 2/22/11)

Tapia explained the desire to prioritize the health of the ecosystem. Doing this left conservationists with a choice between monitoring the island once it had been cleaned of goats or putting tortoises back. Because Lonesome George never reproduced, re-tortoising would mean compromising the focus on evolutionary purity by releasing nonnative tortoises. This shift from a species-based approach, which has long dominated Galápagos conservation, to a more ecosystem-scale approach was discussed during a 2005 CDRS workshop. But conservationists were not quite ready to contradict their historical focus on restoring evolutionary processes by putting non-native tortoises on Pinta. A long-time CDRS conservationist explained the debate and how he proposed a solution to the impasse:

> So one of the reasons we removed the goats from that island—it did have a herbivore, the tortoises—now without the goats there was nothing. That's not natural either. Obviously the island needs a herbivore if we want to maintain the idea that Galápagos keeps a natural way…So we thought that Española tortoises are the most similar to the Pinta ones, so why not start putting several years of production of tortoises from Española on Pinta in order to have another viable population that will fulfill the role of a herbivore eventually… But then the scientists start coming in and 'Oh, no...this and that'...they start calculating how much the small tortoises will start eating and rubbish like that. So it was a stand-off, the whole project. So I said, here we have so many tortoises… that are from various islands and we can't repatriate them. I'm sure there is a way of sterilizing them. So we put trackers on big animals—adults that will start moving and eating—until you guys find out what you want to do! It seems that it was a brilliant idea and they went for it and now there are tortoises there. (10/31/11)

For him, scientists' calculations were a challenge to conservationists' ability to do something to maintain the health of the Pinta ecosystem. Scientists were not all reconciled to the idea of putting nonnative tortoises on Pinta and were also concerned that juvenile tortoises would make little dent in the densely vegetated island for decades until they were grown. He suggested using mixed hybrid tortoises kept at the breeding center, but not allowed to mate—because they were hybrids, no one wanted to release them into the wild to contaminate other "pure" tortoise lineages. But if they were sterilized, they would not pose that threat. By putting telemetry tags on them, scientists could also watch their movements and gauge how much vegetation they ate and what impact they had on the island environment. So after several years of planning and surgeries to sterilize tortoises, thirty-nine tortoises tagged with radio transmitters were liberated onto Pinta. Cyborg tortoises stripped of their reproductive ability would stand-in for evolutionarily pure tortoises. Cayot described the scene on a project blog:

> Watching the tortoises upon arrival was thrilling. The moment they hit the ground, they were ready for action. They immediately began moving off through the vegetation, knocking down whatever stood in their path, finding juicy plants to forage on, and exploring their new world. Doves and lava lizards began using the pathways smashed down by the movements of the tortoises, and the third day, Joe Flanagan filmed a Galápagos dove landing on the back of a tortoise. All seemed right with the world.[99]

But while Cayot—and the global media—were enthused about returning tortoises to Pinta, not all scientists agreed. Peter Pritchard, a turtle conservation expert who has worked in Galápagos, but is not a central adviser on management decisions told me the project was "ridiculous":

> Getting a number of tortoises of unknown origin, cutting off their male parts, and putting them on the island—one wonders what on earth is going on? What is the point? They can't breed so they are either going to live there for a few years or maybe quite a lot of years and then they start over. So I thought it was one of the silliest things I've heard in a long time. Literally has no real point. And it would confuse things if these animals started to die off and we wouldn't be able to tell if they were original Pinta skeletons or if they were skeletons from the subsequent liberation. You can't say they did it for the tourists because there aren't any tourists on Pinta. I have colleagues who, like me, feel that was one of the most pointless things ever done. (Interview 6/12/12)

But most the scientists I spoke with working closely with CDRS today on tortoise management support the re-tortoising plan as a proactive step forward and opportunity to collect

[99] http://retortoisepinta.blogspot.com/ (Accessed November 3, 2013)

pilot data on tortoises' roles as ecosystem engineers (Hunter and Gibbs, 2013). Debate still remains about the next steps—whether to put additional, reproductive tortoises back on the island. In interviews, scientists and conservationists told me the most likely scenario would be putting Española juveniles from the breeding center on Pinta, since the Pinta species seems to have evolved from the Española species. Even Pritchard was more supportive of this plan:

> That is a somewhat better idea because they are very closely related genetically and the Española tortoises may be the direct ancestors of the Pinta tortoises. That being the case, let's just do the experiment again like nature did it before. Put Española tortoises on Pinta and maybe they will reshape themselves evolutionarily to something that belongs there. (Interview 6/12/12)

For Pritchard, retortoising Pinta with closely related Española tortoises would be acceptable because it would allow nature's evolutionary experiment to continue. In this scenario, conservationists would in effect be resetting the clock on Pinta—re-introducing Española tortoises that colonized the island some 3.2 million years ago and allowing them to re-adapt to the island's conditions so that they "belong there" in an evolutionary sense. Although this is not something people would be able to see—genetic evolution of tortoises takes hundreds of thousands of years—as Pritchard told me, "the tortoises have time." Human ability to see the results of this experiment is less important than rectifying past predation.

The long-running debate about whether to retortoise Pinta, and with what tortoises given George's inability to reproduce, points to the limits of goals to "conserve evolution." Without the native keystone species to lead restoration efforts, debate opened about how scientists interpreted the evolution they were trying to conserve. They debated the relative importance of fidelity to historical genetic lineages and the basic functioning of the ecosystem. The politics of knowledge in this debate turn not only on scientists' areas of expertise (botanists are perhaps unsurprisingly most concerned about ecosystem function), but also on personal interpretations of what is an appropriate intervention based on what nature is considered evolutionarily natural. The debate also highlights tensions between scientific desire to run models and gather more data before making an intervention and the conservationist impulse to do something—a conflict that does segregate actors by training or functional role but which many interviewees internalized—a condition Robbins and Moore term "ecological anxiety disorder" (2013).

The Pinta case is also significant in charting a new direction for Galápagos conservation in which adherence to an evolutionarily pristine model of nature is beginning to give way. By introducing nonnative tortoises to Pinta, conservationists prioritized ecosystem health over fidelity to genetic readings of purity. But the compromise that necessitated these 39 tortoises be sterilized and surveilled points to a very limited opening for accepting culturally and technologically mediated natures—here, as in other forms of Galápagos conservation, human intervention is acceptable only to the extent that it serves to restore prehistoric nature.

Conclusion

This chapter has explored the biopolitics of conserving evolution through four areas of work: population surveys, introduced species eradication, captive breeding, and rewilding. Conservation goals in the Galápagos are more specific than preserving biodiversity—because of the islands' significance in the annals of evolutionary science and framings of the archipelago as "natural laboratory," in situ protection work has always turned on the idea of "conserving evolution." Through population surveys and readings of the islands' natural history, conservationists classify some natures as endemic and native—and valuable—and others as cultural introductions, a blight on the landscape. Management is split into two predominant forms of nonhuman biopolitics—the pastoral power of protecting flocks of native species and the sovereign power to take the life of foreign species to ensure the health of natures that belong.

The four areas of work explored here demonstrate not only how the goal of conserving evolution has been implemented in management plans, but how doing so ties together nonhuman species, the production of landscapes, and complex, contested human subjectivities. It also highlights the complex relations between nature, culture and technics, pointing to the impossibility of separating nature from cultural influences.

The biopolitics of managing nonhuman life is intertwined with a contested politics of knowledge. Through survey work as well as the labor of controlling introduced species, distinctions are made between the subjectivities of trained scientists, who are often white foreigners, Ecuadorian conservation workers, and local residents. None of these classifications are mutually exclusive, nor do individuals in different groups share the same opinions or training. But their different understandings of nature—particularly visible through eradication work—highlight the politics of knowledge that goes into "conserving evolution." Western scientists' understandings of the islands' nature has driven the conservation agenda in the Galápagos over the past fifty years, making those without such training subordinate.

But even among scientists, just what the goals of "conserving evolution" are is debated. In a conversation quoted earlier, I had asked Cayot about to what extent conservationists can return an ecosystem to a previous state—"as much as possible," she told me. To follow up, I asked her whether the idea of returning to 1534 was possible in an evolutionary sense:

> EH: So why I think this is so interesting, at a very abstract, theoretical level, doesn't evolution always move forward?
>
> LC: [laughs] Um... That's an odd question. Because evolution, it moves forward in the sense that time moves forward. It doesn't necessarily mean that it improves. It just moves forward. So for example, again tortoises aren't a great example

> mainly because of their longevity, but if you have a population that humans have reduced—say Española, to 15 animals—that means evolution is moving forward because you've eliminated all kinds of genes I'm sure, so you have a very limited group. That's not necessarily a positive thing because you have a very limited group. The question isn't whether evolution moves forward, the question is whether evolution is allowed to be as natural as the pre-human situation. (Interview 7/17/13)

In her response, Cayot agrees that evolution always moves forward, but highlights the idea that it is not necessarily an improvement. But she maintains a distinction between some evolution being more natural than other evolution—the goal here then is not just to conserve any evolution, but to preserve more natural, prehistoric evolution. To follow up, I asked Cayot what constitutes *natural* evolution—she said it changes along with changing scientific methods of analysis—from geography to morphology to genetics, which is now the gold standard for examining the evolutionary history of tortoises. But in addition to changing scientific methods, the debate over re-tortoising Pinta Island shows that how to manage "the natural" is still a contested idea even when scientists are working off the same data. To what extent Pinta can and should be restored—using nonnative tortoises or not—remains a point of contention among Galápagos conservationists.

Another area of contention is the role of humans in the ecosystem. When I asked James Gibbs why Galápagos are considered pristine, he raised the issue of interpretations of islands as pristine being used to argue for limits to human presence in the islands, but noted that such interpretations are beginning to change:

> EH: I think it's really interesting—Galápagos is always said to be among the most pristine islands in the world—what is the benchmark for that? Is it before Tomas de Berlanga came? And how do we know?
>
> JG: I think—that's a debate—I'm not really—this is playing out all over the world, too. It's natural and people take very different points of perspective. Until recently, people wanted Galápagos to go back to pre-Tomas…I say people did: a lot of foreign scientists, they were driving the agenda, you had some really

> prominent people saying 'let's just get all the people out of here.' Whoa! And they were quite serious about that. But now I think people are being much more practical around the world, find a balance—and certainly let's restore populations back to where they can find the services they once did. But let's be practical! Because things have changed, and they are going to change too. I think the recognition that things are going to change with climate change—let's just forget about recreating the world as it was 500 years ago. You actually have no control over it anymore. (Interview 12/16/11)

Gibbs's and Cayot's quotes demonstrate the politics involved in different interpretations of how to best "conserve evolution." By analyzing the biopolitics of conserving nonhuman life, the chapter has demonstrated that not only conservation, but also evolution, is a moral, political and cultural undertaking. The debates about how best to conserve evolution demonstrate that even when the goal has been to return to a prehistoric past, conservationists are producing the future of evolution. As they do so, they produce not only nonhuman subjects of conservation, but also human subjectivities that differentiate among those with appropriate knowledge and skills to manage But as Lonesome George shows, humans do not have complete control over nature, we cannot restore it as we see fit. We remake nature, but not in conditions of our own choosing.

CHAPTER IV: PRODUCING 'PREHISTORIC' LIFE: THE REMAKING OF GIANT TORTOISE GENEALOGIES

Introduction

If Lonesome George is a celebrity tortoise because of his inability to reproduce, another tortoise at the breeding center, named Diego, could be his polar opposite. As tour guides would delight to tell you, Diego is a famous tortoise—a "super-macho" who has sired more than 800 offspring over the past 40 years. But his story is more interesting than just his reproductive prowess: Diego has lived through a century of varied human efforts to save his species. In the 1930s, he was collected from Española (Hood) Island in the Galápagos and taken to the San Diego Zoo as part of an experimental breeding colony—one of nine across the southern United States set up by a New York–based naturalist in an effort to save the species from extinction. But despite the dedicated efforts of zookeepers, the tortoise colonies never reproduced consistently. Shortly after the Galápagos National Park was founded, Diego was returned to the islands, where he lives today with five female tortoises within the rocky walls of a large corral in the Park's Giant Tortoise Breeding Center. Following years of breeding disappointment in the zoos, Diego and other captive breeding tortoises in the Galápagos have had remarkable success. Although he often hides out of site in the thick, thorny shrubs that grow in his corral, Diego is an aggressive tortoise, still thought to be in the prime of his reproductive years at around 100 years old. He is the star stud of the breeding program and thus a key player in conservationist goals to "restor[e] the tortoise dynasty" in the Galápagos (Merlen 1999). To date, the breeding center has produced and returned more than 4,000 juvenile tortoises to their “home” populations across the archipelago.

But this success did not just happen naturally. Nor can it be attributed solely to Diego. Drawing on interviews, archival research, and participant observation at the San Diego Zoo and the Galápagos breeding center, this chapter traces a genealogy of tortoise breeding over the past hundred years to explore the diverse array of people, tortoises, and other vibrant matter involved in the production of tortoise life. In contradistinction to celebrations of Diego’s reproductive prowess, this evidence demonstrates that breeding success is attributable to decades of experimentation and learning as zookeepers, scientists and conservationists struggled to optimize the reproduction of this species. This history demonstrates that what is at stake in the breeding program is not the preservation of a past state of nature, as conservation goals are often framed, but the production of wildlife (c.f., CDF and WWF 2002, Merlen 1999). The giant tortoises are not the last remnants of a ‘pristine’ evolutionary history, but are now the product of genealogies that enfold human management practices in the bodies and bloodlines of wildlife.

In the first half of the chapter, I situate the remaking of wildlife genealogies through conservation breeding in literature that frames conservation as a field of nonhuman biopolitics in which human management shapes populations of endangered species to particular political ends. Examining conservation breeding as a biopolitical strategy challenges basic conservationist framings that unproblematically paint the Galápagos as a site of pristine nature by demonstrating the role of human knowledge in producing such framings. This approach also demonstrates that what is at stake in breeding baby tortoises is not only the reproduction of an endangered species, but the reproduction of framings of the archipelago as a site of pristine nature—an understanding of nature that is central to both the tourism industry and the continued legitimacy of conservationist management.

In the second half of the chapter, I analyze the production of 'pristine' nature by focusing on the assemblages of reproduction at the center of wildlife genealogies. I draw attention to the multiple agencies and spatialities brought together in practices of experimentation—first at the San Diego Zoo, where keepers struggled to keep giant tortoise colonies alive and healthy, and then following Diego back to the Galápagos, where conservationists were eventually able to gain enough control over tortoise reproduction to standardize and replicate breeding practices. The case demonstrates how scientific knowledge becomes enfolded in animal genealogies through the production of wildlife itself. But in contradistinction to celebrations of the seemingly limitless possibilities of modern biology to remake genealogy, attention to the slow, provisional processes of knowledge production in this case stresses the how difficult it is for people to achieve control over biological processes.

Saving "Prehistoric" Animals

When Charles Darwin visited the Galápagos in 1835, he wrote of the giant tortoises: "These huge reptiles, surrounded by the black lava, the leafless shrubs, and large cacti, seemed to my fancy like some antediluvian animals" (Darwin n.d. [1845]), p. 356). This quote, and its framing of giant tortoises as prehistoric creatures, is commonly cited in popular conservationist literature and nature documentaries (Bassett 2009, Steadman 1988). The giant tortoises' enormous size, plodding gait, thick leathery scales, wrinkled skin, and armored carapaces are put to work to help frame the remote archipelago as a land before time—a past world where giant reptiles still roam widely. Until about 50,000 years ago, different species of giant tortoises once inhabited every continent but Antarctica and Australia; they died off as human populations spread (Auffenberg 1974). Today, the Galápagos species are one of only two remaining lineages (the other lives in the Seychelles); their ancestors are thought to have floated out to the archipelago from South America at least 2 million years ago (ibid, Caccone et al. 1999). The marshalling of such scientific evidence is often used to frame the tortoises' 'prehistoric' nature as the 'natural' truth of the islands (which have no indigenous human population). It is a backbone of conservationist justifications for protecting the archipelago as a site of 'pristine' nature. The reproduction of giant tortoises through conservation breeding—the national park's first major undertaking when it was established in the 1960s—thus serves as a strategy to reinforce pristine framings of the archipelago. The reproduction of tortoises is a biopolitical strategy that not only augments populations of endangered species, but in doing so allows for the reproduction of the Galápagos as a site of pristine nature and thus the continued legitimacy of conservationist management.

These seemingly "prehistoric" qualities and lineages have inspired much interest and concern about the fate of the species. Amid growing concern among scientists of species extinctions in the early twentieth century (Barrow 2009), naturalists' concerns about the scarcity of tortoises spurred a century-long effort to try to "save" the species. Over the course of the past century, what were considered the best ways to do this have changed immensely—from preserving specimens in museums to breeding new tortoise life first in zoos and then in the Galápagos.

The Rothschild and California Academy of Science expeditions at the turn of the twentieth century took on the ethos of a "race with extinction" (Fritts and Fritts 1982) bringing back as many specimens of tortoises and other species as possible to be preserved for posterity in natural history museums, continuing a long-standing imperial, paternalistic relationship with

South American nature as an ideal site for Western collection (Pratt 1992). The backers of these expeditions exercised a power to take animal life in the name of science by employing professional collectors to hunt local flora and fauna and then carefully prepare the specimens for return to museum "centers of calculation" (Latour 1987). The California Academy crew spent more than a year trekking across Galápagos to ensure a complete collection, and Rothschild instructed his collectors to "carefully go over the entire ground of each island" and to bring back several species of birds as well as every tortoise specimen they could get. He later explained to his mentor, the Curator of Herpetology at the British Museum (Natural History), that "my chief reason for telling Dr. Harris to bring away every tortoise they saw, big or little, alive or dead, was that the … hunters had already reduced them by more than half … and I wanted to save them for science" (Rothschild 1983, p. 197). Together, the expeditions took more than 500 tortoises to San Francisco and London, which served as the basis for museum displays as well as the first modern account of Galápagos tortoise taxonomy, published by the California Academy's John Van Denburgh in 1914. Largely on the basis of differences in shell shape, Van Denburgh established that each island was home to a distinct population of tortoise.

In the 1920s, as modern zoos became more common and successful at caring for various species (Hanson 2002), the focus of saving giant tortoises shifted away from preserving dead specimens in museums to caring for living animals. The director of the New York Aquarium, Charles Townsend, became the first to try to save the Galápagos tortoises by breeding them. For Townsend, because tortoises had been threatened by "human devices," human intervention was necessary to save the species—something he thought would be best accomplished under the care of Western zoos (Townsend 1928). As one of his collaborators wrote, "If the 'galapago' … is to survive, it is scarcely probable that his native soil will provide the environment" (Banning 1933 quoted in Owens 2003, p. 9). In 1928, Townsend directed a Galápagos expedition that captured 180 live tortoises, which he distributed among nine zoos, aquariums, and botanical gardens along the southern border of the United States and in Bermuda, Panama, and Australia—areas which were thought to be the most climatically appropriate for the equatorial reptiles.[100] As Townsend wrote in 1928, "The few Galápagos tortoises in northern zoological gardens have never been located under conditions favorable to reproduction either in this country or in Europe" (1928, p. 153).[101] None of the tortoises he collected would be "placed in zoological gardens situated north of the latitude believed to be climatically favorable to their propagation" (1928, p.167).[102]

For Townsend, the purpose of these colonies was the survival of the species—he wrote that "the only hope of keeping the stock alive was to establish [it] in conditions where its safety and continuance would be assured as far as human devices go" (1928, p. 163). But the project did not aim to preserve the species only for the sake of conservation. Instead, Townsend wrote that "should these animals increase under the present experimental conditions, as is expected, the Zoological Society will eventually arrange to make them available to breeders as food producers suitable for southern and especially arid regions."[103]

Townsend's work at the New York Aquarium as well as his previous expedition to the Galápagos set the conditions of possibility for breeding tortoises. The transition from stuffing

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[100] Colonies of ten to thirty tortoises were sent to the Botanical Gardens in the Panama Canal Zone, the Boyce Thompson Southwestern Arboretum at Superior, Ariz., zoos in Houston and San Antonio, Texas, New Orleans, La., San Diego, Calif., Honolulu, Hawaii, and Sydney, Australia, and the grounds of the aquarium in Bermuda.

[101] Indeed, of the 144 Galápagos tortoises Rothschild kept at his Tring estate and later at the London Zoo, few survived more than a few years in the cool, damp climate (Rothschild 2008, Chambers 2006).

[102] No specific mention of what latitude was considered too far north is mentioned in Townsend's remaining notes at the NYZS. The San Antonio population was the northernmost colony he placed, at 33.293N.

[103] Thus conserving the giant tortoises was something justified through the value of the species as a source of food—much as it had been used for centuries by sailors and settlers. He continued, "the Zoological Society is interested solely in the increase of these animals with the ultimate view of wider distribution as a food species that may be of value in southern states" (1928, p. 167).

tortoises for museum research to caring for living animals shifted scientists' role in shaping tortoise genealogies from contributing to extirpation to molding the conditions of their reproduction. But caring for giant *living* reptiles required a qualitatively different set of skills than did preserving them for eternal life on a museum shelf. Caring for giant *living* reptiles required a qualitatively different set of skills than did preserving them for eternal life on a museum shelf. Instead of the taxidermic work of skinning, de-oiling, stuffing, and preserving tortoises in arsenic, zookeepers faced the challenge of feeding tortoises, keeping them warm, and caring for them when they were ill, all issues that would need to be addressed before the goal of breeding tortoises became a reality. Whether Townsend's zoos could not only keep the tortoises he had collected alive, but also provide an atmosphere in which they would produce new life to carry forward this prehistoric species was a question that zookeepers would struggle with for the next several decades.

Conservation Breeding and the Production of Wildlife

Today, captive breeding programs are a relatively common, if not widespread, conservation strategy, particularly for charismatic species like the giant tortoises, and one of the key roles of conservation-oriented zoos. In 2011, the IUCN Conservation Breeding Specialty Group reported that more than 3,000 vertebrate species have bred in captivity under such programs (Anon. 2011). The ultimate goal of these programs is to reintroduce captive-bred populations to wild habitat to recreate "self-sustaining wild population[s]" (Ebenhard 1995, p. 438, Rahbek 1993). But when Townsend orchestrated his tortoise colonies, captive breeding was a relatively novel species conservation strategy. Although people have brought home exotic creatures from far-flung travels for centuries naturalists mostly failed in their eighteenth and nineteenth century attempts to "acclimatize" various tropical species to metropole climates

(Drayton 2000, Ritvo 1997). Indeed, few of the giant tortoises Rothschild kept in England lived more than a few years in the damp, chilly climate, hastening their entry into museums (Chambers 2006). Breeding "wild" animals was both a practical impossibility and thought to be unnecessary until naturalists began to pay more attention to the extirpation of wild species in the late nineteenth and early twentieth centuries (Barrow 2009).

The first conservation breeding project emerged from William Hornaday's efforts to save North American bison (*Bison bison*). By 1907, after many struggles and sick animals, Hornaday had succeeded in breeding bison in captivity at the Bronx Zoo and reintroducing them to the Western plains. He described his captive breeding of bison as essential for maintaining the species' wildness. For Hornaday, the "only way to maintain the bison as a purebred species 'in full vigor for the next two hundred years or more' would be by establishing a series of herds on public lands in 'ranges so large and diversified that the animals will be wild and free'" (quoted in Barrow 2009, p. 119).

But the idea of breeding and raising animals in captivity and then reintroducing them as "wild and free" in more "natural" spaces (often called "re-wilding") blurs traditional distinctions between wild and domesticated animals. Indeed, the very definition of each turns on whether a population of animals breed in captivity under human care or whether they reproduce on their own in the "wild." Breeding for conservation (nominally opposed to domestic breeding for aesthetics or profit) points to the human role in shaping "wild" nature—something anathema to most understandings of the existence and evolution of wild species.

When Darwin wrote *On the Origin of Species*, he drew a basic distinction between "artificial" (or human-influenced) and "natural" selection. Needing evidence for his theory of evolution by natural selection, he turned to farmers and domesticated breeders as the best place to see processes of selection in action. He opened *Origin* with detailed examples of elaborately fan-tailed and striped pigeons developed by pigeon fanciers. Domestic breeding provided an ample source of evidence of the inheritance of particular traits and an easily accessible analogy for natural selection (Ritvo 2010). But Darwin was clear that domestic breeding was a form of "artificial" evolution. As he wrote, "Man can act only on external and visible characters: Nature…cares nothing for appearances…She can act on every internal organ, on every shade of constitutional difference, on the whole machinery of life. Man selects for his own good: Nature only for that of the being which she tends" (Darwin 2004 [1859], pp.101-102).

But with advancements in knowledge and technology since Darwin's day, "Man" is now able now to work on far more than "external characteristics" of animal life, even if we have not yet grasped the "whole machinery." Recent studies have explored the human role in shaping diverse species—from human companions (Haraway 2008) to experimental animals (Franklin 2007, Rader 2004, Haraway 1997). In her book on Dolly the cloned sheep, Sarah Franklin (2007) demonstrates the "remaking of genealogy" by knitting together a Foucauldian genealogy that explores the history of the present—the event of a cloned animal—with Dolly's bloodlines. In doing so, she shows how practices of selective breeding, genetic engineering, and cloning enfold centuries of scientific and technological development as well as capitalist production, nation-building, and imperial governance into the animal's genealogy (ibid). I deploy a similar conceptual methodology in tracing how Diego's history over the past hundred years shapes the genealogies of his descendants. To date, such studies have focused mainly on the socio-natural genealogies of *domesticated* animals such as mice, sheep, dogs, poultry, and cattle. Because of its focus on ostensibly "wild" species, conservation breeding pertains to something of a different beast. It further challenges Darwin's distinction between artificial and natural selection by inserting humans' care as a surrogate for "Nature." In the Galápagos, the goal of conservation breeding is expressly not to alter species' characteristics, not to remake genealogies according to productive rationales or desire for loving companion species, but to reproduce "wild" nature by breeding in fidelity with past evolutionary processes.

Conservation and Nonhuman Biopolitics

An emerging literature frames conservation as a biopolitics of nonhuman life (Biermann and Mansfield 2014, Lorimer and Driessen 2011, Buller 2008, Whatmore 2000). This work builds on Foucault's formulation of biopolitics as the assertion of governmental technologies through which life is classified, ordered, and brought into being (Foucault 1984, 1994 [1970]). Foucault distinguished between two forms of biopower through which states managed human life—technologies of the body, or anatopolitics, and technologies for managing collective populations, or biopolitics (1984). Scientific knowledge is central to biopower—particularly biological understandings of human life and the production of national statistics. Although Foucault was concerned with formations of social power, his analytics have been extended to attend to the role of natural science as a tool for producing knowledge to manage natural resources, often in the service of the state or capital (Braun 2000, Drayton 2000).

Reworkings of biopolitics to attend to the management of endangered nonhuman life extend this focus on natural science by exploring the ways in which conservation practices order animal (and plant) life. This work examines the taxonomic technologies of treaties, databases, and practices of scientific knowledge production through which endangered species are defined, enumerated, and managed (Thompson 2004, Whatmore 2002). Understandings of endangerment are produced as animal subjects are "enmeshed in the categorical and practical orderings of people," (Whatmore and Thorne 2000, p. 186). By addressing constructions of nonhuman life through categorical orderings, a biopolitical lens sheds light on how nonhuman subjects are marshaled to particular (human) ends. Seen in this light, conservation is not simply the protection of wild species and their habitats from human encroachment, but the production of particular understandings of animal natures through technologies of classification, monitoring and surveillance, and human care. In the Galápagos, such conservationist framings of particular natures as prehistoric and endangered predominately serve two related ends: ecological restoration and tourism. Giant tortoises figure prominently in both as a major draw for tourism and funding for restoration efforts, of which tortoise breeding is a central strategy.

But conservation breeding is not only about the production of *understandings* of nature, but productions of wildlife itself. Investigating the biopolitical production of nonhuman life unsettles notions of the purity of wild nature. Wildlife is not part of an external Nature, but a "relational achievement spun between people and animals, plants and soils, documents and devices in heterogeneous social networks…" (Whatmore 2002, p. 14). What a species *is* is not fixed, but something that evolves along with the scientific and cultural frameworks through which we engage it. Animal bodies are shaped through human orderings such that becoming-animal is a "relational process in which animal subjects are configured through particular social bonds, bodily comportments, and life habits that are complicated…by the various ways in which they may be enmeshed in the categorical and practical orderings of people" (Whatmore and Thorne 2000, p. 186). Wild animals, writes Whatmore, quoting Latour, are "simultaneously the touchstones of 'a world that came into being without men…and sciences' and the objects of intensive surveillance and regulation in the name of conservation" (2002, p. 37). They are at once the products of evolutionary genealogies and culturally figured objects of science and conservation. Wildlife is produced through the relational imbrications of social and biological histories (Hinchliffe 2007).

In this vein, conservation breeding is an important site for analysis because of the way it merges social and biological histories as scientific knowledge is applied to manage the reproduction of species. This case extends work on conservation biopolitics to a question of ontology, exploring not only how people manage nonhuman natures, but also how human knowledge figures in biological reproduction. Breeding biopolitics is not a matter of human control over nature, but one provisional mode of 'living with nonhuman life' (Lorimer and Driessen 2011). By addressing how and why animal lives are brought into being, I explore the ways in which conservation breeding produces new animal life in accordance with goals of ecological restoration and nature tourism.

Remaking Genealogies

Animal reproduction in the context of conservation remains understudied. The bodies of conserved animals too often seem to preexist the technologies through which they are classified and reframed through encounters with humans. But animal breeding has been the center of much critical study outside of the realm of conservation. Recent work has explored the human role in shaping the reproduction of diverse species—from breeding "pure-bred" companion animals (Haraway 2008), to industrial products designed to maximize profit on food products (Shukin 2009, Grasseni 2005), to experimental animals integral to the production of scientific technologies (Franklin 2007, Rader 2004, Haraway 1997). These studies demonstrate what Sarah Franklin terms the "remaking of genealogy" as people have shaped the bodies and bloodlines of animals through centuries of animal husbandry, selective breeding, and now genetic engineering. Animal genealogies are "inextricable from the social values and historical conditions of their human authors" (2007, p. 7). They emerge from centuries of scientific and technological development as well as capitalist production, nation-building, and imperial governance.

To date, critical studies of the remaking of genealogy have focused mainly on domesticated animals such as mice, sheep, dogs, poultry, and cattle. (Indeed, it is because of human interventions that such species are considered domesticated). Because of its focus on ostensibly 'wild' species, conservation breeding pertains to something of a different beast. In the Galápagos, conservation breeding aims to preserve the purity of, rather than remake, tortoise genealogies. But by extending work on the remaking of domesticated species to wildlife, I show how histories of human intervention aimed to save an endangered species have remade its genealogies. Diego's story demonstrates that giant tortoises are neither purely natural beings nor cultural constructions, but constituted relationally through breeding practices that are conditioned by human histories of scientific knowledge production and environmental protection. These social histories have been enfolded in tortoise biology as the animals' breeding encounters and the ontogeny of offspring have been reshaped through the breeding program. Although giant tortoises once roamed the Galápagos before human presence there, the tortoises involved in these breeding projects can no longer be considered 'pristine.' They are productions of a wide field of overlapping socio-natural networks that span prehistoric and human-influenced genealogies, and wild and captive landscapes.

This case also extends studies of the remaking of animal genealogies in another way. In much of this work, concentration on the successful feats of modern science—e.g., the cloning of Dolly the sheep or the production of a mouse with a human ear—sites studies in high-tech laboratories where unprecedented interventions in reproduction constitute a new era of "biological control" (Franklin 2007, p. 32). The implication is that life is open to manipulation and that given the proper resources and time for experimentation nearly anything is possible.[104] This case, however, attends to decades of experimentation during which zookeepers, scientists, and conservationists struggled to care for giant tortoises in captivity. Comparing the varied success of breeding in San Diego and the Galápagos demonstrates the challenge of what naturalists initially assumed would be a relatively straightforward undertaking.

As sites of experimentation, the zoo and breeding center can be understood as laboratories for the production of nature. Laboratories are scientifically important spaces because of the way they reconfigure relations between people and nature within their borders. They are enhanced environments for producing natural knowledge and objects—places where scientists can gain some degree of control over biologies that escape their vision and grasp in the 'real' world (Latour 1999, Knorr Cetina 1992). But not all biology laboratories are high-tech, sterile spaces (Livingstone 2003, Kohler 2002). I follow the spatial analytical focus of work on the key sites of scientific production by looking at the zoo and Galápagos breeding center as rather low-tech experimental spaces.

Analyzing processes of experimentation draws attention to the negotiations among people, tortoises, technologies, and broader environments involved in *assemblages of reproduction*. I use the concept of assemblages to stress the interplay of a wide field of human and nonhuman agencies involved in these experiments (Deleuze and Guattari 1987, Latour 2004b). Instead of attributing the eventual success of tortoise breeding to either Diego's 'natural' prowess or to human mastery of nature, concentration on assemblages foregrounds the importance of a diverse array of "vibrant matter" (Bennett 2010)—things that are not alive, but produce particular effects when combined in larger assemblages. In this case, the vibrant matter

[104] See for example recent (Spring 2013) media attention on scientific speculation about the possibilities of "de-extinction" by cloning extinct species using preserved DNA (Zimmer 2013).

that matters for tortoise reproduction includes things such as soil, incubators, and rearing pens. In the following sections, I explore how human actors came to realize how and why these things matter. I compare the San Diego and Galápagos breeding efforts as what Law and Lien (2012) term "choreographies of practice," or processes of surveillance and care through which people learned how to help assemble tortoises and vibrant matter in such a way as to produce their desired outcome. This draws attention to the process of knowledge production as caregivers attuned their practices to a diverse array of distributed agencies (Hinchliffe et al. 2005).

Analyzing the practices through which conservationists learned to help assemble tortoise reproduction provides a lens into both the construction of scientific knowledge about the species' biology and the concomitant remaking of genealogy as these practices enabled their continued reproduction. This dual focus extends readings of conservation as a field of nonhuman biopolitics by attending to the intermeshing of social and biological histories. The biopolitical focus also situates conservation breeding as a strategy that serves both ecological restoration as well as the tourism industry in the islands. Giant tortoise breeding, then, is not simply a matter of protecting 'pristine' wildlife, but of producing wildlife to meet particular goals.

Learning Reproduction: Tortoise Care at the San Diego Zoo

It is easy enough to conceive of nonhuman agency when discussing an animal like Diego whose virility has garnered international fame. But recognizing distributed agency in the San Diego Zoo and the Galápagos breeding center is not just a matter of observing one tortoise's aggressive masculinity. Indeed, Diego was not known as a particularly virile tortoise in San Diego. As the zookeepers learned, many factors affected the reproductive success of the tortoise colonies—from climate and diet to soil and incubation. The period of zoo-based management from the 1930s to 1960s is one in which zookeepers learned to be affected, a phrase Latour uses to discuss how humans are conditioned by the material things with which they work (Latour 2004b, also Lorimer 2007). Through several years of daily observation and care for these reptiles, they attuned themselves to "reading" or understanding giant tortoise ecology (Hinchliffe et al. 2005). Although San Diego and other zoos achieved some success at producing a new generation of giant tortoises, the zoo colonies ultimately failed to live up to Townsend's dreams. But the experience at San Diego, one of the most successful of Townsend's colonies, is important for two reasons: first as a comparison with which to understand how giant tortoise reproduction was eventually successfully re-assembled in the Galápagos; and second, as a period for the development of much knowledge about giant tortoise reproduction and ecology, areas virtually unknown at the start of the project.

When Townsend returned from his 1928 tortoise-collecting expedition, he had received a "score of applications" for the tortoises (1928). One of them was from San Diego Zoological Society President Harry Wedgeforth, who described his personal commitment to raising tortoises and a potential five-acre enclosure with grassy sloping hills and shade trees he thought would be most suitable for them.[105] Wedgeforth's bid was successful and the zoo soon received 30 of Townsend's collection (Townsend 1928). Although he was not part of this first cohort, Diego joined the tortoise colony in San Diego in the mid-1930s with six other juvenile tortoises, all from Española Island.[106] Although the specific records for this group are now lost, these new tortoises are thought to have been brought back by one of several wealthy gentleman naturalists

[105] H.Wedgeforth to C. H. Townsend, January 10, 1928. New York Aquarium Director's Files. H.M. Wedgeforth Folder. RG 7, Control 1009. Wilderness Conservation Society Archives.

[106] Although the specific records for this group are now lost, these new tortoises are thought to have been brought back by one of several wealthy gentleman naturalists who lent their yachts for scientific expeditions and sport fishing in Galápagos.

who lent their yachts for scientific expeditions and sport fishing in Galápagos. Based on surviving records, these tortoises were thought to have been between ten to twenty years old (Interview 1/25/12). When keepers eventually numbered the herd, then-nameless Diego became known as "No. 21." At the zoo, the tortoises all lived in a large grassy yard, which they quickly turned to mud. They were favorites of young zoo-goers, who could climb on the backs of these giant reptiles for a tortoise ride.

In the first years of Townsend's tortoise experiment, the focus was not on breeding, but simply keeping the young giants alive and growing. In the beginning, Townsend kept a running tab on tortoise deaths in the colonies from his office in New York. By December 1930, fifty-three of the original hundred and eighty had died. The San Diego herd had lost eleven to enteritis, and the Superior, Ariz., herd lost twelve to pneumonia.[107] Despite their enthusiasm, none of the caretakers really knew much about the needs of these giant tortoises. The tortoises' behavior and ecology in the Galápagos had only been briefly observed during collecting trips. Whether they would reproduce outside of the native environment was very much an experiment that depended both on the tortoises themselves as well as on these men's abilities to produce a suitable environment. In what follows, I examine the various problems faced in breeding efforts and how caregivers responded to them in order to track the evolution of knowledge about tortoise biology through conservation efforts.

What a suitable environment would be was a matter of trial and error. Townsend tried to standardize living conditions and diet for the colonies, visiting the herds and writing to keepers

[107] C.H. Townsend Files. New York Aquarium Director's Files. Folder: "Tortoises Lost 1928-1931." Wilderness Conservation Society Archives.

about diet and wintertime care.[108] He moved several tortoises out of cool climates without sufficient winter protection.[109] Even in San Diego, reported a later curator, "during the winter months…it is necessary to 'put the tortoises to bed' every evening to protect them from the cold and rain, since these animals are prone to respiratory ailments" (Shaw 1967, p.122). In addition to warm housing, Townsend advised daily feeding of greens and vegetables. In the Honolulu colony, long-time keeper Jack Thorp reported that "in the early days of their captivity we had some trouble with their digestion and their feces were watery and smelly; not like the compact stool as described for the animals in their natural habitat. The diet was improved by adding coarse roughage to the fare of lettuce, cabbage and fruit" (Thorp 1969, p. 30).

By 1937, things were looking up: Townsend reported that the colonies were in "prosperous conditions" and growing satisfactorily—length and weight being the prime measures of the colonies' health (Townsend 1937, p. 287). He reported good success in the warmer climates of southern Florida, Honolulu, and Bermuda, but noted that there had also been "good growth in Houston and San Antonio, due to the daily feeding of vegetables, in addition to warm housing in winter." [110]

But two years before his death in 1944, although the transplant tortoise populations had stabilized, Townsend deemed his breeding experiment a failure, noting that "eggs deposited in our comparatively cold soil fail to hatch" (1942, p. 109). Meager numbers of hatchlings and unpredictable successes were far from what he had envisioned as saving the giant tortoise. False

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[108] See for example MacDougal to Townsend Correspondence, May 11, 1928. C.H. Townsend Files. New York Aquarium Director's Files. Folder: Boyce Thompson Southwestern Arboretum, 1928-1930. Wilderness Conservation Society Archives.

[109] Townsend to Crider Correspondence, December 5, 1930. C.H. Townsend Files. New York Aquarium Director's Files. Folder: Boyce Thompson Southwestern Arboretum, 1928-1930. Wilderness Conservation Society Archives.

[110] Townsend to Crider Correspondence, December 5, 1930. C.H. Townsend Files. New York Aquarium Director's Files. Folder: Boyce Thompson Southwestern Arboretum, 1928-1930. Wilderness Conservation Society Archives.

starts were frustrating: Townsend reported that "attempts have been made at Miami, Florida, to hatch the eggs in protected tubs of dry sand. Two eggs hatched in 1940 and the young tortoises were kept indoors during chilly weather: now the young tortoises are nearly two years old. That experiment was encouraging and it was repeated in 1941, but no eggs hatched" (1942, p. 109). By 1941, only nine baby giants had hatched: seven from three different clutches in Bermuda and two in Miami. Although females in the various colonies regularly laid eggs (demonstrating that Townsend's young tortoises had reached breeding age), most proved to be infertile.

During the 1950s and 1960s, keepers attempted to address a variety of problems they thought might be behind this sporadic reproduction success—from trying to improve copulation success, to nesting behavior, to incubation chambers. A rivalry developed between the Honolulu and San Diego Zoos, which each re-did their tortoise enclosures to try to increase reproduction. As current SDZS Herpetology Curator Kim Lovich told me, "It was almost like there was this internal competition with the Honolulu Zoo. We are close with them, and they got Galápagos tortoises and so did we. I think they beat us by a year or two. Then it was like, how can we get these guys to breed? What else can we do? How many more eggs can we get? …they had pretty good success and so did we. But even then we didn't have the incubation parameters or how to take care of the eggs down … So it was a learning process…They would get good clutches, but from what I can see the fertility rate was really low" (Interview 1/25/12).

After some initial hatchlings in 1954, the Honolulu Zoo tried to find the "hidden factors in establishing a consistent reproduction program" (Thorp 1969, p. 30). They built mud pits for the tortoises to wallow in, in hopes of increasing males' fertility. They also separated the males and females for 6 months of the year, thinking that "attempts at mating carried on throughout the year might have been 'too much of a good thing.' It was apparent that, though the males persisted, the females were not receptive and just clamped their bodies tight to the ground" (Thorp 1969, p. 30).

Eager to also produce new tortoises, in late 1957, the San Diego Zoo modified its tortoise enclosure by digging out one end of the yard to a depth of 40 inches and replacing the soil with sand. "This," then-curator Charles Shaw wrote, "we hoped, would do the trick insofar as tortoise reproduction was concerned" (1959, p. 4). "What was most lacking in the captive environment of our tortoises was a suitable area for copulation. The earth in our tortoise enclosure is what is known locally as adobe, which makes an extremely hard and unyielding surface. After many years of observation we felt that the primary reason for the infertile eggs was simply the inability of the male tortoise to get the rear of his shell into the proper position to achieve copulation." (1967, pp. 121-122).

Another problem was females' inability to dig nests to lay their eggs and adequately protect them. Shaw (1967) describes a female who sniffed and dug holes for several weeks, but didn't lay her eggs. "It appears that during particularly dry winters in the San Diego area, the females may have difficulty in finding a nest site to their liking. In such cases, we have employed a lawn sprinkler covering a wide area to wet down the sand thoroughly. This generally induces the female to lay. Usually the nesting and laying process is completed in a single evening" (1967, p. 123). But eggs were often broken during the nesting process, as females dropped one on top of another into nests or while they covered them with dirt. At one point, San Diego keepers tried to patch cracked eggshells with a vinyl acetate solution, although they too proved to be infertile. Another strategy was for a keeper to simply catch the eggs as females laid them, but even this did not prevent them from cracking (ibid).

Thus in processes of experimentation the keepers tested various "tricks" with "vibrant matter"—mud, adobe, sprinklers—to address reproductive problems. By 1958—thirty years after the San Diego Zoo got its first giant tortoises—the adjustments paid off: that October, the Zoo had its first five giant tortoise hatchlings. This, Herpetology Curator Charles Shaw wrote, was "perhaps the most exciting event ever to occur in the history of the reptile side of things at the zoo" (1968, p. 12). In 1961, another group of 4 babies hatched at San Diego. "The newly hatched tortoise babies are perfectly formed miniatures of the adults, but are more attractive in color," Shaw wrote. "They look like a piece of polished ebony, with more or less conspicuous yellowish rings surrounding a large central spot of shiny black in each of the large plates on the carapace or upper shell" (1961, p.12). Not all the babies survived, but most grew rapidly, leading Shaw to declare the "new generation" had begun.

But despite these successes, the process was far from routine. Practices that worked once did not necessarily work again; reproduction remained tricky. Fertility rates were alarmingly low. Between 1961 and 1967, the San Diego Zoo incubated 258 tortoise eggs, but only 17 hatched (Shaw 1967). Clutches were incubated in a large crock, which was kept in the warmest corner of the Reptile House, but the temperature was not consistent and the incubation periods ranged greatly, from 174 to 246 days. The Honolulu Zoo also used an artificial incubation chamber—a large cement pot. As Thorp described, "Four inches of soil from the nest were placed in the bottom, after the container itself was well saturated with water. The eggs were placed carefully one upon another in the same manner as they were deposited by the female. The opening was then sealed with glass and black tar paper." (Thorp 1969, p. 31). That year, Honolulu incubated twenty-seven eggs and hatched twenty-two, showing an 81.48 percent fertility rate. Thorp was confident about the program: "One incubation season is insufficient from which to draw conclusions," he wrote. "But it seems that the Galápagos tortoise is capable of reproducing itself in considerable numbers if given proper management in captivity" (1969, p. 31).

But nearly a decade after the first successful hatchlings in San Diego, Charles Shaw was less optimistic. Because of low fertility rates in his colony and others, he concluded that the giant tortoises were probably incapable of reproducing in large numbers: "it is my own conviction that these tortoises probably, within at least recent times, have never reproduced in substantial numbers. They may now be inherently incapable of doing so."[111]

Thus, after forty years of zoo-based care, Townsend's breeding experiment was far from the success he had hoped. Although keepers had come a long way in their ability to understand the needs of the tortoises—from limited copulation availability to sandy nesting soil to warm incubation chambers—relatively few tortoises had been born in captivity. What's more, as these babies grew, it became apparent that many at San Diego were not entirely healthy—they suffered from slightly deformed or soft carapaces that grew too fast for their bodies (Staeheli 1972, Lovich interview 1/25/12). (Keepers now attribute this to both possible cross breeding of tortoise populations[112] as well as diet and overfeeding.[113]) Today, the San Diego Zoo still has 11[FC] of its original Townsend herd and has hatched about 100 Galápagos tortoises, though only one of

[111] He based his argument on the few predators Galápagos tortoises face in their natural environment, citing Hendrickson (1965) who wrote that "only the […]nearest fraction of the eggs laid had to survive to adulthood in order to replace the old animals which died annual. If, once a decade, thing worked out to allow the year's nests to produce new recruits to the population, there would probably be more than enough young to replace the oldsters who disappeared. The population would remain stable and at the capacity of the land" (1967, p. 31).

[112] Up until about ten years ago, the San Diego Zoo kept all of its giant tortoises together in one yard or separated males from females for much of the year. All Townsend's original tortoises were taken from Isabela Island, but because zoos received additional donations, most either never knew or lost track of what original populations their tortoises were from. Only in the last ten years have geneticists recommended that zoos separate their giant tortoises by population (species or subspecies).

[113] In Honolulu, new tortoise hatchlings were fed bone meal, horse meat, and dog food in addition to fruits and vegetables because they were thought to need more protein. This was not uncommon zoo practice.

the new generation still remains with their herd.[114] Although Townsends' herds have had high educational value for scientists (and zoo visitors), zookeepers were unable to consistently assemble the necessary elements to make tortoise reproduction thrive. Looking back on this history demonstrates how provisional knowledge of the species was when the breeding experiments began and just how uncertain goals to revive it were. This points to the multiplicity of conditions that matter for reproduction, demonstrating that successfully continuing the tortoise genealogy was not a simple matter of human will to save nature. However, the keepers did learn a substantial amount about tortoise reproduction, which was later applied and refined in the Galápagos.

Diego Goes Home: A New Breeding Center in the Galápagos

Not much is known about Diego's ("No. 21's") specific behavior in San Diego; he certainly had not yet earned his "super-macho" reputation. But by the mid-1970s, No. 21 had become known as a rather irascible tortoise that did not fit in well with the rest of the herd. In 1951, zookeeper Charles Shaw had written that "The Hood Island tortoises are…inclined to be much more quarrelsome, fighting more frequently among themselves than do the zoo's other tortoises" (1951, p. 3). No. 21 fit this description, but by then, the zoo did not know for sure which island in the Galápagos he was from. As Tom Fritts, a taxonomist and biologist then working at the San Diego Natural History Museum told me, based on the saddle-like shape of No. 21's shell in comparison to the more domed shells of the other tortoises at the zoo, as well as his coloring and behavior, "We could tell Don Diego [No. 21]…was different. He stayed away from the tortoises. He was more aggressive. He was in about five times as many agonistic

[114] Others have either died or been sold to private tortoise collectors. Because of deformities and unclear lineages, geneticists have deemed them inappropriate for further conservation breeding (Lovich interview 1/25/12.)

encounters with other tortoises as any other tortoise there. And the only other females he mated with were also other saddlebacks and semi-saddlebacks" (Interview 1/29/12, Schafer and O'Neil Krekorian 1983).

Figure 4.1 Diego Returns to the Galápagos Giant Tortoise Breeding Center, 1977

Photo source/ CDRS Archives

Fritts and Craig MacFarland, who had just spent two years surveying tortoise populations in the Galápagos, were convinced that No. 21 was an Española tortoise, and that he could do more good at the new breeding center in the Galápagos than he could in San Diego. So they arranged to get him back to Galápagos where he could join the other remaining Española tortoises at the breeding center. Despite a bit of trouble fitting him on a plane, No. 21 arrived at the *Centro de Crianza de Tortugas Gigantes* on Santa Cruz Island in 1977, after forty years at the San Diego Zoo (Bacon 1978, Fritts Interview [1/29/12]).

The Centro de Crianza was the first major conservation initiative started in the Galápagos.[115] In 1965, the giant tortoise breeding project began when CDRS staff brought Pinzon eggs back to their headquarters on Santa Cruz Island, where they incubated eggs and then raised hatchlings until they were large enough to survive in the wild. On Española Island park guards only found fourteen remaining tortoises. In 1966, they brought the first adult Española tortoises to headquarters to breed out of fear that the few remaining animals would not find each other on the dry island. The first clutch of twenty Española babies hatched in 1971. In 1975, when they were five years old, they were reintroduced to their home island (Merlen 1999).

Over the next decade, with substantial funding from the World Wildlife Fund (WWF, now the World Wide Fund for the Conservation of Nature), the *Centro de Crianza de Tortugas Gigantes* [Giant Tortoise Breeding Center] expanded to captive breeding of eight different populations of Galápagos tortoises. Today, in addition to the original center on Santa Cruz Island, two others have been built to raise tortoises on Isabela and San Cristobal Islands. Over the past forty-five years, the Galápagos giant tortoise program has become one of the most successful captive breeding and reintroduction projects in the world. More than 4,000 juvenile tortoises have been raised in the centers and returned to their home populations. In the words of one local author, CDRS and GNPS are "restoring the tortoise dynasty" (Merlen 1999). Today the national park estimates there are some 20,000 giant tortoises living in the wild and reproducing *in situ* in Galápagos.

[115] See Chapter 1, which details the founding of these institutions, which was primarily organized by a group of international scientists working under the auspices of UNESCO in coordination with the Ecuadorian government. CDRS was dedicated in 1964, when it began on-island operations; the first GNPS park wardens began working in 1968. The headquarters of the sister institutions are adjacent on Santa Cruz Island; indeed, the Centro de Crianza sits between them. Started by CDRS, it was co-managed for years and was officially transferred to the GNPS in 2000.

Diego has played a large roll in this success. About sixty years old, the newly christened "Diego" joined twelve females and two males from Española who were kept in corrals at the CDRS-GNP headquarters. He was originally put in a corral with another male and several females, and but his behavior toward the smaller male was so aggressive that keepers eventually moved him to his own pen. Today, Diego lives with five of the Española females in one of nine corrals and is the center's most prolific tortoise. Although he often hides out of site in thick, thorny shrubs, Diego is an aggressive tortoise, still thought to be in the prime of his reproductive years at around a hundred years old. He is popular with tourists—one of few named tortoises and the subject of jokes about virility that tour guides use to entertain what are often overly warm and sleepy visitors. (Nearly every organized tour through Galápagos includes a stop at a tortoise breeding center.) Diego thus embodies the nexus of both biopolitical aims of the breeding program—ecological restoration and tourism. Below, I examine how elements of tortoise reproduction were reassembled in the Galápagos in such a way as to make Diego's reproductive success possible by overcoming the infertility that plagued zoo colonies.

Breeding Atmospheres: Making Natural Spaces of Experiment

In the Galápagos, as in San Diego, producing baby tortoises was a process of experimentation and learning to read tortoise behavior. In the Galápagos, where conservation goals have always focused on preserving evolutionary processes, conservationists' strategy for breeding baby tortoises was to "duplicate [the] natural conditions" (McFarland 1974) of tortoise development—something that they had greater access to as a model for the breeding program. But as in San Diego, producing baby tortoises was a process of experimentation and learning to read tortoise behavior. Diego did not become a prolific stud until a host of other elements were assembled—from human practices of egg collection and care, to the "vibrant matter" (Bennett

2010) of nesting soils, incubators, and rearing pens, to the thermoregulation of baby giant tortoises. Through processes of experimentation in which different human and nonhuman elements assembled and re-assembled tortoise reproduction was eventually optimized and stabilized, and their genealogies became hybrid. Attention to the specific choreographies of assemblage and conservationist practice in the Galápagos can explain the differential success of the two breeding programs. It is not that one key element was missing in San Diego, but that the various elements of the assemblage came together more fluidly after additional experimentation in the Galápagos breeding center.

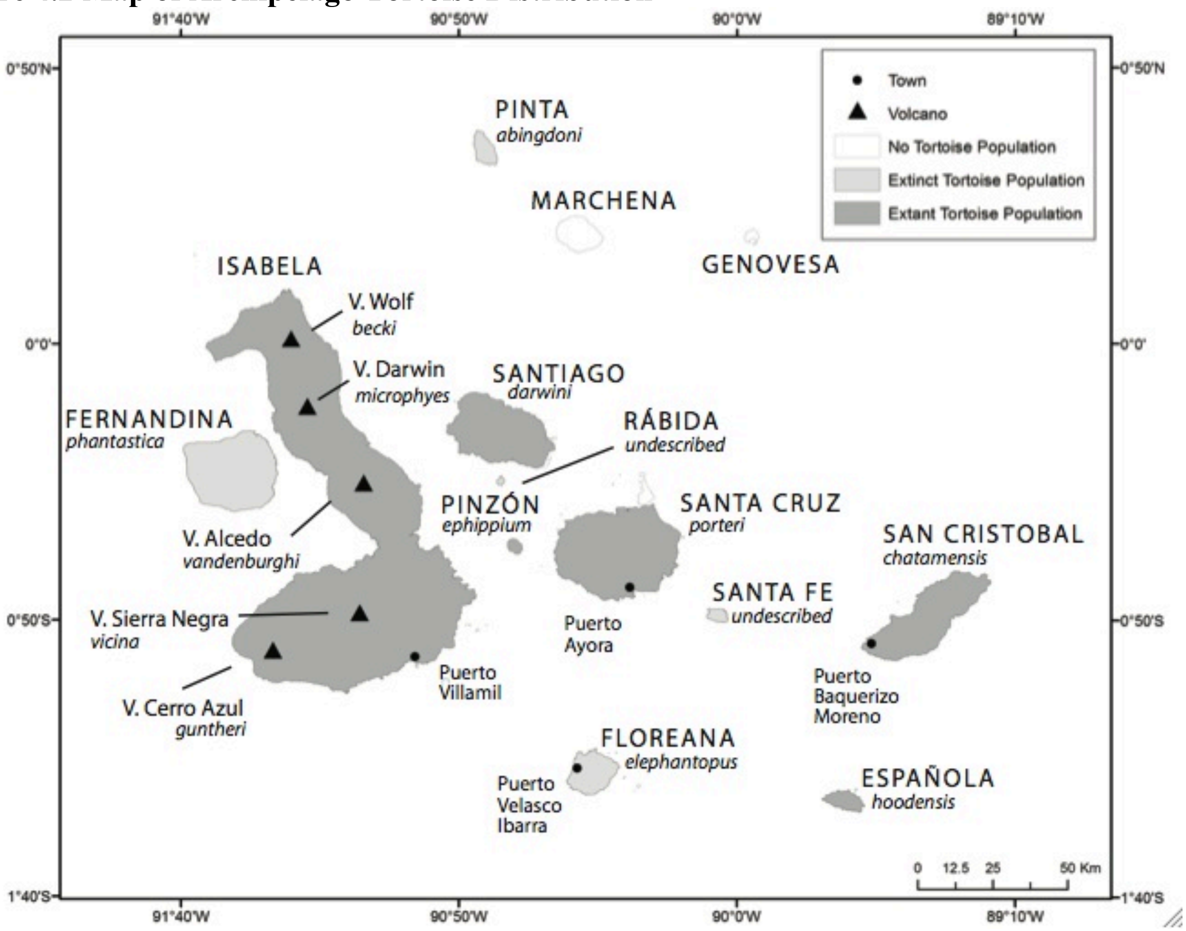
As a site of experimentation, I frame the breeding center as a laboratory for the production of nature in which conservation scientists were able to gain some control over tortoise reproduction. Laboratories are scientifically important spaces because of the way they reconfigure "outside" relations between people and nature within their borders. They are enhanced environments for producing natural knowledge and objects—places where relations of strength between natural and social orders are reversed, allowing scientists to gain some degree of control over biologies (and chemistries and physics) that escape their vision and grasp in the "real" world (Latour 1999, Knorr Cetina 1992). But not all biology laboratories are high-tech, sterile spaces like those required for genetic engineering (Livingstone 2003). I follow the spatial analytical focus of work on the key sites of scientific production by looking at the Centro de Crianza as a rather low-tech experimental space situated in the "lab-field border zone" (Kohler 2002) between the "wild" natural spaces of Galápagos and the zoos that house Galápagos tortoises further afield. The Centro de Crianza is a space in which scientists have been able to gain some control over the "wild" biology of tortoise reproduction, eventually allowing for the creation of baby tortoises in a predictable and replicable way.

To do this, the main challenge for conservationists was how to raise enough healthy tortoises to withstand reintroduction and eventually breed on their own *in situ*. They faced two central problems: improving hatching success of incubated eggs and improving high mortality among juveniles, who suffered from physiological deformities and respiratory problems (MacFarland, Villa, and Toro 1974). During the 1970s and 1980s, scientists worked out solutions to these problems that allowed them to standardize the production of baby tortoises and replicate their methods in two additional breeding centers on other islands (Marquez, Cayot, and Rea 1999). Although human agency is a key part of this story, even human action had to be proscribed, made to conform to the other actants in the assemblage, and routinized to keep the choreography moving (Law and Lien 2012). The key to the breeding center's strength (as any laboratory's, Latour 1999) is its ability to routinize the form and process of assemblage of the diverse elements of giant tortoise reproduction, including mating pairs, egg handling, incubation temperature, feeding practices, and thermoregulation. In what follows, I analyze how these choreographies of practice in the Galápagos developed around three key experimental sites within the breeding center: corrals, incubators, and rearing pens.

Corrals

The spatial organization of the Centro de Crianza is fundamentally different than it was at the San Diego Zoo. Unlike zoo populations, at the Centro de Crianza, breeding tortoises have long been separated according to population of origin. Each corral at the breeding center houses a distinct population of five to twenty tortoises, all individually numbered so they can be kept track of. As shown in Figure 4.2 below, today ten of what were once fifteen different populations or subspecies of giant tortoises remain. Tortoise breeding in the Galápagos has always focused on increasing the number of tortoises living in each of these wild populations—making the geographical and biological distinctions between these populations key.

Figure 4.2 Map of Archipelago Tortoise Distribution



Source: Adapted from Poulakakis et al. 2008

For Galápagos conservationists, the goal was to preserve the evolutionary sanctity and biological purity of different tortoise populations. As one long-time CDRS scientist told me, "…the original park goals…were not only to preserve the biological diversity, but also maintain ecological and evolutionary processes… because evolution was such a major thing in Galápagos history, they wanted to maintain evolutionary processes in an unaltered state" (Interview 1/30/12). In this way, conservation breeding in Galápagos differs from other practices of animal husbandry and laboratory manipulation (Franklin 2007, Ritvo 1997). They all constitute processes through which humans work to improve species, but what is distinctive about conservation breeding, at least in the case of the giant tortoises, is the form this "improvement" takes. Because of the emphasis on retaining evolutionary processes and restoring "pristine" nature, the goal of the Centro de Crianza is not to improve specific *biological qualities* of the species, as it is for horses, sheep and "purebred" dogs that are bred to type (Haraway 2008, Franklin *ibid*), but to improve the endangered species' *population numbers* as well as the "prehistoric" purity of these populations.[116]

The spatial organization of the breeding center reflects this goal of retaining population purity—tortoise populations are clearly separated and marked as they move through each site of the breeding process. The nine corrals that house groups of adult tortoises are the foundation for what is today a highly routinized process of production of baby tortoises that works through ordered surveillance and care. Five different populations of giant tortoises are now raised at the Santa Cruz Centro de Crianza: adult tortoises from Española, Pinzon, and Floreana breed at the center and eggs from two close islands are brought back from "natural" nests to be incubated and raised at the center. Every year, the Centro breeds a cohort of more than one hundred babies, under the leadership of Park guard Fausto Llerena, a septuagenarian who has worked with them for more than 30 years. The parameters for breeding baby tortoises are elaborated in an operating manual (Marquez, Cayot, and Rea 1999) that details both seasonal care through periods of nesting, incubation, and hatching, as well as weekly schedules for feeding and cleaning. As a volunteer at the center in August 2011 and repeated visits during the following seven months, I

[116] Species purity is today measured through genetic phylogenies, something I take up in a separate paper that explores the discovery of hybrid tortoises from a lineage thought to have gone extinct more than 150 years ago. GNPS is now beginning to bring this extirpated population back to life through directed breeding.

learned these routines first hand. Each corral, about 20x50 square meters enclosed by lava rock walls, has a feeding platform, wading pool, and a sandy nesting site carved into otherwise natural vegetation—dense, thorny shrubs, Mu-yu-yu trees, and Opuntia cacti that grow well in lava rock. Three days a week Fausto, another Park guard, Moises Villafuerte, and volunteers feed the adult and baby tortoises coarse greens (either otoy stalks or portotillo branches—there is not much palatable vegetation in the corrals, except for Opuntia cactus pads, which fall periodically) and fill their watering pools. Each tortoise is numbered so that the park guards can keep track of them. The corrals house between five to twenty adult tortoises [some corrals are much larger than others], females generally outnumber males.

Figure 4.3 Galápagos National Park Guards Mark Excavated Tortoise Eggs

Photo/ Elizabeth Hennessy, August 2011

During nesting season from July through November, Fausto and Moises survey the corrals daily to look for fresh nests, which are covered with slightly domed dirt caps. On average, female tortoises can lay two to three clutches of six to fifteen eggs per year. Females use their hind legs to dig holes that are generally about 25cm deep and 15 cm wide. Once they drop their clutch, they then recover the nest with dirt, urinating on it frequently to create a muddy cap that will dry into a hard shell. As a volunteer, Fausto and Moises taught me to excavate the nests the afternoon after they were laid. I watched them wrench off the dirt caps with worn machetes, somehow never puncturing an egg, and then carefully scoop out anywhere from two to fifteen eggs about the size of a pool ball. Fausto then marked the top of each egg with an X, being careful not to rotate the egg and dislodge the yolk membrane's connection with the shell. He also recorded (on the egg, in pencil) the number of the dam (identified by muddy rear feet), the nest number, and the number of eggs in the nest. We then carefully walked the eggs to a small house at the center of the breeding area, where they would be installed in incubators.

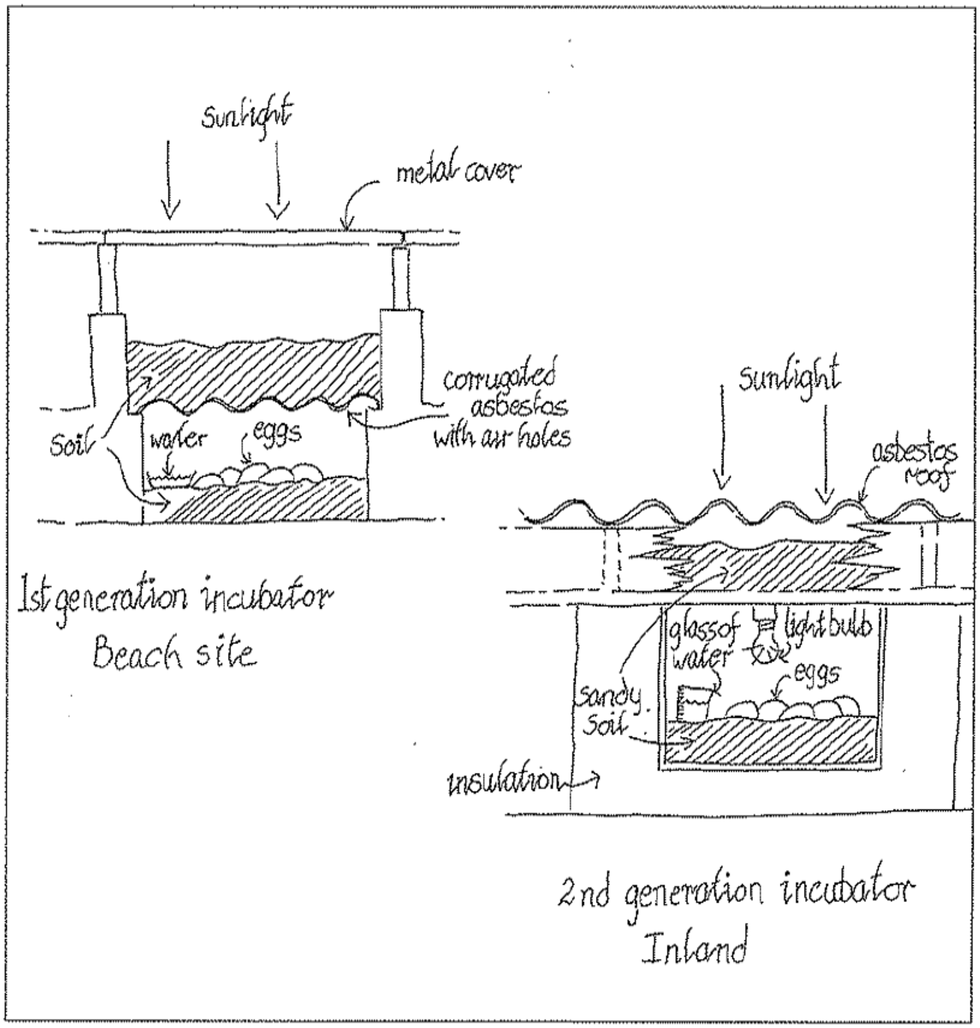
Incubators

Today, about 70 percent of the incubated eggs will hatch and grow into healthy juvenile tortoises. But in the early years of the breeding program, only about 25 percent of incubated eggs hatched (Marquez, Cayot, and Rea 1999). Although the processes of human care have been standardized to facilitate regular successful breeding, this was only accomplished through a period of experimentation in which different elements of the reproductive process assembled and re-assembled. If the adult corrals provide the foundation for successful breeding by separating tortoises by population, then incubators and rearing pens for juvenile tortoises were key experimental spaces in which conservationists were able to gain some control over tortoise reproduction by recreating "natural" atmospheres of reproduction.

The incubators served as a techno-natural assemblage in which controlled climate and humidity have not only increased hatching success. Since the first Pinzon eggs were incubated in 1965, conservationists have used four different incubators for the eggs, each one giving them slightly more control over moisture, humidity, and temperature, which are crucial for successful ontogeny. The first incubator was a lava rock base with a "nest chamber" made from corrugated asbestos covered in soil and capped with black metal (Merlen 1999, p. 16; See **Figure 4** below).

Inside, staff placed a bowl of water of keep humidity levels high. When the temperature rose to 35C, they opened the chamber door to cool it (*ibid*). However, the incubator was located on the beach and the sea air was thought to be too cool for the eggs and small hatchlings kept in chicken wire pens nearby.

Figure 4.4 Design of Early Tortoise Incubators



Source/ Merlen, 1999

In 1970, a new tortoise rearing house and incubators were built about 200 meters inland to remove the eggs from the salty breeze. The new incubators followed the original design, adding insulation and a light bulb to generate heat, but this assemblage was still not sufficient to improve hatching success. In the mid-1980s, CDRS contracted U.S. and Ecuadorian biologists to improve the breeding program. The team, led by Howard Snell, overhauled the incubation process. By then, it was well known that the sex of many reptiles is determined by the temperature at which they are incubated. So they ran several experiments to figure out whether this applied to giant tortoises, and if so, decide on the ideal temperatures for incubation. This required incubators in which scientists could more exactly control temperature. Snell first imported modern incubation ovens, which he said only lasted for about a year because of erratic power surges. Galápagos, he said, necessitated a lower-tech solution, so he built two double wooden cabinets heated by hair dyers, which he rigged to cycle on and off according to a temperature gauge (Snell Interview, 1/30/12). (See **Figure 4.5**, below.)

Figure 4.5 Hair-dryer Heated Incubation Cabinet

Photo/ Elizabeth Hennessy, August 2011

Clutches of eggs were placed in plastic tubs filled with vermiculite to hold heat and moisture and covered with plastic. The team's experiments not only showed that the tortoises were temperature-sex dependent, but also greatly improved hatching success. Today, these incubators are still used: park wardens "cook" two-thirds of each clutch at 29.5C to produce females and one-third at 28C to produce males—a ratio aimed to facilitate quick population growth. The incubators demonstrate that even low-tech apparatuses can have considerable influence on the production of life. Standardized in a routine choreography, the incubators not only ensure successful development of embryos, but allow scientists to control male/female sex ratios. While they allow for considerable biological control, the parameters of this control are very narrow; scientists could not bend tortoise reproduction to their will, but had to learn to adapt their breeding methods to optimize success.

Rearing Pens

Snell's team also revamped the rearing pens. The original rearing house, built in 1970 with funds from the San Diego Zoological Society, was a thirteen-sided round cement building with tortoise pens around the interior. The pens had concrete floors, small water dishes, and 1,000 watt tungsten blubs to provide light and heat. But even in this dedicated, modern space designed for the purpose of raising tortoises, the juveniles did not grow well—pointing to the fact that even comparatively well-informed attempts to manufacture nature are not always successful. Scientists thought the hatchlings were not getting enough sunlight,[117] so they built exterior runs on each pen so that the tortoises could wander outside. They also built a few outdoor overflow pens to house the growing number of hatchlings.

Snell's team reworked the rearing pens after doing an experiment to see whether indoor or outdoor rearing produced healthier tortoises. Snell said that after reviewing survivorship records from the rearing house, they realized there was very high mortality associated with the house. As he told me, "when we got there in '84 the first thing we did was start an experiment where we realized that there were thermal problems with hatchlings being on the cement, so we wanted to get them on natural substrate. So those original cinder boxes, we filled them half up

[117]Lack of sunlight is now known to be a common cause of metabolic bone disease in reptiles; it causes imbalances in calcium and phosphorous, which can lead to the softening or spotting of carapaces in turtles and tortoises.

with large boulders and then gravel and then dirt to provide drainage. We also gave them some shade so the tortoises could live there…We did a very simple experiment where we kept half the tortoises where they used to be and put half the tortoises outside. They survived better, grew better, outside" (Interview 1/30/12). In the outdoor pens, the tortoises had greater access to sunshine, soil warmed by the sun instead of cool concrete, and were able to "roost" at night (Merlen 1999). The outdoor pens provided access to sunlight that allowed the reptiles to thermo-regulate, while still sheltering young tortoises in a controlled atmosphere that limited landscape hazards and predation.

These outdoor pens are still used today. When each new cohort of eggs hatches (January-April), they are separated according to population, numbered, and placed in small pens where they will spend the first years of their lives. When they are two years old, they are transferred out of the rearing pens and into a corral for juveniles so that they can learn to climb over rocks, walk far distances, and become acclimated to a natural landscape. Babies are fed a "salad" of the same greens as adult tortoises, chopped into small pieces. When the young tortoises are four to five years old, they are repatriated to their home populations.[118]

Incubation and rearing experiments have dramatically improved breeding success—hatching rates went up to about 70 percent from and average of 26 percent in the 1970s while mortality of juveniles decreased from 14 percent to 1.6 percent after the construction of more outdoor rearing pens (Cayot and Morillo 1997). Now part of a routine choreography at the center, the incubators and rearing pens were experimental spaces in which scientists were able to

[118] See Chapter IV on repatriation efforts. There is not good longitudinal data on the survivorship of repatriates, but 50 percent of Española repatriates are thought to have survived, which biologists consider successful (Gibbs interview 12/16/11). The first Española repatriates have now reached breeding age and have begun to reproduce *in situ*.

gain control over tortoise reproduction by simulating “natural” atmospheres of development. Outdoor rearing pens provided access to sunlight that allowed the reptiles to more naturally thermo-regulate, while still sheltering young tortoises in a controlled atmosphere that limited landscape hazards and predation while providing ready food and water. In these ways, CDRS and GNPS staff were able to maximize the exposure of eggs and hatchlings to beneficial conditions while limiting negative exposures actually found in the wild. From organization to incubation to feeding, the practices of caring for tortoises in each of these carefully constructed sites have allowed for the continued genealogy not only of Diego as a hyper-prolific stud, but for each of the different populations of Galápagos giants.

Conclusion: Conserving Hybrid Natures

Because of the center’s success, CDRS herpetologists wrote that following decades of human intervention in producing tortoise life, a return to natural reproduction *in situ* was near, at least for Diego’s Española population: “As we enter the new century, intensive management of this population may no longer be necessary…Española is returning to a more pristine condition as a result of the research and management programs …By the end of this century, the Española tortoise population will be well on its way to complete recovery” (Cayot and Morillo 1997, p. 180). Today, Diego remains at the breeding center, where he and his female corral-mates continue to reproduce. His story provides a unique window into the complex interactions been humans, tortoises, and a diverse array of vibrant matter that has gone into “saving” the species by producing “prehistoric” life.

Comparative study of assemblages of reproduction in San Diego and the Galápagos demonstrates that the reproduction of wildlife is neither a natural matter of tortoise biology nor the product of human mastery of nature. Instead, the diverse assemblages that comprise the breeding center create tortoises with genealogies that enfold millennia of evolutionary selection as well as recent human-designed and assisted reproduction. Diego's prowess is not 'natural'—he was not a star stud in San Diego, but only became so through the particular conditions assembled in the Galápagos. Analyzing the processes of experimentation in San Diego and the Galápagos—from the configuration of nesting sites, to incubation chambers, to diet and exposure to sunlight—emphasizes the diverse assemblages of vibrant matter that go into the reproduction of tortoise life. It attends to both the construction of scientific knowledge about an endangered species and how this knowledge is employed to facilitate the continued reproduction of the species. Highlighting the socio-natural processes of tortoise reproduction, allows us to attend to the role of human labor, vibrant matter, and technologies as an irreducible part of the production of wildlife. Successful captive breeding is not attributable to one tortoise's virility nor a matter of human control over nature. As caretakers' struggles to optimize tortoise reproduction demonstrate, successful breeding does not constitute an unmitigated level of biological control. Instead, the production of wildlife involved decades of close attention to a wide variety of material agencies as scientists, conservationists, and zookeepers learned to be affected by vibrant matter that matters for tortoise reproduction.

In the Galápagos, this prolific production of tortoise life allows for the continuation of a prehistoric species endangered by humans' past predation. These assemblages of reproduction are apparatuses of nonhuman biopolitics used to produce ideal populations of tortoise life in accordance with conservationist goals to manage the extinction of an endangered species. Giant tortoise breeding also serves as an important tourism activity for both the entertainment and education of visitors to the islands. Reproducing tortoise life allows for the reproduction of the Galápagos as a site of pristine nature, a framing that is central to both conservation and tourism.

The end goals of this production may be to preserve or even restore evolutionary processes, but these tortoises are not prehistoric creatures untouched by humanity. Even as conservation has sought to protect nature, it has taken an active role in shaping it. The experience of conservation breeding demonstrates how social and biological histories become enfolded in through the reproduction and remaking of wildlife genealogies.

CHAPTER V: GENETIC PHYLOGENIES, NONHUMAN BIOPOLITICS, AND THE RE-ANIMATION OF LIFE

"The past is never dead. It's not even past." - William Faulkner, 1950

Introduction

This is a story about resurrection. It is a monster story about zombies—the tale of an extinct species of Galápagos giant tortoise that has been brought back from the dead. In 2008, a team of Yale conservation biologists conducting genetic analyses of populations of giant tortoises in the Galápagos Islands hit upon a remarkable discovery: out of a set of more than 1,600 individuals' blood samples, 84 of the sampled tortoises were first-generation (F1) descendants of a species of giant tortoise from Floreana Island that by all accounts went extinct more than 150 years ago (Poulakakis et. al. 2008). When Darwin visited the island he noted seeing tortoises there, but twenty years later, sailors reported they were gone (Broome 1929). This, the team noted, is thought to be the first "rediscovery of a species by way of tracking the genetic footprints left in the genomes of its hybrid offspring" (Garrick et. al. 2012).

But when these "extinct" tortoises first turned up, the team didn't know what they were – they called them "aliens." What's more, they were not found on Floreana, but on a volcano on the opposite edge of the archipelago, where they had interbred with the native population. So while their re-discovery was remarkable, it has also posed a problem for conservation: how to manage a new population of "mixed" hybrid aliens in a place that has long focused on retaining the evolutionary "purity" of its populations.

This chapter explores how these taxonomic misfits were discovered, eventually made sense of, and put to use in a conservation project aimed to restore the ecosystem of their "native" island. In the context of broader ecological restoration projects in the Galápagos, these resurrected tortoises are now at the center of plans to "re-tortoise" Floreana Island through captive breeding and recolonization.

In exploring the re-animation of these zombie tortoises, I examine the nonhuman biopolitics of conservation genetics and what it means for thinking about the origin of species, that famous evolutionary question. I ask what the monstrosity of these tortoises can tell us about the origins of pristine nature? I argue that genetic science is redefining pristine nature in the Galápagos from spatially isolated populations to the purity of lineages. As a result, conservation practice is increasingly concerned not only with the sanctity of territories, but also of genealogies. In an era in which genetics offer the ability to assert an unprecedented level of "biological control," genetic studies of tortoise evolution have unleashed new forms of monsters that compromise the purity of species lineages. In the context of "conserving evolution" these monsters must be purified—made to fit "natural" patterns of evolution in the islands.

This chapter examines how genetic science is reshaping the methods and possibilities of conservation practice. In comparison with debates about genetic reconceptualizations of human life, relatively little critical work has explored the ramifications of the genetic revolution on animal lives. Two exceptions are work on the production of animals for scientific research, a broad field from which much genetic science emerged (Kohler 1994), and livestock agriculture, a field in which genetics has become a key strategy for utilitarian ends, such as increasing production value (e.g., Morris and Holloway 2009). But genetics are also reshaping conservation with the profound ontological possibility of bringing extinct species back to life.

In this chapter I trace how genetic reconstructions of the phylogeny, or evolutionary history, of one group of endangered species is shifting the strategies and possibilities of biodiversity preservation. In the Galápagos, genetic knowledge is both reinforcing and destabilizing assumptions on which conservation policy has long been based from the contours of what once seemed to be clearly isolated and distinct populations, to the evolutionary relationships among them. In doing so, it produces new understandings of nonhuman species purity and monstrosity as conservationists are faced with a new population of "impure" and misplaced genetic hybrids. I examine how genetic information is used to define "pure" tortoise populations and how the protection of the purity of these genetic lineages becomes the goal of conservation that seeks to preserve evolutionary processes. Tracing how the "alien" tortoises first emerged from the cracks of phylogenic representations of evolutionary history and were eventually made legible within this classificatory framework puts the biopolitical power of genetic mappings into relief. But at the same time, attention to the alien's monstrosity and the technologies necessary to make sense of them destabilizes such mappings of pristine evolutionary history.

In the following sections, I first review how the genetic revolution reshaped understandings of life itself, paying particular attention to the reformulations of nature and the biopolitics through which it is managed. I then explore applications of genetic science in conservation before turning to the specifics of the case. To trace the emerge of the re-animated tortoises from "aliens" to hybrid Floreana specimens, I examine several of the genetic maps produced by the Yale team, analyzing how they reshape the nature, geography and biopolitics of this endangered species. Finally, I discuss two possible options for restoring the Floreana population—backbreeding to a state of genetic purity and delineating between hybrids with high-and low-genetic conservation values. I conclude by analyzing the relation between genetic readings of animal nature, the origins of pristine nature, and rewilding as a strategy for preserving the evolutionary processes for which the Galápagos are so famous.

Genetic Revolution and the Redefinition of Life

Over the past century, genetic science has revolutionized the study of life—from the rediscovery of Gregor Mendel's experiments on plant heredity in 1900 to Watson and Crick's discovery of the double helix structure of DNA in 1953 to the mapping of the human genome at the close of the century. In 1943, Julian Huxley called the joining of genetics and evolutionary theory the Modern Synthesis—demonstrating that genetics provided the mechanism of inheritance missing from Darwin's theory of evolution by natural selection (Huxley 1943). As Crick famously declared, the structure of the double helix, with its self-replicating, complementary base-pairs, held the "secret of life" (Watson 1968, p. 197, quoted in Keller 2000, p. 23). Watson and Crick's discovery was a crowning moment of mid-century biology. For half a century, biologists had sought an entity analogous to atoms and molecules, the fundamental elements of physics and chemistry that would explain the stability of traits inherited through generations. The double helix thus cemented the Modern Synthesis; genes were broadly cast as the informational basis of life, a code with the potential to unlock secrets of development (Keller 2000). This essentialization, and fetishization, of genes as *the* sources of biological value, both for shaping life and as a vein for commoditization, has been widely celebrated, perhaps nowhere so clearly as in Richard Dawkins's account of the "selfish gene" as the self-sustaining "master molecule" of life (Dawkins 2006 [1976]).

But essentializations of genes as determinants of the structure of life are far too simple a story. During the second half of the twentieth century, genetic science focused on the identification of DNA evolved into study of genomics and the recombinant possibilities of biotechnologies. Triumphalism over the isolation of genes has faded as we realize the complexity of systems through which genes themselves are controlled. Recent work, particularly in the fields of evolutionary development and epigenetics, has considerably complicated the notion that genes are stable foundations of life by showing that they themselves are evolutionary products (Keller 2000, Oyama 2000). As Haraway notes, "a gene is not a thing, much less a "master molecule" or a self-contained code" (1997, p. 142). The field of epigenetics demonstrates that genes are not blueprints, but are triggered in a dance of chemical interaction with their cellular and ecological environments (Oyama 2000).

With this shift to the study of the complexity of developmental systems, the "century of the gene" did not last (Keller 2000). But even if we can no longer claim that genes hold the secret of life, genetic science has profoundly changed the conceptual landscape of biology. This has wide-reaching implications for related fields that draw on this new scientific gaze, forms of imagining and intervening in life, and ways of defining and governing the body politic.

The isolation of genes as mechanisms of biological inheritance ushered in new understandings of "life itself"—for both humans and nonhumans (Franklin 2000, Rose 2007). The turn to genetics in biology is an epistemic shift in understandings of life, much as the move from natural history to biology was with the advent of evolutionary theory (Rose 2007, Franklin 2000, Foucault 1970, Canguilhem 1960). As Rose argues, the rise of genetics amounted to a "reorganization of the gaze of the life sciences: their institutions, procedures, instruments, spaces of operation, and forms of capitalization" (2007, p. 44).

Among the key implications of the geneticization of biology are the ways it has produced new geographies of life. Understandably, most critical analyses of genetics focus on its implications for human populations, although nonhuman animals have figured centrally in the development of genetic science (Rader 2004, Haraway 1997). In the following section, I review major implications of how genetics are reshaping the nature, geographies, and biopolitics of human and nonhuman lives.

Genetic science has shifted the biological gaze from the molar scale of bodies to the molecular scale (Rose 2007). This shift to the molecular scale invokes new bodily spatializations, or corporealizations, in Haraway's terms (1997), as bodies come to be represented through genetic maps that open new doors for valuation, fetishization, and commodification. For example, medicine at this scale is no longer a question of corporeal management through diet, exercise, regulation of blood flow, surgeries, or organ transplantation; instead, "…life is now understood, and acted upon, at the molecular level, in terms of the functional properties of coding sequences of nucleotide bases and their variations, the molecular mechanisms that regulate expression and transcription, the link between the functional properties of proteins and the molecular topography…" (Rose 2007, p. 12). This is true not only for people. In the realm of livestock management, animals are assessed not on their external appearance, but on their genetic qualities as markers are identified that signal increased milk production or lower fat content (Holloway et al. 2009).

At a broader scale, genetic science is also used to map the genealogies and spatial distribution of particular populations. By tracing the frequency of allele distributions in a given population, population geneticists study the evolutionary processes of selection, genetic drift, gene flow, and mutation. This allows them to trace the evolution of viruses, like H1N1 (Braun

2007) as well as to study patterns of human and nonhuman evolution. In these ways, the genetic maps produced through the shift from the molar to molecular scale respatialize conceptions of life while also providing new sites for intervention.

Such genetic maps reflect particular ideas about naturalness, which figure centrally in genetic imaginaries (Franklin 2005). Dominant, reductionist interpretations of genes as the informational basis of life are underwritten by understandings of nature as distinct from culture and comprised of lawlike principles (Keller 2000). Read in this way, genetic maps of human genealogy and dispersal are only the latest technology for mapping racial politics, part of a long history of attempts to delineate natural categories of difference (Livingstone 2010). For example, much debate about the Human Genome Project has focused on its impact as a technology for defining a biological basis for racial identities (Fujimura et al. 2008, Koenig et al. 2008). In addition to redefining race, genetic genealogies are also used to trace the origins of populations (Nash 2012). Joan Fujimura and Ramya Rajagopalan use the term "genetic geography" to "refer to how, through the tools and practices of human genetics, bits of genomic sequence become associated with specific geographic locations, posited as the place of origin of people who possess these bits" (2011, p. 7). In these ways, then, genetics are used to stabilize particular understandings of race and their spatial belonging. As we will see later in the chapter, such readings of genetic race and spatial origins occur not only in relation to human populations, but are also gaining currency in the realm of conservation biology, where I argue genetic tracings of evolutionary history provide new grounds for understanding and managing nonhuman natures.

Conservation Genetics

Over the past 20 years, the molecular gaze has reshaped understandings of biodiversity and how to best "save" it. As John Avise explains in a popular textbook, conservation genetics involves the application of genetic science to several different concerns of conservation management from the scale of populations to much broader evolutionary processes (1996). genetic analyses not only allow better understanding of endangered species, but offer the ability to preserve diverse genetic material to allow for a wide range of possible future adaptations (Frankel and Soulé 1981).

From an early focus on intra-population diversity arising from concerns about inbreeding in small populations of endangered species, applications of genetics in conservation have extended to the analysis of population structures, species boundaries and hybridization, and species phylogenies and macroevolutionary processes. For example, estimations of the genetic diversity of small, endangered populations are one of the central uses of genetic science in conservation. In the 1980s, conservation biologists developed the concept of a minimum viable population, a threshold below which low levels of genetic diversity in breeding populations could threaten long-term sustainability (Soulé 1987). More recently, with advancements in genomics—including the mapping of several endangered species' genomes—conservation biologists are increasingly turning from quantitative genetics to evolutionary studies of endangered populations. Among the central questions of this field is whether and how loss of genetic diversity impacts species extinctions. Such work shows that major factors driving contemporary evolution are the same as those associated with current biodiversity loss: habitat loss and fragmentation, overharvesting, and introduction of alien and invasive species (Höglund 2009, Stockwell et al. 2003). Molecular science has also shed light on the evolutionary history of endangered species, particularly through the reconstruction of genetic phylogenies. "Molecular clock" dating allows scientists to build relationship trees that represent probable evolutionary patterns. Through the genetic gaze, conservation biologists not only have new ways of representing biodiversity, but new reasons and means to intervene in nonhuman lives, from management of breeding and reproduction, to the well-publicized attempts (thus far unsuccessful) to revive extinct species—most famously the wooly mammoth—by using historical DNA from preserved specimens in recombinant cloning technologies. These technologies, while not all perfected, have the potential to both strengthen the scientific rationale for current conservation practice and to reorient conservation priorities substantially. How and to what effect genetics are influencing the conservation of particular species and places is an understudied question that requires critical attention.

Conservation Biopower

In this chapter, I extend the frame of conservation biopolitics to attend to the ways in which genetic science is reshaping the management of giant tortoise populations in the Galápagos. As genetics become an increasingly common tool for conservation management, it is important to analyze how and to what effects this scientific knowledge is made to articulate with desires to "save" endangered natures. A biopolitical frame is particularly relevant for analyzing the possibilities genetic knowledge opens for the management of nonhuman natures because of its focus on how and to what effect particular populations and their qualities are defined and managed.

In addition, a biopolitical lens also makes clear similarities between new genetic definitions of the purity of "pristine" wild natures and the quest to purify populations that underwrote the eugenics movement of the early twentieth century, which was closely aligned with the American conservation movement (Allen 2012, Spiro 2009, Brechin 1996). An affinity between "conserving the race" and "conserving natural resources" tied human eugenic policies and nature conservation together for several key American figures (Brechin 1996).[119] Philosophically, what linked these two fields was a belief in science as the key to solving problems coupled with a focus on conserving the "best" in the human population and natural environment, often as defined by Mendelian genetics, plant and animal husbandry, and Progressive era politics (Allen 2012). What's more, eugenics and conservation were often linked by metaphors of nature, particularly parallels between the myth of preserving pristine wilderness and visions of an (imagined) pristine early Nordic race, which served as a guide for racial preservation (ibid).

As I will explore in this chapter, such concerns about the purity of tortoise races figure centrally in conservation management in the Galápagos. Genetic science has opened a new way of understanding and measuring this purity, and thus new options for managing species. Indeed, many of biopolitical logics—neo-eugenic delineations of natural purity, desire to optimize the health of a population, and the production of high-value animal bodies—resurface in new ways as genetics are applied to manage the tortoises. Thus in exploring the articulation between genetic science and conservation in this particular case, I examine how genetic knowledge potentially shapes different options for conservation management. Doing so contributes an important analysis of the understudied affects of genetic science on conservation while also complicating the notion that specific genetic information necessarily carries with it any particular biopolitical interpretation.

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[119] Madison Grant is perhaps the foremost among them (Spiro 2009), although Garland Allen is currently working on a monograph tracing the eugenic-conservation ties of several other prominent men in early twentieth century American life (see Allen 2012 for work on two of these figures, Grant and Charles Goethe).

Monstrosity

The “alien” Galápagos tortoises demonstrate how genetic science has revived an extinct species. I develop the “alien” terminology Caccone used—somewhat jokingly—in her published analyses by situating it in critical analyses of monstrosity. Theorists have used monstrosity as a tool for assessing the ways in which particular life forms subvert the dominant classifications through which biopower operates. As Borges’ “Chinese encyclopedia” did for Foucault, monsters demonstrate that taxonomies speak less to the true essences of things, and more to particular cultures and ways of seeing the world (Bowker and Star 1999, Foucault 1970). As those that do not fit the dominant classifications on which modern systems of organization are built, monsters are fearful precisely because they are unknown (Ritvo 1997, Haraway 1992). As Jamie Lorimer and Clemens Driessen write, “Monsters are monstrous for crossing categories or for straddling species groupings. [They pose] threats as much by being a physical threat as by endangering the cultural order through which we make sense of the world” (2011, p. 3).

But these alien tortoises are not only classificatory anomalies, but ontological beings who—while not outwardly grotesque or frightening—were shocking to received wisdom about the isolation of tortoise populations. As such, I label them monsters—affective forces whose power rests in their ability to shock (Milburn 2003, Derrida 1995). Whether creatures that disrupt temporal orderings, such as zombies arisen from the dead, or spatial boundaries, like aliens from an external world, monsters challenge the status quo (Comaroff and Comaroff 1999). For this reason, Haraway (1992) finds monsters promising creatures to follow and Derrida celebrates teratology as a challenge to hegemony, a critique of the history of normality (Milburn 2003). As Milburn writes, “monsters disrupt totalizing conceptions of nature and destroy taxonomic logics, at once defining and challenging the limits of the natural” (2003, p. 604).

But what makes a monster, whether real or metaphorical, is not necessarily shocking physical characteristics. For the monsters that escaped Linnaean classification schemes, "only a small divergence from what seemed ordinary or natural sufficed to make a monster" (Ritvo 1997, p. 131). Ritvo continues, explaining that "as a group…monsters were united not so much by physical deformity or eccentricity as by their common inability to fit or be fitted into the category of the ordinary—a category that was particularly liable to cultural and moral construction" (p. 133-134). For eighteenth century natural historians, previously undocumented species like kangaroos and platypuses were monstrous enough to spur taxonomic revision. They necessitated a "re-drafting [of] the boundaries of previously well-defined categor[ies]" (Ritvo 1997, 12). Thus monsters were key to the scientific process of natural history as species that did not fit their categorizations confronted taxonomists and forced them to rework them in order to make sense of outliers.

Monsters were also crucial for Darwin's theory of evolution. Darwin used monsters to demonstrate how breeding altered the form of domesticated species—the breeder "often begin[ing] his selection by some half-monstrous form" (OS 70) and encouraging its development through artificial selection (Milburn 2003, p. 606). As Milburn recounts, "through the ministrations of the breeder, this little monstrosity comes to proliferate in the population, and eventually a new breed may be produced out of that single strange birth. Darwin draws an analogy between this artificial selection and the "natural selection" occurring within wild populations of organisms, and he suggests that monsters and other "sports of nature" are not only remarkable evidence that variations do occur naturally, but that these variations may, in certain cases, be inherited to such an extent that new species evolve" (p. 606). Thus monstrosity has the potential to destabilize essentialist notions of species; there may be monstrosity in each of our histories, as well as an open future for new biological forms. Indeed, for Derrida, the monster represented "'the species of the nonspecies,' the nascent germ of a species about-to-become," that "perhaps heralds an entire population of hopeful monsters whose aberration remains to be classified" (Milburn 2003, quoted in Lorimer and Driessen 2011, p. 604). Thus for Derrida, like Haraway, the promise of monsters lay in the possibility for the creation of something new, a possibility always in tension with the classifying impulse of biological science to render the unknown knowable.

This tension associated with the making of new biological forms is reflected in historical fear of hybrid crossings as animals of different species breed (Hinchliffe 2007, Ritvo 1997). In the context of conservation, fear of hybridity emerges anew because genetic science provides a new way to assess purity. In an era in which genetics offers the ability to assert an unprecedented level of "biological control," the recombinant technologies of genetic modification and so-called cloning have unleashed new forms of monstrosity (Franklin 2007, Haraway 1997). In this seemingly post-Darwinian world in which Petri-dish origins rework millions of years of evolutionary history, genealogy is no longer destiny, but "life is assembled in ways that were, until quite recently, considered to be biologically impossible" (Franklin 2005, p. 60). Transgenic creatures such as Dolly the cloned sheep and OncoMouse™, with genes transplanted from a different organism's DNA, are monsters created through modern techno-science (Franklin 2007, Haraway 1997). But both transgenic creatures and the genetically defined hybrids I analyze here cause similar anxieties about the sanctity of life for many, particularly Westerners, concerned with racial purity and reassured by firm borders between Nature and Culture (Haraway 1997). They both, as Haraway writes, unsettle Western discourses that prize the purity of nature as “transgressive border-crossing pollutes lineages…transforming nature into its binary opposite, culture” (1997, p. 60).

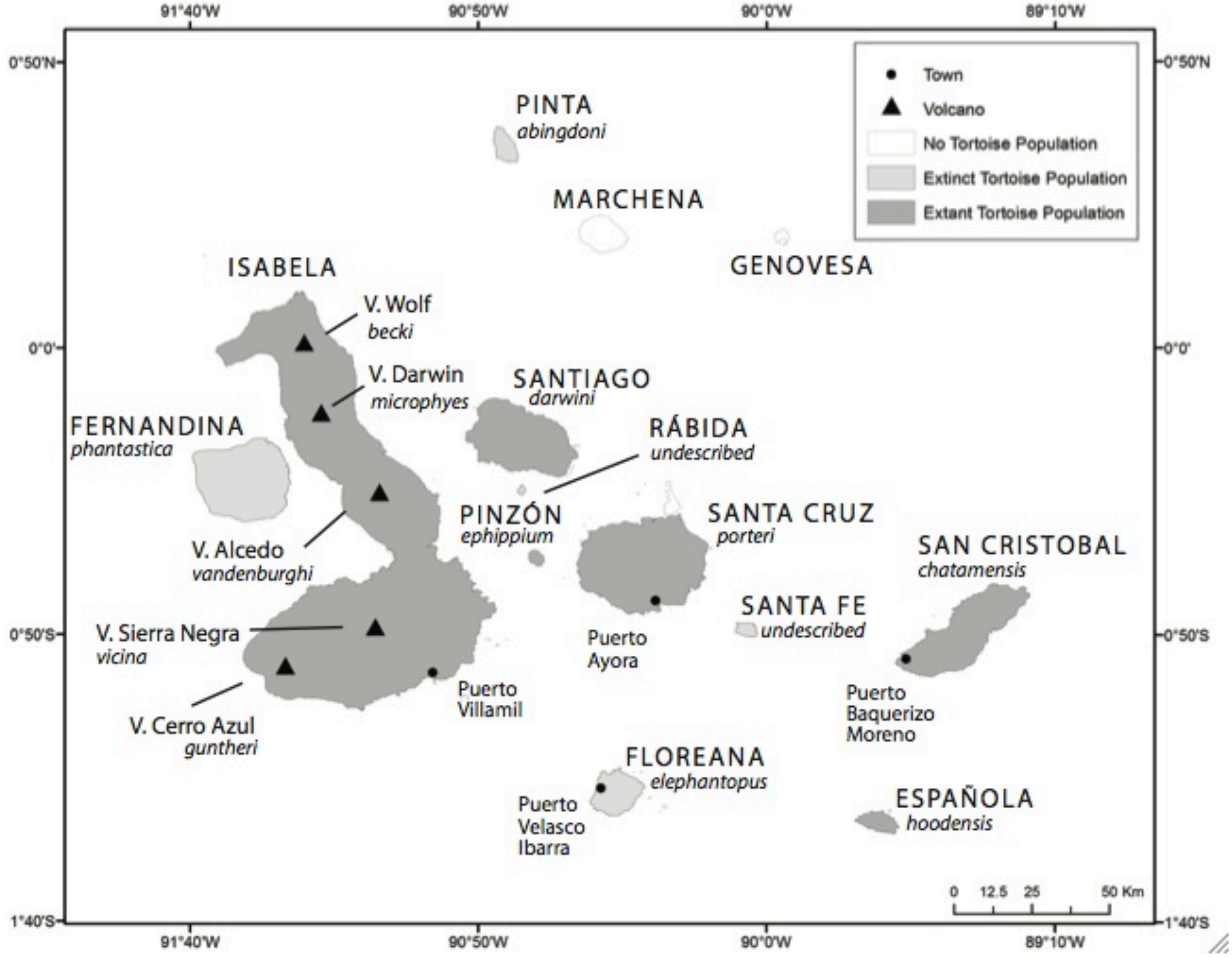
Finally, attention to the processes through which monsters emerge—in this case, genetic tracings of evolutionary phylogeny—unsettles naturalness in another way as well, by highlighting the inseparability of nature, culture, and technics. In the transgenic era, laboratories are key sites for the production of new forms of life—spaces in which recombinant technologies remap biological genealogies. Genetics is a productive science through which not only transgenic cyborgs but also genes themselves emerge. Genes become legible only within the human and nonhuman relations of corporate investment, laboratory science, and computer-assisted modeling that constitute technoscience (Haraway 1997). They are not stable, natural things in themselves \, but nodes “of durable action where many actors, human and nonhuman, meet” (Haraway 1997, p. 142). Genetic natures, then, are perhaps best understood not as biological essence nor as matters belonging to a discrete natural realm, but as enfoldings of nature, culture, and technics, given shape as they emerge from particularly situated contexts. As I will argue, this is no less true of genetically defined hybrids than it is of transgenic laboratory productions. Both trace their origins to genetics.

In these ways, then, genetic science is reshaping the nature, geographies, and biopolitics of life. Genetics offers possibilities for both new definitions of what is natural and for the production of new hybrid forms. Tree of life maps based on genetic lineages constitute a new spatialization of life that enables scientists to trace geographies of evolution. Together, these knowledge productions constitute a biopolitical force for defining populations and races, creating a benchmark for assessing the naturalness of nature. Tracing the production of monsters and how they subvert genetic classifications enables us to see how genetic science operates as a biopolitical force and capable of resurrection.

Galápagos Case

In what follows, I focus primarily on the work coordinated in one laboratory, run by Dr. Adalgisa (Gisella) Caccone at Yale University, although its networks reach far beyond the Galápagos and Connecticut. Below I explore how the remarkable discovery of living descendents of an extinct species of giant tortoise emerged from work on the genetic diversity of extant tortoise populations and the relatedness of geographically distinct populations on the archipelago's various islands. In particular, I focus on the Caccone team's work reconstructing the phylogenic histories of Galápagos giants and its implications for both how we understand the evolution of this iconic species and the possibilities of conservation management. The lab team's work highlights a tension between the desire to save a pre-existing species and the opportunities technologies of genetics and breeding offer to remake nature.

Figure 5.1 Distribution of Giant Tortoises



Distribution of giant tortoises in the Galápagos Islands. Shaded islands indicate tortoise populations. Dark shading represents extant (still living) populations and lighter shading represents extinct populations. [Adapted from Poulakakis et al. 2008]

Genetic science first entered into tortoise conservation efforts in the mid-1990s after Jeff Powell, a drosophila and mosquito geneticist at Yale University, visited the Giant Tortoise Breeding Center during a Yale alumni tour of the archipelago in 1991. As he told me, their Park naturalist guide walked them through the breeding center to show the adult breeders and baby tortoises. Powell asked about pens of adult tortoises kept at the center that do not breed—these, the guide explained, are separated by sex and not released into the wild because they were collected from local residents when the park was founded—no one knows where they are from, so they are not allowed to breed so as not to create a population of “mixed” evolutionary heritage. Powell thought a genetic analysis could shed light on these animals’ origins and went to talk with the lead herpetologist at the Charles Darwin Research Station, which at the time administered the breeding center. The herpetologist, Linda Cayot, told Powell she had been looking for a geneticist to work on the tortoises for years. So over the next few years, Powell and his partner, Gisella Caccone, who has since taken over the project, began working with CDRS and the national park to take blood samples from tortoises across the archipelago.

Their first project addressed low genetic diversity in the breeding and repatriation program for Española Island (see Chapter IV). In the 1960s and 1970s, the only fifteen remaining Española tortoises were all brought to the breeding center, where they have proved to be highly prolific—today, more than 4,000 juvenile tortoises have been raised at the center and repatriated to their home islands, some 1,800 of them to Española. But more than a third of these Española young have been sired by only one male. This, as Caccone’s team has shown, has reduced the effective population size of the Española tortoises from fifteen founding tortoises to about six—meaning that rates of genetic diversity in the new population of offspring do not reflect fifteen different founders, but only show the diversity acquired from a founding population half that size (Milinkovitch et al. 2004). To combat this, and maximize possible genetic diversity, Caccone’s team has recommended new pairings of the breeding tortoises to reduce the dominance of the single male.

The Española project was the first of a series of collecting trips the team conducted with the National Park staff to sample tortoise populations across the archipelago. As they amassed a collection of blood samples and a database of DNA sequences from the various tortoise populations, they began to address questions of phylogeny, the evolutionary relations among tortoise populations. Among the first projects sequencing mitochondrial DNA (mtDNA) to identify the Galápagos tortoises' closest living relative outside of the archipelago—the South American Chaco tortoise (*Geochelone chilensis*). The Galápagos giants and the smaller Chaco tortoise have a common ancestor, now extinct, from which the Galápagos line diverged between 6-12 million years ago (Caccone et al. 1999). Building on this work, Caccone's lab has mapped probable patterns of dispersal within the archipelago. Tracing patterns of mtDNA, they found that the first tortoises—probably gravid females—arrived on one of the two eastern-most islands (San Cristobal and Española) 2-3 million years ago before dispersing to the other islands, largely following the geography of ocean currents (Caccone et al. 2002). They found that colonization of the volcanic islands probably occurred shortly after they formed through processes of range expansion, demonstrating once again the archipelago's significance for evolutionary science: as one team member wrote, "The endangered giant Galápagos tortoises represent a rapid allopatric radiation and further exemplify evolutionary processes in one of the world's greatest natural laboratories of evolution" (Beheregaray et al. 2004, p. 6514).

Caccone's lab thus provided genetic proof of island allopatric speciation—the process of the radiation, or divergence, of the traits of populations of tortoises through geographic dispersal to different islands and volcanoes. To do this, her team first had to collect blood and DNA samples from tortoises living on each island, a process that involved arduous fieldwork, coordination with the national park, CITES permits, and quick turn-arounds to fly frozen samples from the Galápagos back to New Haven. Back in the laboratory, the team compared DNA samples from different populations to isolate genetic markers that would differentiate them. As the database grew, so did their confidence in the genetic definitions of the various populations.

Alien Tortoises?

Every classificatory system produces outliers, and the tortoises were no exception. In an early paper, Caccone noted the presence of several “aliens” among the tortoises sampled on Volcano Wolf at the northern tip of Isabela Island, whose genetic sequences did not match those of other Volcano Wolf tortoises (Caccone et al. 2002). I will devote the rest of the chapter to telling the story of these alien tortoises and how they went from being unidentifiable outliers to the miraculous “reincarnation” of a species that became extinct more than 150 years ago. Perhaps then, these tortoises are not so much aliens as zombies—creatures quite literally brought back from the dead. In what follows I trace how these “aliens” became discernible—recognizable and classifiable—as Caccone’s lab added to its database of tortoise samples, particularly by analyzing DNA from specimens collected in an earlier scientific era and stored in natural history museums. These well-preserved museum specimens allowed Caccone’s team access to genetic material from populations of tortoises now long dead—including bone and carapace fragments from Floreana Island, where the native tortoises went extinct in the mid-1800s (Russello 2010, Broom 1929).

Analysis of mtDNA and microsatellites from museum specimens showed the Floreana population (*C. elephantopus*) to be evolutionarily distinct from other Galápagos tortoise populations. More surprising, it also demonstrated that eleven of the twelve “alien” samples from Volcan Wolf fit within this Floreana group (Poulakakis et al. 2008). [The twelfth was shown to have Pinta ancestry (*C. abingdoni*) making it related to Lonesome George—who, ever since he was found in the early 1970s has been thought the last remaining tortoise from Pinta.] Thus the “aliens” morphed from being outliers that were not native to the volcano, to also being lasting vestiges of life long thought to have gone extinct. The DNA of these alien tortoises appeared to demonstrate crosses between 'native' Wolf Volcano tortoises and tortoises from Floreana [or Pinta]—making them, in effect, hybrids that did not belong squarely in either category.

These findings, based on relatively small sample sizes, prompted the lab team to return to Volcan Wolf, where they thought much of the population could be of "mixed" ancestry. In 2008, the team, along with the GNPS, conducted a massive survey of Wolf Volcano, and returned home having sampled more than 1,600 tortoises. This analysis turned up eighty-four first-generation (F1) hybrid Wolf-Floreana tortoises with a "pure" Floreana parent. As the authors wrote, "To our knowledge, this is the first rediscovery of a species by way of tracking the genetic footprints left in the genomes of its hybrid offspring" (Garrick et al. 2012, p. R11). But while this work presented a remarkable re-discovery of life thought lost forever, it also posed a considerable problem for conservation efforts: in a place that has long focused on protecting the evolutionary distinctiveness of spatially isolated population, the hybrids not only crossed spatial boundaries between populations, but also mixed the lineages of two distinct species. In what follows, I explore this story in more detail, analyzing the process through which these hybrid tortoises were made knowable and have since become part of a project to re-animate the Floreana species. In particular, I focus on the ways this remarkable re-discovery and re-animation of an extinct species through genetic science is re-orienting the nature, geographies, and biopolitics of this iconic lifeform.

Placing Aliens

The rediscovery of living descendants of the extinct Floreana tortoise species through a "genetic footprint" is a first for conservation. It has almost literally "breathed new life" into the tortoise conservation program in Galápagos. But while the case is novel, the technologies used to measure genetic diversity and reconstruct the evolution of endangered species are part of an increasingly common set of tools in conservation biology. The use of genetics and common breeding techniques to bring a species of tortoise back from the dead illustrates the possibilities genetic approaches create for managing endangered species. To be sure, reconstitution of a lost population is a rare possibility. More widely applicable are genetically informed interventions in breeding projects to increase genetic diversity like the one discussed above or the use of genetic definitions of biodiversity to retarget conservation resources and reshape protection territories (Lulka 2004). In all of these cases, the genetic technologies redefine endangered species and in turn reshape understandings of natural life, its geographies, and the ways in which it is governed. In the following sections, I explore the Floreana case in more detail to analyze how genetic science is morphing the nature, spaces, and biopolitics of conservation.

Nature

As shown in Figure 5.1, each island, and in some cases volcano, in the Galápagos has long been thought to be home to a distinct population of giant tortoises (Van Denburgh 1914). The tortoises were assumed to be, as Darwin wrote, “aboriginal” to the islands—to have somehow arrived in the archipelago (perhaps via a hypothetical land bridge to South America, as George Baur proposed in 1891) and then dispersed over the course of millions of years to the major islands that had enough suitable vegetation to support populations (Journal, quoted in Van Denburgh 1915, p.226). For more than a century, herpetologists have debated whether these geographically isolated populations were different enough to be distinct species of giant tortoises or just variations in kind. The criteria for their analyses were principally morphological distinctions among the geographically isolated populations—the stuff of classical natural history (Van Denburgh 1914). Over the past 30 years, genetic science has provided a new means for classifying these tortoise populations based not on a Linnaean grid, but on genetic measures of relatedness. The shift from the molar scale of bodily analysis to the molecular level opened a new site and methodology for classificatory technologies, a shift from an animal's phenotypic to genetic traits. This shift has significant implications for the practice of conservation in the Galápagos and elsewhere because the genetic gaze offers new technologies not only for differentiating species, but also for assessing the health of very small populations.

Caccone's lab uses the tools of population genetics to study evolutionary biology, analyzing the patterns and forces that shape the distribution of genetic diversity in populations. They do this by assessing the frequency with which particular sequences of alleles appear in a given population. The specific kinds of DNA (mitochondrial or nuclear) and technologies used to do this have changed over the past 30 years– from microsatellites to single nucleodtide polymorphisms (SNPs). With varying degrees of precision, they allow scientists to isolate genetic markers, or particular DNA sequences, which can be used to identify individuals or to differentiate populations or species. In 2002, Caccone published her lab's first phylogenetic reconstruction of the giant tortoises, based on blood samples from 161 individual tortoises across 21 population sites in the Galápagos (Caccone et al. 2002). They sequenced six mtDNA regions from tortoises in each population—a total of 4,481 base pairs—and then conducted a network analysis that developed statistical clusters of haplotypes, or combinations of DNA sequences. They grouped populations according to their genetic constitution and sorted the network of relations between these populations in a phylogenetic tree that maps their evolutionary relations according to the frequency of allele sequences. In this way, genetic data provides new maps of the species' evolutionary history, making visible for the first time the presumed process for which the Galápagos are so famous.

Caccone's analysis both reinforced some assumptions about the tortoise populations and turned up a few surprises. She found that six of the eleven extant populations had monophyletic maternal lineages—meaning they comprised discrete evolutionary groups, which was consistent with the prevailing belief that the various tortoise populations had evolved separately because of geographic isolation. But one of her most surprising findings complicated this view: genetic analysis indicated that there was not one, but two distinct populations of tortoises on the east and west sides of Santa Cruz Island, one of the largest islands in the archipelago. The two Santa Cruz tortoises populations are similar in size and domed carapace shape, suggesting they both evolved in the island's densely vegetated habitat. But Caccone's classification showed the two populations to be as distinct as any other two in the archipelago. This finding, as one lab member explained to me, is very significant for conservation management because the eastern population of tortoises lives in an area undergoing rapid human development (Russello interview May 23, 2012). Conservationists now want to target efforts to protect this small population, which was previously considered unnecessary because of strong protection on the western side of the island. (Unlike the western side of the island, where much of the tortoise habitat has been protected in a reserve since the 1960s, the eastern side is heavily used for agriculture.)

In this case, then, genetic markers were used as a means to classify animal populations, stabilizing the evolutionary identities of some, but also defining new populations based on genetic difference. Thus genetic science works here as a nonhuman biopolitical discourse, used to define the qualities of a population so that it might be appropriately managed. Delineation of the genetic essences of the different tortoise taxa—or races, as they are often called informally by scientists—resonates with critiques of genetic essentialism as a neo-eugenic logic of defining racial purity. In addition to external phenotypic markers, ecological behavior, and geographic location, genetic sequences are used as a means to classify the existence and belonging of particular animals in a racial group.[120] In this way, genetic markers have become a new currency through which to assert the naturalness or purity of pristine nature in the Galápagos. The genetic gaze is redefining the very life that conservation takes as its duty to protect.

These genetic reclassifications have turned up several problems for conservation management—most notably the "aliens" that turned up through haplotype mapping of tortoise populations. The aliens' genetic sequences were "aberrant"—they did not fit the classificatory schema (2002, p. 2056). As Caccone told, me, laughing: "I called them aliens because I didn't know… and it stuck…maybe it wasn't an appropriate name. But I was looking at aligning sequences of mitochondrial DNA for that operation and…there were a few animals that just looked like they were from Mars! There were something like sixty substitutions between these animals and any other adult in the population" [Interview April 2012]. Exteriority in this case was a matter of gene substitutions: whereas most of the tortoise populations had closely related haplotypes that differed by an average of only three substitutions (and no more than seventeen in about 4500 base pairs), these "aliens" differed from tortoises found in the same geographic location by twenty-seven to seventy substitutions.

The "Martian" tortoises that crept through the grid of Caccone's phylogenetic classification are members of a long history of monsters that have escaped the classificatory gaze of natural science (Derrida 2002, Ritvo 1997). Although to the eye, phenotype did not definitively mark them as markedly different from other Volcano Wolf tortoises, their genotype did. Although these tortoises have most likely lived and bred with the "native" population for a

[120] In using the term race, I do not intend to dramatize this particular animal biopolitics by drawing parallels to human struggles. I am just noting the language often used by scientists and conservationists and do want to recognize particular parallels this logic shares with human biopolitics. I return to this in the conclusion.

couple hundred years, they are now judged “out of place”—anomalous to the animal spacings created through genetic readings of geographic belonging (Lorimer and Driessen 2011, Philo and Wilbert 2000). These tortoise monsters—whether “aliens” spatially out of place, or “zombies” returned from the past—are not scary because of any physical features, but they do pose a physical threat both to the spatial isolation of tortoise species on distinct islands and volcanoes as well as to the purity of their distinct lineages. If monsters threaten cultural orderings, then in the Galápagos it should be no surprise that aliens are those that do not fit a reconstruction of natural evolutionary history. The classification of these tortoises as alien outliers highlights the power of genetic markers to not only define the natural, but to actually make nature.

Geographies

By exploring the evolutionary relationships between the various populations of Galápagos tortoises, Caccone and Powell’s work has created not only new understandings of the nature of each group, but also has respatialized this iconic species. The shift from molar to molecular scales of analysis has produced a new geography of the natural in the Galápagos in two ways: first, by mapping the networks of evolutionary relationships among tortoise populations, the team has opened a historical depth beneath the Cartesian geography of island differentiation. Second, genealogical analysis has lead to re-imagining patterns of spatial dispersal through which tortoises came to populate islands across the archipelago. I explore each of these three in turn.

Depth of Relation

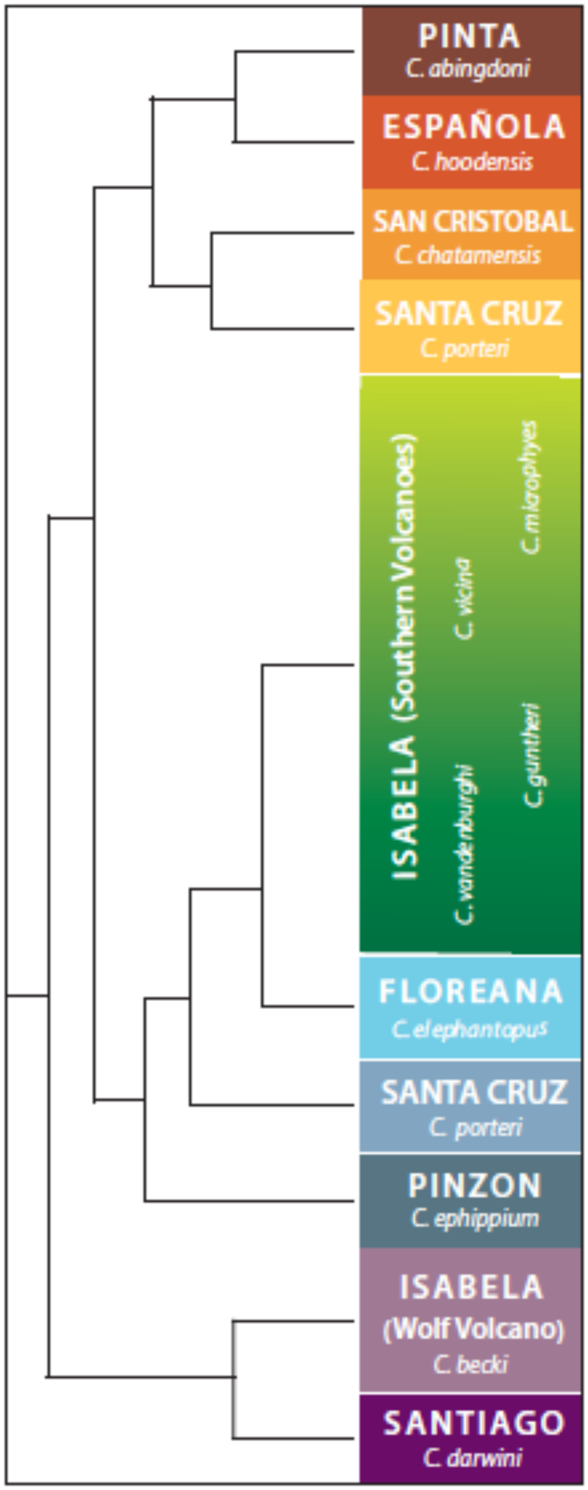
Drawing on Canguilhem and Foucault, both Sarah Franklin and Nicholas Rose argue that the turn to genetics in biology was an epistemic shift in understanding life, similar to the move from the classificatory gaze of natural history to the questions about life that underwrote the emergence of biology. The life sciences, as Franklin notes, were "founded on notions of evolutionary change, the underlying connectedness of all living things, and a biogenetic mechanism of heredity through which life reproduces itself (1995, quoted in Rose 2007, p. 41). To know an organism in the epistemology of natural history "was to place it in a taxonomy, identifying it by allocating it to its proper genus and species on the basis of its observable characteristics" (Rose 2007, p. 42). But, as Foucault traces, this shifted as questions of the origins of life shaped the emerging study of biology in the nineteenth century: "When a depth opens up beneath the taxonomic table, the depth of vitality within each entity that can belong to the organic world, only then did biology in the form that it would exist for one hundred fifty years, become possible. That biology…was defined by an epistemology of depth, a style of thought that understood the visible characteristics of plants, animals, and humans in terms of underlying organic laws that determined them, and the functions that they served in preserving life and averting death" (Rose 2007, pp. 42-43).

Rose argues that with the emergence of genetic science, an epistemology of "life as information" has replaced one of "life as organic unity" (2007, p.45). While I agree that the molecularization of life constitutes a fundamentally new way of understanding life, it does not necessarily constitute a shift in the question being asked. In several fields, particularly population genetics, study of life as an organic unity remains the main paradigm. As Robert Kohler explains, the science of population genetics, developed largely by Dobzhansky, who trained Powell, aims to address the question of the origin of populations: "In population genetics, chromosomal mapping was transformed from an end itself to the means to new, evolutionary ends. The products of Dobzhansky's practice were not improved genetic maps but maps of distinct local populations and graphs of their phylogenies and gradual changes. It was a kind of genetic biogeography…" (2002, p. 297). Thus opposed to the genotopia, which for Franklin characterizes the ideal space of genetic modification, arborescent genealogy remains the ideal spatialization of population genetics.

Genealogical mapping, more than an understanding of genes as blueprints for life, is the use of genetics that informs Caccone's study of the tortoises. Her lab team's genetic tracings of population histories have opened a new space of analysis concerning this iconic species. They have unveiled an understanding of the origins of these populations long assumed but not previously mapped. While scientists working in Darwin's tradition thought the tortoises evolved in the Galápagos, previous methods of field biology and classificatory taxonomy had not shed much light on issues of relatedness. The phenotypic morphological distinctions and geographic isolation on which tortoise taxonomies were based did not provide insight into their origins.

Thus the work of Caccone's lab has opened a new depth to the study of this natural life, providing new proof demonstrating the evolutionary relationships among populations of this iconic species that played an important role in inspiring Darwin's theory of evolution. We can visually see this depth in 'tree of life' mappings of tortoise phylogeny. Figure 5.2, below, maps relations among ten different groups of Galápagos tortoises, shown in color on the right-hand side, based on mtDNA control region sequences. Each sampled tortoise is placed with a clade, or lineage, which can be traced back to common ancestry. (The nodes at which lineages diverge denote hypothetical common ancestors.)

Figure 5.2 Phylogeny of Giant Tortoises



Genetic analyses sort individual giant tortoises into ten lineages, which can be traced back to hypothetical common ancestors. The four populations on southern Isabela Island, historically considered separate species, are more closely related genetically than other populations. The Floreana population is shown in light blue; the Wolf Volcano population in lavender. This tree also shows two distinct lineages on Santa Cruz Island, despite one historical species classification. Adapted from Poulakakis et al. 2008.

Caccone's lab team constructed this evolutionary tree using samples they had collected in the Galápagos as well as DNA from specimens collected in the past centuries and stored in natural history museums. This expanded data set allowed them to reconstruct the historical relations among additional groups of now-extinct tortoises. One former lab member, Michael Russello, who collected and analyzed many of the museum DNA samples, told me the aim was to provide a historical context for understanding the current distribution of genes—rather than populations—across the archipelago: "I started by trying to put living Galápagos tortoises within a more historical and broader context, so bringing in work with museum specimens of extinct species to begin to get an idea of how living species are related to extinct species and what that might tell us about the origins of the living species, what it might tell us about their population history, and also tying into how we can define conservation units in the system." (Interview May 23, 2012). This redefinition of conservation units is central to how genetics offer the possibility of changing conservation practice. Previously in the Galápagos, conservation units were defined by island, that is spatially—as they are for most national park territories (Zimmerer 2006). Genetics changes such definitions by analyzing temporal lineages that sometimes do and sometimes do not align with spatial definitions of populations.

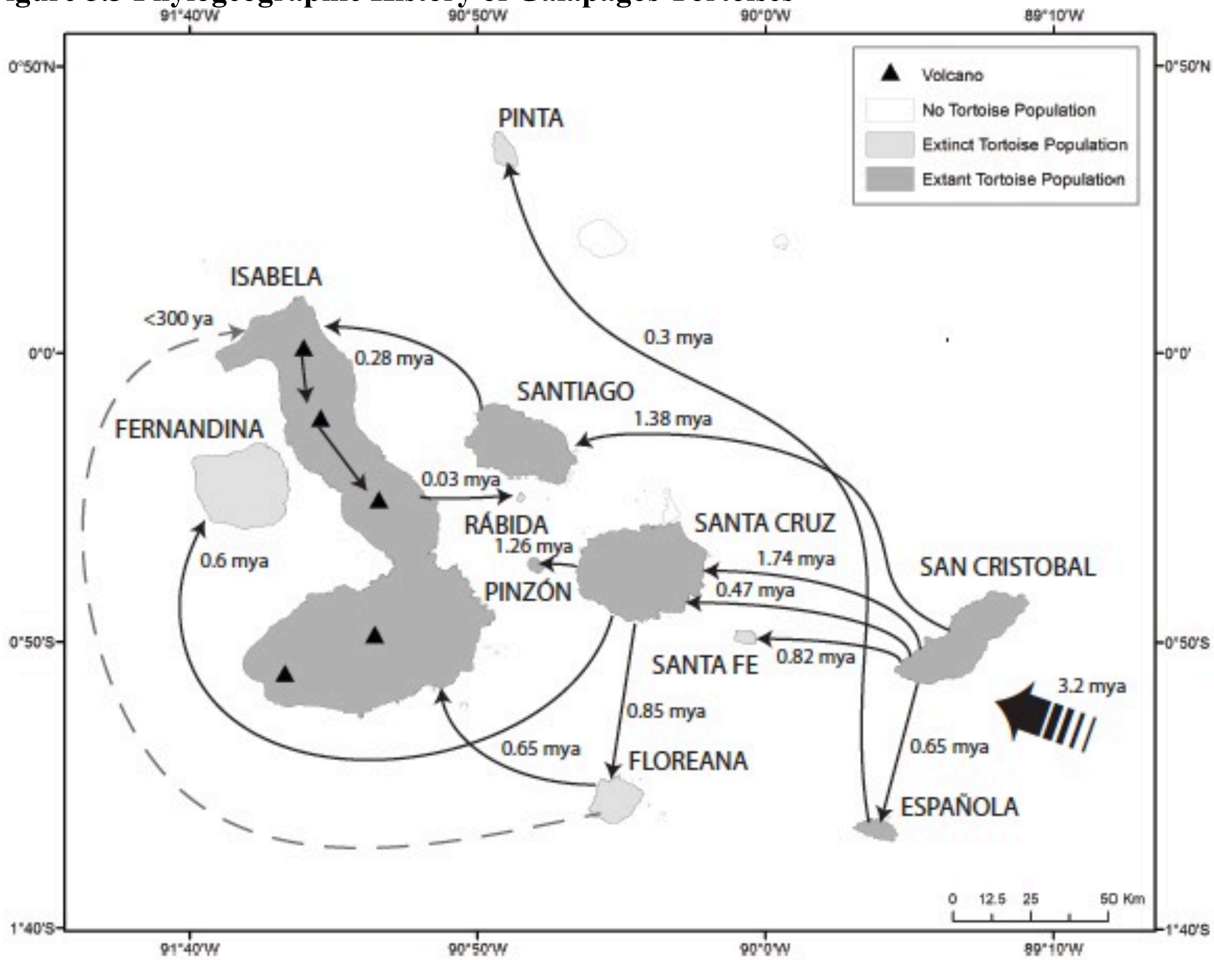
This historical comparison made new sense not only of the relatedness of populations, but also of the "alien" tortoises. The two shaded gray bars in this figure represent the "alien" tortoises sampled on the north of Isabela Island, which have resurfaced as members of the Floreana Island clade. This genealogical placing of the aliens was, Russello said, "absolutely a huge surprise" made possible only with historical data from the museum samples. He explained,

"...we were just interested at the time in trying to understand the relationships initially, but having that population genetic information allowed us to begin to identify these individuals from these either extinct or highly endangered animals…The only way we were able to do that is because we had that historical context" (Interview May 23, 2012).

Spatialized Genealogy

Tracing genealogy led to a geographic remapping of the tortoise histories. Caccone's lab spatialized the genealogy shown in the tree above in maps that depict the dispersal of populations from island to island over the past 3 million years. While scientists had long thought the populations of tortoises differed on each island, the basic assumption was that they were most closely related to other tortoises with similar morphological type (saddleback or domed) or tortoises on geographically proximate islands. But the genetic lineages challenged this notion. As Caccone wrote, "Evidently there has not been a simple linear migration from older to younger islands, yet many aspects of the phylogenetic patterns do make clear biogeographical sense" (2002, p. 2063).

Figure 5.3 Phylogeographic History of Galápagos Tortoises



Phylogeographic map shows tortoise dispersal throughout the Galápagos since the first tortoises arrived from continental South America some 3.2 million years ago. "Natural" dispersals are represented by solid black lines. The human translocation of the "alien" tortoises is represented by the dashed line. Adapted from Caccone et al. 2002.

In this map, the various branches from the evolutionary tree above are read as spatial dispersal over the past 3.2 million years. Each node in the tree is a dispersal event, represented by the arrows and estimated time frame (millions of years ago), which show the flow of tortoises among the various islands in a general east-to-west pattern, which follows the formation of the islands. [Easternmost islands are thought to have emerged 3-5 million years ago, western-most islands as little as 1 million years ago.] The oldest tortoise populations, on San Cristobal and Española Islands, gave rise to populations on the younger islands through at least three different dispersal events. No one knows exactly how or why the tortoises dispersed – a matter of chance to be sure. Perhaps unsurprisingly for an animal with such stout legs, giant tortoises are not strong swimmers, but they can float. Perhaps super-heavy El Niño rains washed a few out to sea (Cayot Interview 28 September 2011). Only a gravid female would be necessary to found a new population. Female tortoises have been shown to carry sperm for at least two years.

But, as Caccone noted, this was not a simple linear dispersal. One surprise was that the Pinta tortoise (Lonesome George) was not most closely related to tortoises on nearby islands, particularly Northern Isabela, but to those from Española Island in the southern reaches of the archipelago. George and the Española tortoises are both saddlebacks, so in some ways this relation is not surprising, but the dispersal distance was notable. But as Caccone pointed out, this dispersal does make biogeographic sense—it follows the pattern of northwesterly ocean currents that sweep through the archipelago.

The alien tortoises unsettle the natural currents of this map as well. Spatially, the genealogical classification of the aliens found on Volcano Wolf as part of the Floreana clade sites their belonging to an island across the archipelago. They are not only taxonomic monsters, but geographically out of place—"unlikely to be accounted for by natural drifting" as Caccone wrote (2002). The aliens' dispersal is not classed as 'natural,' as were most of the other migrations, which according to the molecular clock of DNA occurred in deep historical time and is represented by a solid black arrow. Instead, it is considered unnatural, human-caused, and represented by a dashed line. The question of exactly how these aliens got to Volcan Wolf remains a mystery, but is thought to be the work of sailors from centuries past, who collected the tortoises as a source of fresh meat. Floreana and Volcan Wolf were both popular stopovers and staging grounds for Pacific voyages. As Caccone et al. note "The frequent passage of whaling ships by Volcan Wolf sailing toward fertile whaling sites to the north and west of the Galápagos Archipelago may have made this site an ideal location for whaling crews to deposit excess tortoises collected elsewhere to be retrieved upon return" (2002, p. 2057).

Hybridity

The aliens then, were both geographically and temporally out of place in this spatialized genealogy. These tortoises that "belong" to the Floreana clade surfaced on a distant island, in a time scale that appears to have occurred within the past 200 years, not over several hundred thousand years as did the "natural" dispersals (Garrick et al. 2012). A new understanding of the alien tortoises emerged out of these two spatializations of evolutionary history. They were "hybrids" whose genetic lineages crossed the taxonomic borders between species, the geographic isolation of islands, and even the temporal definitude of extinction. The aliens became monsters—albeit not particularly frightening ones—because of their crossing of categories. As Jamie Lorimer notes, discussing Derrida's understanding of monsters, they are "vital, virtual, and affective"—not ontologically stable or independent from the perspectives from which they are experienced. Their monstrosity, their hybridity, as Lorimer and Driessen note, is "an emergent affect of the particular orderings of normality and difference" (2011, p. 604).

In genetic orderings of species normality, the notion of hybridity does not stem from the classical species concept developed by Ernst Mayr in which two animals are taken to be from different species if their hybrid offspring is infertile. Here, hybridity is measured not by fertility, but in sequences of DNA—genetic markers. In 2008, Caccone's lab returned to Volcan Wolf on a massive tortoise sampling expedition. This time, their analysis of the 1,669 blood samples they brought back to New Haven found not eleven, but eighty-four tortoises that had the genetic marker of the Floreana tortoises. But these tortoises were not "pure" Floreana tortoises; instead their genes showed them to have a "purebred" *C. elephantopus* as one of their immediate parents (Garrick et al. 2012).

As Garrick et al. (2012) explain, "Genetic marker-based assignments can be challenging, however, in systems with a history of hybridization. In such cases, hybridization generates offspring with genomes that include parts of both parental gene pools, and subsequent crosses between hybrids and purebreds, or between two hybrids, lead to mosaic-like genomes" (p. R10). To make sense of "mosaic-like genomes" the team used computer simulations to assess a variety of different possible hybridization scenarios, which allowed them to identify the 84 as Floreana hybrids and to determine the most likely parental crossings that produced them. Thus the team was able to make sense of the alien tortoises on Volcan Wolf, to make them legible within the molecular gaze of population genetics. But as I have discussed, they are hybrid tortoises in more than just the sequences of their DNA. As Caccone's team has demonstrated, they are also nature-culture hybrids because the human role in their dispersal puts them outside the history of natural evolutionary trajectories for which the Galápagos are so famous.

But they are also hybrids in another sense—not only in the problematic sense of the mixing of supposedly discrete, unlike kinds, which both of these examples rely on, but because they have emerged through relations among nature, culture, and technologies (Hinchliffe 2007). As Haraway wrote of monsters, "If organisms are natural objects, it is crucial to remember that organisms are not born; they are made in world-changing technoscientific practices by particular collective actors in particular times and places….Organisms emerge from a discursive process. Biology is a discourse, not the living world itself" (1992, n.p.).[121] In this case, the monsters have emerged from the technologies of population genetics—fieldwork, blood sampling, PCR, genetic

[121] Source: http://www.egs.edu/faculty/donna-haraway/articles/donna-haraway-the-promises-of-monsters-a-regenerative-politics-for-inappropriated-others/ Accessed February 7, 2013.

sequencing, statistical modeling, and academic publishing— through which "aliens" were produced and made legible. It was only through combinations of all of these elements that an "extinct" species of giant tortoise could be re-discovered in the "wild." The hybrid, technical genealogy through which these tortoises were produced presents both an unprecedented opportunity and an interesting challenge for the conservation of pristine nature.

Biopolitics

Having "rediscovered" an extinct species, a new biopolitical question faces scientists and conservationists in the Galápagos: how best to manage this new population. The emerging answer appears to be that the national park will re-animate the Floreana population by breeding the hybrid aliens in captivity and releasing them into the wild on Floreana. Breeding giant tortoises in captivity and repatriating them to their 'home' islands has long been a centerpiece of Galápagos conservation efforts, something the Galápagos National Park has been quite successful with over the past 40 years and now has down to a routine system (see Chapter IV). In this context, entering the Floreana tortoises into the breeding program is in some ways an obvious step.

A new population of Floreana tortoises could then play a role in a large "macro-restoration" project on Floreana run jointly by the national park and Charles Darwin Research Station. The project is designed to restore the island's natural environment and improve quality of life for the about 200 (human) inhabitants who live there. As described on the CDRS website, "The environmental component is designed to identify the areas of greatest biodiversity concentration, reduce the risk of further new species introduction, and manage already existing introduced species, in addition to determining the feasibility of reintroducing species such as the island's emblematic mockingbird."[122] Reintroducing giant tortoises would restore the island's largest native herbivore and could potentially also draw additional tourists to see these zombie tortoises.

Thus in addition to breathing "new life" into an extinct population, the Floreana tortoises could help to meet conservation goals of protecting the archipelago's native biodiversity and ecosystems. In this way, the translocation and hybridization of Floreana tortoises centuries ago—judged negatively as a corruption of natural evolution—could have a beneficial outcome for the species: "…despite hybridization often being considered largely deleterious to biodiversity conservation, in some cases as for Darwin's finches in the Galápagos, it can also act as an important source of novel genetic variation. Here we have demonstrated another beneficial aspect of hybridization: its legacy may occasionally be the creation of opportunities to resuscitate imperiled species through targeted breeding efforts" (Garrick et al. 2012, p. R11).

But how exactly to manage the tortoises' hybridity within the context of these conservation strategies has been a topic of debate among the Galápagos herpetology crowd. Because the tortoises are not of "pure" evolutionary lineage, the conservationists, geneticists, and ecologists involved in Galápagos tortoise management have basically agreed that they could not simply be moved to Floreana and released into the wild. During the year I was conducting interviews, I discussed two possible solutions with different members of this cohort (more on rewilding debate in Chapter III). The first idea that surfaced in conversations was to "backbreed" the tortoises to a purer genetic state in captivity before reintroducing them to Floreana. As Caccone explained to me, a new population of Floreana tortoises could be established by selective breeding of the hybrid tortoises. I asked her how that might work:

[122] Source: http://www.darwinfoundation.org/english/pages/interna.php?txtCodiInfo=86 Accessed February 12, 2013.

> GC: "How does it work?…it works like any other kind of artificial selection, how do they make races of different dogs or cats? The same way! Not based on phenotypic data – for those, you would pick some phenotypic attributes you would want to preserve – the horns or the quantity of milk in cattle – but what we would do is that we have the genotypes of all the animals, so we would say, ok, we want to match this individual with this one because they have the most diversity, for instance, at certain loci and then we would breed them. You get hatchlings. We would wait for the hatchlings to grow up a little bit to get some blood from them. Then, ok, on average you should have 50% of your blood from [each parent]…what is actually your allele composition. You will select from that group the animals that have the most of [Floreana], the most alleles from [Floreana], and do that again and again. [Breeding the offspring back with the parent.] Depending on what is the composition of your base animals, your breeders, we are calculating from an F1 [first generation hybrid], so two F1s mating, [it would take] four generations [of back crossing] – which is still 100 years! I'm not saying it's an easy fix. You would have an animal that is 90% of Floreana or Pinta or whatever it is you want to get back.
>
> EH: That's considered pure?
>
> GC: Well, that's up to you what is considered pure – 90% of the genes or allele combinations that were present in the original population. Now how much of that we've lost forever because we only have a few animals, that's a different story.

As Caccone explained, the process of selective breeding is a familiar one, and indeed was a crucial inspiration for Darwin's theory of evolution. Livestock breeders have long bred animals to enhance desired traits, and increasingly use genetic technologies to do so—from genetic valuations of animal life quantified in Estimated Breeding Values, to using genetic markers to profile particular characteristics, and even genetic modification of trait genes (Morris and Holloway 2009). Although the goal of conservation breeding differs, similar techniques are used.

As discussed in Chapter IV, the key distinction between livestock breeding and conservation breeding is the idea of improvement around which populations are shaped. The goal in conservation breeding of the giant tortoises has always been to retain the evolutionary isolation of lineages and populations, their natural purity, not to choose particular traits for improvement. But genetic markers can be used to evaluate which of the hybrid tortoises have "high conservation value." As Garrick et al. reported, of the eighty-four hybrid tortoises determined to be F1 descendents of a purebred Floreana tortoise (based on patterns of nuclear genetic variation), twenty-six of these also had *C. elephantopus*-like mitochondrial DNA. "Thus, despite being hybrids, these individuals are of high conservation value given that both biparentally- and maternally-inherited genetic markers from the imperiled tortoise species are represented in their genomes" (Garrick et al. 2012, p. R11). Thus the "most pure" animals would potentially be used to breed a purer race of Floreana tortoises not marred by the evolutionary traces of animals from other populations.

It is difficult in hearing proposals that seek to breed animals to a past state of evolutionary purity not to be reminded of the quest to purify populations that underwrote the eugenics movement. The metaphors of pristine, originary nature that linked eugenics and American conservation in the early twentieth century are central to Galápagos conservation that seeks to preserve evolutionary processes. The logic resurfaces in this case in desire to preserve the lineage from further degeneration through hybridization coupled with the ability to manage the population through selective breeding.

In the Galápagos, tracings of tortoise genealogy take on profound significance not only because they make processes of evolutionary speciation visible, thus underscoring the archipelago's significance in the annals of evolutionary history, but also because the sanctity of these genealogies are in a large part what conservationists are trying to protect. Before Caccone's lab reconstructed the tortoises' phylogenies, conservation was a matter of protecting and breeding individual populations. Now it is a matter of protecting the lineages of these populations. Thus the notion of backbreeding the Floreana lineage to 90 percent purity becomes a legitimate conservation strategy.

The idea of reverse evolving a population, of rewinding the molecular clock to restore a past genetic state, runs counter to evolutionary theory, which is by its nature always forward moving (Grosz 2004). Indeed, the notion of trying to preserve evolutionary lineages by protecting the isolation of populations, or arresting hybridization is also a denial of the monstrosity through which the distinct lineages were created. As Foucault notes in his discussion of genealogy, echoing Darwin (Milburn 2003), things are always in process: "… if the genealogist refuses to extend his faith to metaphysics, if he listens to history, he finds that there is 'something altogether different' behind things; not a timeless or essential secret, but the secret that they have no essence or that their essence was fabricated in a piecemeal fashion from alien forms" (1977, p. 142). Desire to erase the hybridity of these aliens is an assertion a genetic definition of race to define the essence of what the Floreana species should be. This essentialization of the species thus seems to run counter to desire to protect evolutionary processes. Of course, for the conservationists, the distinction is that human translocation is responsible for the hybridization of these alien tortoises, and is thus not a natural evolutionary occurrence. The evolution they want to protect is one that preceded human presence in the Galápagos.

But it was not a theoretical but practical objection that Caccone raised. As she noted, backbreeding is not an easy strategy—giant tortoises are the longest-living species on earth. Given the nearly 20 years it takes them to reach sexual maturity, it would take nearly 80 to 100 years to backcross four generations. Nor was this a strategy all Galápagos tortoise conservationists agreed was desirable.

A second strategy emerged from a workshop on the future of tortoise management put on by the National Park in July 2012. Caccone, several of her former lab members and several other ecologists and herpetologists involved in tortoise conservation discussed another approach to using genetic values to shape a conservation breeding and repatriation program. Below, Linda Cayot, formerly Herpetology Director at the Charles Darwin Research Station and a now consultant working with the Galápagos Conservancy, explained to me later:

> LC: …this is how we're thinking now. Ok – you could have a tortoise with Floreana genes and some of them would be considered high conservation value because they would have half or more. Or they could be considered low conservation value if they only have a quarter or something. So the ones with high conservation value would be put into a breeding program. The ones with low conservation value would probably be released onto Floreana.
>
> EH: Wow, really?
>
> LC: And this would be true for Pinta as well. High-value Pinta tortoises would be put into a breeding program and low-value would be released to Pinta. The thinking here is that natural recruitment on an island is very low for a long-lived species like a tortoise. So you have close to 90-99 percent mortality in most years. So what this does is it that means you're not losing that genetic diversity from the low conservation values, but you are increasing the number of high conservation value tortoises by breeding them in captivity where they have much higher survival rate. So in the long run the wild population will have a lot more high value animals than low value animals, over the next 10 to 20 years, if we are putting back young with high values. Because what we don't want to do is reduce the genetic diversity to the point where it could be a problem. And since we don't have pure animals, this is the best we can do.
>
> EH: Ok, so the idea is not to back-breed them?
>
> LC: That just takes way too long with tortoises. We need to get tortoises out there. I think everybody got to the point where ok, we'll do it this way, and just use the high breeding value tortoises in the breeding program. The final bit, which is what finally got us to agreement [laughing], is that those tortoises that are hybrids but not Pinta or Floreana – Wolf has hybrids from all over the place – if they are the right size, not way too big for Pinta, they would be sterilized and released onto Pinta so that we could build that adult population up more for island restoration but not have those genes in the wild populations. At the same time we would be cleaning off to a large extent all

> the foreign tortoises on Wolf. We would be helping to try to clean Wolf, restoring Pinta and Floreana tortoises. That's what we came up with!

This proposed approach takes the tortoises' ecological roles as dominant herbivores into account alongside concerns about genetic purity. Through a dual strategy of breeding and immediate reintroduction to Floreana (or Pinta: more on this story in Chapter III) the team would be able to make progress toward two conservation goals: restoring native ecosystems and reestablishing a population of Floreana tortoises. I was initially surprised to hear that they would put low-conservation value tortoises in the wild because the strategy seemed so opposed to the goals of backbreeding, which would have ensured as close a return to genetic purity as possible before reintroducing the animals. The strategy is also novel for the differentiation of the aliens into high and low value tortoises, which based on the patterns of their alleles would either be kept in captivity to breed a new core population of Floreana tortoises or sent into the wild to graze until they met a likely quick demise.

While this second strategy is a looser interpretation of conservation goals to protect evolutionary processes, it retains the fundamental logic of returning to a state of pristine nature. This is particularly evident in the plan to "clean" Volcan Wolf of other, less valuable tortoises without Floreana or Pinta alleles, sterilize them, and send them to Pinta. I asked Linda Cayot why not just let a new population of Pinta tortoises evolve, but the question was too outside her frame of the possible to be taken seriously. As she told me, conservation in Galápagos has always been about preserving the distinct populations, so they would not start mixing them now that they had genetic information to make these distinctions at a finer resolution. The tortoise populations differentiated over the course of millions of years; the conservationists see their role as erasing or cleaning the negative impacts of human extirpation and translocation of these animals out of their natural evolutionary homes during the past 300 hundred years. To bring the Floreana species back to life is to make amends for the past sins of our own species. This is a pastoral biopolitics of rewilding "pristine" nature enabled by the molecular gaze of technoscience.

Conclusion

Trained on the giant tortoises of the Galápagos Islands, the sustained genetic gaze of Caccone's lab clearly demonstrates what has been said over and over about the archipelago—that it is an exceptional place in which to see evolutionary processes. Tracing gene sequences allows us a glimpse into the prehistoric past, where we can trace the movements of an iconic species that would eventually inspire one of our greatest scientific minds. This is remarkable stuff, indeed—both the technoscience itself and what it reveals about the origins of life. But it is important to recognize that molecular reconstruction of tortoise origins is knowledge firmly situated in early twenty-first century networks of population genetics and state-led conservation.

Foucault argued that "life" did not exist as such until the advent of biology in the eighteenth century when scientists began to trace the relatedness of living things. Technologies of the molecular gaze have opened a similar ability to *produce* life—both past and future. The molecularization of life involves both an epistemic and ontological shift—not only an ability to isolate the foundations of life itself, but also a capacity to intervene in it through genetic engineering. But the life produced in this tale is not that of Frankenstein, laboratory creations. Genetics in conservation biology enables new ways of knowing, evaluating, and intervening in the lives of particular endangered animals and species. Nonhuman molecular biopolitics is not only a matter of cloning or genetic modification, but a matter of making live a particular interpretation of pristine nature. The pairing of genetics and conservation here resonates both with early eugenic-influenced American conservation policies aimed at preserving the best natural lineages as well as with critiques of modern genome mapping as biological reinscriptions of race.

These redefinitions of life are also reorienting conservation practices by changing definitions of pristine nature. Instead of seeking to protect the spatial isolation of tortoise populations, conservationists in the Galápagos are now equally concerned with the genetic purity of tortoise lineages. It is no longer only a question of space, but one of time. The management of this endangered species now involves not only particular spatialities and territories, but also negotiating temporalities/genealogies.

So what, then, is the origin of this species? The story of the Floreana tortoises, with its tracing of the ancestors of alien hybrids and its miraculous efforts to reanimate an extinct species, was made possible through this molecular gaze. Although laboratory science played a crucial role, this is not a story of laboratory origins, but of how technoscience enabled the re-animation of an extinct species in the wild. Should their origin be placed two million years ago, when perhaps a sole tortoise drifted west from Española Island and colonized a new home? Or do we trace it to the whalers who likely dumped extra cargo from Floreana at the base of Volcan Wolf? While their story cannot be separated from this history, I would argue that the origin of the Floreana species lies in the phylogenetic map that placed them not from Volcan Wolf or Floreana, but from Mars. Before this map, the "aliens" did not exist as such; if they were seen at all, they were classified as *G. becki*, native to Volcan Wolf. Only genetic mappings created this origin story, through a past life of island dispersal and genetic relation. These genetic mappings also created a future for an extinct species, opening a door for re-animation. Science frames its work as reflecting a natural truth, but this story demonstrates how science produces life—not only by splicing together unnatural hybrids, but by breathing new life into a species that was thought lost.

For Derrida, the monster represented "'the species of the nonspecies,' the nascent germ of a species about-to-become," that "perhaps heralds an entire population of hopeful monsters whose aberration remains to be classified' (Milburn 2003, quoted in Lorimer and Driessen 2011, p. 604). In some ways, these tortoises are that germ—they hold the potential not only for a new hybrid lineage of Galápagos tortoises, but also a potentially new understanding of the goal of conservation in Galápagos. Allowing these alien tortoises to continue to live and to evolve on Volcano Wolf would reflect not a desire to return to a state of pristine nature as it evolved before human influence, but an acceptance of the human role in shaping future genealogies of this species as well as others across the globe.

However, what we find here are monsters that have quickly been wrangled back into the grid. To preserve evolution's nature, the aliens, the hybrid tortoises, cannot be allowed to exist as such. They must be purified, so they can fit their place in the archipelago's evolutionary history. But as monsters, they have done their job. Tracing the origins of this life through the networks of technoscience and conservation demonstrates the inseparability of nature, culture, and technics. Conservation biologists may use genetic sequences to redefine and restore the purity of species, but the very act of doing so betrays their aim. To reiterate Haraway, "organisms are not born; they are made in world-changing technoscientific practices." This could not be more true of a species once past, but now re-animated.

CHAPTER VI: THE CONTRADICTIONS OF COMMODIFYING TORTOISE ENCOUNTERS

> George…is a conservation icon. The voice he offers endangered species is loud and clear. Like it or not, his celebrity status bestows upon us and him an obligation to the rest of the world. He must remain in captivity for the rest of his years and continue the good work he has started. As a flagship, he must keep on preaching the conservation message and converting tourists to the conservation cause.
>
> - Lonesome George biographer Henry Nicholls, 2006, p. 191

> It is said that if you look into the eyes of [giant tortoises], you will see a gaze that is both mysterious and piercing. Tortoises can remain staring for long periods of time as if wishing to examine life and its purpose. The eyes, which presumably have stood witness for at least a century, also carry years of experience which enables them to perceive the motives and ambitions of those visiting the islands: weather [sic] they come to destroy this peaceful refuge or simply to admire it…The slow, deep stare of the tortoise marks the approval of the visit or the announcement of the newcomer's death; it is a safe welcome or a curse which will be carried out without fail in the most varied of circumstances.
>
> - Octavio Latorre, *The Curse of the Giant Tortoise*, 2005, p. 1

Introduction

Walking along a wooden boardwalk that snakes through cacti and leafy *Scalesia* trees, tourists follow a path that will lead them to the most famous individual piece of nature in the Galápagos Islands: the giant tortoise Lonesome George. Emerging from the cover of over-head leaves, the boardwalk turns to open into a partially covered viewing platform that overlooks the corral George shared with two female tortoises until his death in June 2012. For 40 years, George, the last of the species of tortoise from Pinta Island (*Chelonidis abingdoni*), lived in captivity at the Giant Tortoise Breeding Center, where he became a favorite of hundreds of thousands of tourists and an ambassador for conservation. On the platform, tourists sporting ubiquitous zip-off khaki pants, sun hats, motion-sickness patches, and varying patterns of sun burn strained to get a decent photograph of George, who often passed the afternoons sleeping halfway out of site in the shade of a small lean-to.

As a volunteer at the center, I had the opportunity to observe George on a daily basis while I helped deliver branches of portotillo leaves for his thrice-weekly meals, sweep up after him, and scrub his small pool. While I came to feel a sense of awe and cariño for George, more entertaining than this hundred-year-old tortoise were the crowds of tourists who streamed through the center with cameras ready to record a shot of this prized icon of the islands. Over the course of two days in March 2012, I spent several hours sitting on the platform to chat with tourists and their guides, listening to guides' stories and tourists' questions. Tourists understood this tortoise was famous, but, like many celebrities today, they often did not know why. Guides explained that George was not the biggest or oldest tortoise, but that he was famous because he was the last of his species following centuries of human predation. As his biographer writes, George's story is "an exploration of our troubled relationship with our fragile planet" (Nicholls 2006, np). To balance the morality tale that has made George an icon for conservation, the guides also entertained with tales of George's lack of luck with the lady tortoises, his "crush" on the woman scientist who tried for months to obtain a sample of his sperm, and the diets he had been put on after displaying a propensity to binge on papaya and cactus. They anthropomorphized his captive experience to make him relate-able for tourists—George was a charismatic symbol of a lost world before man, but one who faced the same trials of daily life as the humans who visited him. Tourists delighted in these stories, a highlight in what can be a hot, boring hour's walk watching animals that are not very active. (The breeding center visit is standard on tour itineraries in Galápagos, but is a far less dynamic experience than being out on the water or hiking through hundreds of blue-footed booby nests.) But the conservation message was not lost on them. When I asked tourists why they thought George was important, many got a sad look in their eyes and lamented the lack of protection for the natural world and the need to do better for the future.[123]

True to the rhetoric that surrounds him, seeing Lonesome George brought conservationist meaning to a trip full of multi-species encounters. He was a strong reminder that such a trip might not be possible for future generations unless people act to preserve what now exists. But in the Galápagos, George's fame as a conservation icon has had other symbolic meaning. For many local residents whose livelihoods depend on tourism, George is—as one informant told me—"oro"—gold, the symbol of potential prosperity. But for others, George is a contested symbol. The title of a popular history of the islands—*The Curse of the Giant Tortoise*—is telling.[124] For fishers in particular, George has spoken more to the curtailing of their livelihoods than as a route to prosperity. In 2004, George was taken "hostage" by striking fishers upset about the National Park's closing of the sea cucumber fishery. He stands then as more than a symbol for

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[123] Over the course of a couple of hours on two consecutive days in March 2012, I informally surveyed twenty groups of tourists who walked through the breeding center and stopped on George's platform. Groups ranged in size from one individual to eight; some came with guides, some without. Surveys were conducted in English and Spanish, depending on the language in which groups were conversing or in which they addressed me. The sample is by no means representative of tourist opinions, but responses give a general snapshot of tourist understandings of Lonesome George.

[124] The book, by Ecuadorian Octavio Latorre, tells the story of the 'tragedies, crimes and mysteries of the islands.' First published in 1990, it was among the first social histories of the islands. Latorre laments the "tragic colonization process" and writes with the purpose of protecting "the ecology of the Archipelago from a wanton destruction on the name of 'Civilization' [sic]" (no page, 2005 [1990]). For Latorre, the tortoise's message is clear: "ALL ATTEMPTS AT BLIND EXPLOITATION, WITH NO REGARD FOR THE ENVIRONMENT OF THE ISLANDS, WILL END IN FAILURE OR DEATH" (page 3, typesetting in the original).

conservation, but as the interface of multiple claims to natural resources and ways of life in the islands.

This chapter takes a critical approach to understanding the iconism of giant tortoises and the multiple meanings of multispecies encounters in the Galápagos. To do this, I foreground the production of value through tourism encounters, using giant tortoises as an example. Although tortoises are iconic, they are only one of many species commodified in the Galápagos—one could build a similar analysis around blue-footed boobies, flightless cormorants, or the sea lions whose "dog-like" behavior is a perennial favorite with tourists. I bring together animal studies work on human-animal encounters with accounts of the commodification of nature. By doing this, I situate what Donna Haraway calls "encounter value" (2008) in an analysis of the contradictions of commodifying pristine nature through ecotourism. Galápagos tourism turns on the ability to produce value out of human encounters with the natural world—particularly the archipelago's unique species, but also its moon-like landscapes and deep blue seas. But these encounters, which are structured to emphasize the "pristine" nature of the islands, reinforce an unstable bifurcation between natural and social worlds. They also reinforce inequalities between tourists and locals whose understandings of the islands' nature are not conditioned through guide books, and who often are unable to afford the encounters these books celebrate. Situating the animal encounters at the heart of Galápagos tourism in the contradictions of broader political economic patterns and social conflicts helps to explain the persistence of crises in the islands.

Conservation Icons as Boundary Objects

George was—and even in death continues to be—one of many international icons for conservation. Environmental organizations have used charismatic megafauna to promote their cause for decades—the WWF's panda logo and the Frankfurt Zoo's gorilla logo are two well-known examples. Species like pandas and gorillas have been used to broadly promote conservation, while others, like the giant tortoises, are tied to specific places or conservation projects. In the Galápagos, images of giant tortoises have been used in the logos of the Charles Darwin Research Station and Galápagos National Park since they were founded to broadly promote island conservation. (The GNPS logo now includes a tortoise and a hammerhead shark, reflecting protection efforts in the Galápagos Marine Reserve, which was created in 1998.) Although these stylized tortoise logos were not modeled on him, George came to be the living logo of Galápagos conservation during his years in captivity.

The use of "flagship" species to promote conservation is controversial among ecologists who worry that fundraising campaigns based on large charismatic species—whales, dolphins, sea turtles, and tigers—offer only a narrow approach to biodiversity and the complexity of ecosystems (Entwistle 2000). In theory, protecting keystone or umbrella species can help protect wider ecosystems, thus also protecting other, less charismatic, species. But ecologists debate the utility of surrogate species, both in terms of the presumed relationships between keystone and other species and for potentially diverting resources away from other forms of biodiversity (Caro and O'Doherty 1999, Simberloff 1998, Berger 1997). However, Walpole and Leader-Williams (2002) argue that debate about flagship species' ecological roles misses the point: charismatic species play a strategic socio-economic role more so than an ecological role. They support broader conservation efforts by garnering public support and funding. Increasingly, these species are used to sell tourism as well as raise conservation funds (Walpole and Leader-Williams 2002).

In this dual role of promoting conservation and selling tourism, George and other charismatic species are positioned as what Star and Griesemer have called "boundary objects"—

things with some degree of stability that travel through various social worlds and in doing so provoke novel articulations between diverse actors (1989, also Fujimura 1992). Giant tortoises and other species are at the crux of an alliance between science, conservation, and tourism (Grenier 2007). Iconic species are positioned to translate scientists' and conservationists' concerns for the natural world to broader publics, including potential donors and tourists. Charismatic species are often deployed as a public relations strategy across traditional socio-economic and national borders—images of megafauna found in the Global South are used to attract tourists or raise funds in developed Western countries to support conservation in developing nations (Leader-Williams and Dublin 2000).

But the topographies in which these representations of wildlife circulate as boundary objects are power-laden and uneven (Whatmore 2002). As boundary objects, flagship species operate in what Mary Louise Pratt calls "contact zones"—"social spaces where disparate cultures meet, clash, and grapple with each other, often in highly asymmetrical relations of domination and subordination" (1992, p. 4). Differently situated actors have diverse understandings of nature shaped through varied encounters with these species—be they through scientific research, nature documentaries, touristic encounters, or hunting practices (Haraway 2008, Thompson 2002). These different understandings of nature reflect different worldviews, epistemologies, and political economic positions. Successfully using "charismatic" species to sell tourism or fundraise for conservation depends on their ability to speak across difference. But while the animals may serve as boundary objects because of what Jamie Lorimer calls "nonhuman charisma" (2007), this charisma is not an innate feature interpreted similarly by different actors. The kind of encounter variously situated people have with species shapes their perception of charisma, or lack thereof: a tiger appears a different animal to someone on safari or watching a nature documentary than it is to someone trying to protect their livestock from being eaten (Lorimer 2007, Walpole and Leader-Williams 2002).

Walpole and Leader-Williams see the use of charismatic species to sell tourism as having great potential for conservation fundraising and for engendering conservationist support among developing-world populations—they argue that any "dissonance between developed country and local view of species" may be offset through tourism benefits (2002, p. 544-545). But as I will show, the Galápagos experience complicates this view by showing how tourism can actually serve to amplify dissonance among actors with differently positioned multispecies relations. In the following section, I explore how nonhuman giant tortoise charisma works in the realm of tourism encounters. I then explore the production of value through these encounters before turning to analyze the contradictions produced through the fetishization of multispecies encounters.

Encounters of the Nonhuman Kind

Galápagos tourism sells the promise of up-close-and-personal encounters with "wild" nature. Guidebooks celebrate native species' apparent lack of fear of humans. The National Geographic Expeditions website on its Galápagos tours is exemplary. It explains the islands' allure in two quick sentences: "The Galápagos Archipelago, Darwin's living laboratory, is home to an abundance of wildlife. Isolated from the mainland for millions of years, it is that rare wilderness where animals have no instinctive fear of humans."[125] It then identifies trip highlights, including the opportunity to "Snorkel amid shimmering fish, sea turtles, penguins,

[125] http://www.nationalgeographicexpeditions.com/expeditions/Galápagos-cruise/detail (Accessed November 12, 2013.)

and playful sea lions. Cruise to pristine islands and walk among colonies of animals and birds unfazed by your presence. Observe rare giant tortoises at the Charles Darwin Research Station."

Common Galápagos rhetoric frames the archipelago as a place where tourists can return to a more pristine, past world as it was before man became a dominant presence. Because the archipelago had no indigenous human population, it is said that its animals never learned to fear humans, so it is "still" possible there to have encounters with wild nature. Touring Galápagos is an opportunity to step "back in time" to see what prehistoric worlds were like. It is also an opportunity to walk in Darwin's footsteps, to see the very nature that inspired his theory of evolution. Galápagos travel writing frequently combines these two tropes—twenty-first century tourist-journalists write of encounters with species Darwin saw and of re-reading Darwin's *Beagle* journal entries about the islands as they fly out from continental Ecuador or cruise the islands in a yacht (Blake 2010, Nicholls 2006). Henry Nicholls opens his biography of Lonesome George by confessing his desire to "sail into the same coves and set foot on the same beaches as Darwin." He also hoped "to find a quiet spot beneath a cactus and read aloud from his writings, one sentence in particular: 'The natural history of these islands is eminently curious.' I love that" (2006, xvii).

Indeed, Darwin's journal is full of descriptions of first-hand encounters with wildlife. After declaring upon arrival that "Nothing could be less inviting than the first appearance" of these stark island landscapes, he was clearly enchanted by the islands' unique fauna (n.d.[1845], p. 354-355). As he hiked the shores of San Cristobal Island, where he first encountered giant tortoises, he wrote he was "well repaid by the strange Cyclopean scene" (ibid, p. 355). He wrote of trying to ride giant tortoises: "I frequently got on their backs, and then giving a few raps on the hinder part of their shells, they would rise up and walk away;—but I found it very difficult to keep my balance" (ibid, p. 365). He also wrote of picking up an endemic marine iguana by the tail and throwing it into the sea—"it invariably returned in a direct line to the spot where I stood…I several times caught this same lizard, by driving it down to a point, and though possessed of such perfect powers of diving and swimming, nothing would induce it to enter the water; and as often as I threw it in, it returned in the manner above described" (ibid., p. 367). He concludes his remarks by discussing "the extreme tameness of the birds": "A gun here is almost superfluous; for with the muzzle I pushed a hawk off the branch of a tree. One day, whilst lying down, a mocking-thrush alighted on the edge of a pitcher, made of the shell of a tortoise, which I held in my hand, and began very quietly to sip the water; it allowed me to lift it from the ground whilst seated on the vessel: I often tried, and very nearly succeeded, in catching these birds by their legs" (ibid., p. 378).

Darwin's encounters speak both to the ability to get close to wild nature, but also how it remains just out of grasp—how the slippery saddles and plodding gait of a tortoise resists its rider and how birds are just skittish enough to hop out of reach before being caught. The tourist experience is similar—while National Geographic and other companies can reliably promise snorkeling encounters with sea lions and penguins because the species are regularly found at certain visitor sites, the quality of the experience is largely determined by the agency of animals. Some tourists hope for whale sightings, others to see—or not see—a shark while snorkeling. The animals cannot be made to appear during the hour-long window during which a particular vessel is permitted to let passengers snorkel at a given spot. Sometimes while you snorkel sea lion pups will tap their noses on your goggles or swim by you, belly to belly. Sometimes a school of dolphins will travel with your boat, jumping playfully in the wake. Once while I was snorkeling during a tourist cruise a panicked guide whistled us back to the zodiac because she spotted a blue whale some 50 yards from where we were swimming. But none of these encounters can be guaranteed (or prevented)—as one guide told me, a cardinal rule is never to talk about what you saw on the last trip.

The stories and rhetoric are compelling. They sell books and more than a hundred thousand tours a year to wealthy, educated Westerners. Darwin's travel writing has contributed to the creation of what Pratt calls the domestic subject of Euroimperialism—engaging "developed world" publics in the project of modern day exploration through tourism (1992). Galápagos tourism builds on the visions of the internal nature of the islands produced through natural history travel writing. If eighteenth century natural history opened a new field of visibility, postcolonial touristic travel allows modern publics the opportunity to bear witness themselves (Foucault 1994 [1970], Pratt 1992). The emphasis of natural history on the visual and the traveler's account are directly linked to the modern touristic gaze, the desire to encounter and the impulse to document photographically.

The emphasis on animal encounters in Galápagos tourism underscores what Cloke and Perkins (2005) have argued more generally—that tourism is always an embodied performance. As they write, "Any view of nature as a mere *context* for touristic activity is challenged by a recognition of how embodied beings actively co-constitute the changing nature of places and the performances that help to define those places" (Cloke and Perkins 2005, p. 903 [emphasis in original]). But just what exactly is going on in the contact zones of multispecies touristic encounters (Haraway 2008)?

In an exploration of flagship species in the realm of UK biodiversity conservation, Jamie Lorimer outlines a taxonomy of nonhuman charisma. To understand how embodied affect is central to the effectiveness of flagship species, he builds on the hybrid ontology advocated in “more than human” geography and actor network theory. This approach challenges subject-object dualism while highlighting questions about nonhuman agency and ethics. For Lorimer, nonhuman charisma is “the distinguishing properties of nonhuman entity or process that determine its perception by humans and its subsequent evaluation” (2007, p. 915). This charisma takes several forms, influenced by the physiology and phenomenology that shapes humans’ perceptions of other beings, what natural historians call the “jizz” or properties of an organism, human aesthetic preferences for cuddly, big-eyed species similar to human infants, and the “affections and emotions engendered by different organisms” through their interactions with people (2007, p. 921). The corporeal characteristics of different species produce affects through relational encounters with humans. In the case of giant tortoises, as referenced in the second epigraph to this chapter, the animals’ worn, leathery skin and black beady eyes give them a sense of the wisdom of elders. But their reptilian features also speak to their difference from humans, beings that are alien to ourselves.[126] This “aesthetic charisma” is further shaped through the interpretation provided by tour guides and signage at the Breeding Center that gives meaning to corporeal characteristics—for example framing the stare of Lonesome George’s beady eyes as one of solitary wisdom.

Ethical engagements with nonhuman species often turn on anthropomorphisms. Lorimer argues that conservation organizations use flagship species to give a literal ‘face’ to trigger concern for their cause, drawing on the emotional affect of anthropomorphized personhood (2007). Lonesome George, for example, is made to speak for all of the ghosts of his species and other giant tortoise species through a process of individualization, naming, and personification. To do this, he had to be extracted from his “natural” environment—a living logo who could walk

[126] A popular rumor—which I heard from a tour guide in the Galápagos and from keepers at the San Diego Zoo—is that George Lucas modeled the alien character E.T. on the face of a giant tortoise.

away would not work. As referenced in the introduction, the story of George's plight is told in ways that stress commonalities with human experiences to pull on human heartstrings. How could an ethical tourist look into his eyes and not feel sorrow about his human-caused loneliness? How could they not feel a sense, in Haraway's lexicon, of "response-ability" (2008)?

While anthropomorphism is an effective tool for converting tourists to the conservationist cause, it is also a complicated ethical move. Do people, as Milton (2002) argues, need to extend humanity, to individualize nonhumans, in order to care about them (Lorimer 2007)? Lorimer contrasts the "anthropomorphic ethics of cuddly charisma, which leads to a sense of care for a fellow subhuman," with what he calls feral charisma, which is "grounded in a sense of respect for the other and for its complexity, autonomy and wildness" (2007, p. 919). I think both these forms of charisma are involved in multispecies touristic encounters in the Galápagos. Lonesome George is a famous icon no doubt because he has been individualized and personified.[127] But he also generates a kind of wild charisma. Several tourists I chatted with said that seeing George in captivity was deeply disturbing, they did not like that he was on display for tourists and felt that he should be free to live in the wild. Indeed, for many, the lure of the Galápagos is the potential for an "interspecies epiphany" in the wild—what Jamie Lorimer describes as a form of corporeal charisma (2007). Travel writers often reflect on a Galápagos tour as an opportunity to commune with "pristine" nature, to see a world in which humans are the others, to have a visceral,

[127] A complicated ethics of which tortoises are personified also exists. Diego, discussed in Chapter 4, and George are by far the most talked about individual giant tortoises. In the history of the breeding center, others have been named, but their stories were not as unique. Another wild tortoise, who lived in isolation in a crater on Pinzon Island, was named Onan by conservationists for his habit of attempting to mate with rocks and spilling his seed. He was a favorite of Linda Cayot, who buried him on Pinzon and wrote a eulogy for him in the CDRS Noticias. All the named tortoises I am aware of have been males. This, I believe, speaks to a macho culture among scientists, explorers, and locals.

emotional experience that changes their understanding of their place in the world. As one recent travel writer for Fodor's put it: "A trip to the Galápagos can be downright transformative."[128]

It is through these charismatic encounters that flagship species work to recruit tourists to the conservationist cause. As the first epigraph to this chapter suggests, this is the work that Lonesome George performs in his corral at the park headquarters and why, from Nicholls's perspective, he must remain at the center rather than be repatriated to Pinta or put on display at a national museum. Through multispecies encounters, George works to create value. This form of touristic encounter value is both affective—inciting tourists to care about his plight and conservation work more generally—and monetary—through donations tourists contribute directly to funding conservation initiatives. The Director of the Galápagos Conservancy, the U.S. Friends of Galápagos Organization (FOGO), Johannah Barry, explained to me how she worked with the Park and CDRS to use tourist information gathered upon entry to the islands as the basis for a fundraising campaign. She explained: "The idea was to capture the hearts and minds and obviously the wallets of all the people who went to Galápagos. Because we thought then, and it makes all the sense in the world, that they would be your strongest advocates. And that has been the case" (Interview January 10, 2012).

[128] Richard, E. August 8, 2013. "Just Back From: Cruising the Galápagos Islands. Fodor's Travel. http://www.fodors.com/news/one-week-cruise-Galápagos-islands-7014.html (Accessed November 12, 2013).

Figure 6.1 Photo of Tortoise Donation Receptacle at CDRS Headquarters

Photo/ E Hennessy, August 2009 (It has since been removed)

Human-animal encounters are the center of Galápagos tourism. The nonhuman charisma tourists experience by seeing and interacting with "wild" nature produces multiple forms of what Haraway terms "encounter value." As she writes, "trans-species encounter value is about relationships among a motley array of lively beings, where commerce and consciousness, evolution and bioengineering, and ethics and utilities are all in play" (2008, p. 95). Looking closely at multispecies encounters demonstrates that value is produced not only through human labor but also by the liveliness of other species. In this section, we have seen how giant tortoises produce two types of value through their charismatic encounters with humans: both an ethical valuation of the natural world that supports conservation and economic value to support this work through donations. Through tourism, nonhuman charisma also serves the production of capitalist value. In the next section, I turn to analyze the production of value through the commodification of multi-species encounters, situating it in recent literature on the "conservationist mode of production" (Brockington and Scholfield 2010).

Tourism, Conservation, Encounter Value

Figure 6.2 Tortoise Symbolism in Puerto Ayora, Santa Cruz

From top left: A Lonesome George t-shirt; signage from two tourist businesses, a bar/restaurant and a cruise company; the Lonesome George & Co. store in Puerto Baquerizo Moreno, San Cristobal; street art on Darwin Avenue encouraging visitors to "Follow George." All photos E. Hennessy, Fall 2011.

To get to the Giant Tortoise Breeding Center at the Galápagos National Park headquarters, tourists often walk from the dock across town where their cruise ships anchor in Academy Bay. This is often tourists' only stop in town during a weeklong cruise around the archipelago. They walk along the main waterfront street, Darwin Avenue, lined with souvenir shops and tourist restaurants as well as an ever-increasing number of hotels and day-trip providers. Giant tortoise street art instructs visitors to "Follow George," pointing the way to find him. The souvenir shops sell all forms of endemic animal trinkets, art, jewelry, and t-shirts. Indeed, Lonesome George is not only an icon, but a brand (MacDonald 2010). At the upscale Lonesome George & Co. store in Puerto Ayora a stylish t-shirt runs upwards of $35. A "World Heritage Hoodie" is $120.[129]

The commodification of nature in these shops makes clear that national parks are, as Roderick Neumann has argued, "landscapes of consumption" in which nature is commodified for tourists (1998, p. 24). National parks are exemplary capitalist productions of nature because they generate value by transforming landscapes into commodifiable tourist destinations (West and Carrier 2004, Smith 1984). To analyze the production of this form of encounter value, it is necessary to place nature tourism in broader national and international patterns of capitalist commodification (Honey 2008, Gossling 2003, Britton 1991). Although Lonesome George himself is not made into a commodity in the same way a t-shirt selling his image is, the experience of seeing him is. Although George is a public icon—part of an Ecuadorian national park and World Heritage Site—the structure of the tourism industry built around him is privately

[129] Prices checked online Nov. 14, 2013. The U.S.-based company promotes sustainable consumption and donates 10 percent of sales to its educational Academy for Change. http://www.lonesomegeorge.net/pages/story-of-change

owned and profit-seeking. Foreign tourists must pay a $100 fee to enter the islands.[130] A geography of touristic encounters then must examine how particular species are incorporated into processes of accumulation, how they serve as representations of particular places, and how, in turn, the meaning of these places is also created through the practice of tourism (Britton 1991).

Capitalizing on nonhuman encounters is big business in the Galápagos, as it is around the world (in 2012, the number of global tourists topped 1 billion). Growth of the tourism industry in the Galápagos has paralleled the rise of nature tourism around the world since the early 1970s. The first "official" tourism to the Galápagos National Park began in 1969 with some 2,000 visitors. By 1979, just under 12,000 tourists visited the islands. The number has risen steadily over the years—in 2012, just over 180,000 tourists visited Galápagos.[131] In 2007, the last such data available, tourism made up 71 percent of the islands' economy (Honey 2008, p. 131). From 1991 to 2006, total tourist expenditures increased from $20.7 million to $143.27 million. Taylor et al. (2006) estimate that the island-wide economy in Galápagos increased by 78 percent between 1999 and 2005, making Galápagos one of the fastest growing economies in the world (Epler 2007). This growth makes Galápagos a significant sector of the Ecuadorian economy—not only generating tourist revenue, but also employment opportunities. The Galápagos are an international draw for Ecuadorian tourism—the destination that makes the country a unique, globally sought destination and also brings tourists to the continent. To get to the Galápagos, tourists must stop over in continental Ecuador—a travel route that is not a matter of logistics so much as a strategy for monitoring tourists and what they bring to the islands as well as for

[130] The fee was created with the Special Law in 1998 and is designed to keep tourism revenue in the islands. The money is divided among the national park, Galápagos Governing Council, Agricultural control agency, the Navy, and municipal governments. Ecuadorian citizens pay a reduced fee of $6.

[131] Thirty-one percent of these tourists were Ecuadorian nationals; 69 percent were international arrivals. INFORME ANUAL DE VISITANTES QUE INGRESARON A LAS AREAS PROTEGIDAS DE GALÁPAGOS 2012. Enero 2013. Servicio del Parque Nacional Galápagos. Puerto Ayora, Santa Cruz, Galápagos, Ecuador.

increasing dollars spent in the continent. According to 2012 Ecuadorian Ministry of Tourism statistics, the Galápagos accounted for 16.6 percent of total international tourist demand (up from 10 percent in 2005) (Anon. 2012, Epler 2007). But the revenue generated by these visitors accounts for a far greater percentage of the total revenue tourism generates yearly—in 2005, that 10 percent generated 55 percent of the $486 million tourism receipts contributed to the national economy (Epler 2007).

This type and scale of commodification is not usually what one thinks of when visiting a site of supposedly "pristine" nature, but it has become a hallmark of what Brockington and Scholfield (2010) term the "conservationist mode of production." Capitalism and conservation have long been tightly intertwined (Brockington, Duffy and Igoe 2008, Adams 2004, Neumann 1998). In an era of proliferating forms of neoliberal environmental governance (Castree 2007, Heynen et al. 2007, McCarthy and Prudham 2004) and conservation territories, particularly across the Global South (Zimmerer 2006), the relationship is becoming denser (Brockington, Igoe, and Neves 2010, Brockington and Duffy 2010). Although the forms through which "conservation is increasingly conflated with consumption" (Neves 2010, p. 721) vary—from green-washing to ethical consumption (Carrier 2010, Neves 2010)—the commodification of national parks through tourism is perhaps the original model. Brockington and Scholfield argue, drawing on Liz Garland, that wildlife conservation is "a particular kind of capitalist production" that turns the natural capital of wildlife into symbolic capital and, ultimately, money. It "differs from other use of natural resources (timber, mining, fishing, farming) because it does not depend on the physical use and appropriation of the resource. It is consumed by looking, by tourists' gazes, and by the work of photographers and filmmakers" (2010, p. 558). A core justification of nature tourism is that people will pay to see nature, thus it can be saved precisely because of its market value. As Brockington and Scholfield write, “In effect, wildlife and landscapes are produced, reproduced and redesigned as tourist attractions. In the process they are commodified and drawn into the global tourism marketplace as products to be consumed” (2010, p. 746, also West and Carrier 2004). Conservation works as a kind of “environmental fix” that opens new avenues for accumulation (Brockington, Duffy, and Igoe 2008, p. 472). Animal tourism is central to capital’s ability to open and colonize new natural spaces (Duffy and Moore 2010).

What is interesting about the relationship between conservation and tourism in the Galápagos is that, as we saw in Chapter 2, the ability for the state to profit through nature tourism was a core justification for the creation of the Galápagos National Park and Charles Darwin Research Station in the early 1960s. As Christophe Grenier argues in his history of “Conservation Against Nature” in the Galápagos, it was the creation of the CDRS that opened this isolated space to circuits of global capital (2007). From the first days of the CDRS, revenue generation through tourism was a central strategy of Galápagos conservation. In the late 1960s, two sponsored reports, one by the UK Overseas Development Programme and the other contracted to the American Arthur D. Little, Inc., a management consultancy, studied the feasibility of “economic exploitation” through tourism in the islands (Anon. 1969, Grimwood and Snow 1966). The Ecuadorian Government recognized the potential as well; the Ministry of Agriculture and Stockbreeding issued a 1973 study on island resources and opportunities for economic exploitation.

In a 1970, British ornithologist and advertising executive Guy Mountfort, who helped found the WWF, offered his thoughts on Galápagos tourism in the CDRS’ *Noticias de Galápagos* publication. He acknowledged that, uncontrolled, tourism could spell “irreparable” disaster for island ecosystems. But he found the arguments for tourism “compelling” both in terms of relations with the Ecuadorian government and for conservationists' own purposes: "All Governments need foreign currency and particularly the American dollars which at present represent the largest part of the income from tours to remote islands. Few Governments can yet equate the long-term value to science of a unique and unsploit wildlife community with the immediate value of an increase in dollar income." The flows involved in tourism would provide direct benefits for scientists stationed on the remote islands as well: "Where research stations have been created, as on the Galápagos and Aldabra, the regular arrival of tourist ships can be of considerable benefit in providing a mail service, fresh food and water, medical facilities and emergency services. It has also been abundantly proved that in return for the privilege of visiting these islands, tourists will readily provide money for the research stations." Finally, Mountfort stressed the educational value of tourism and the moral need to allow people to see the nature conservationists were asking them to protect: "If the public is asked to subscribe money for the acquisition or operation of wildlife reserves, there is a moral obligation to provide reasonable facilities of access. This benefits the cause of conservation. Most of the organized tours are now accompanied by qualified wildlife lecturers who are actively concerned in the conservation movement….They also indoctrinate tourists with the principles and needs of conservation" (1970, p. 11-12).

The message was not lost on CDRS scientists, who were instrumental in organizing the logistics of tourism operations in the early 1970s. They issued permits to naturalist guides, who they trained in rigorous natural history courses. They set visitor sites around the archipelago, making tour vessels adhere to trip itineraries, instead of allowing them to cruise the islands at will. In the Galápagos and elsewhere, conservation NGOs have long been central to the process of value production through tourism. As Brockington and Scholfield write, they "forg[e] the conditions, discursively and materially, for capital to appropriate aspects or parts of wildlife and nature which had escaped being turned into commodities. In part this is achieved through legitimizing visions of […] landscapes and wildlife and specific types of nature production" (2010, p. 552). NGOs also do this by exploiting the fame of celebrity founders (Brockington 2009). The Charles Darwin Research Station is perhaps a paradigm case of conservationists seeking to capitalize on a famous name. As the current CDRS executive director—a former financier hired to rebuild a failing organization—told me, the organization has the best possible brand name, the challenge for him is how to translate it for fundraising. His challenge suggests that even a famous brand name does not work on its own to raise awareness for conservation science, but like species' charisma, requires interpretation to be successfully mobilized in international networks of capital.

Analyzing conservation and tourism development as mutually dependent activities complicates common understandings of conservation as a check on capitalist development (Brockington, Duffy, and Igoe 2008, O'Connor 1998). As it extends capitalist relations of production, the commodification of nature through tourism introduces a set of contradictions that belie the role of eco-tourism as a supposedly sustainable solution to tensions between conservation and development. In the next section, I explore the contradictions of nature tourism in the Galápagos through critiques of the commodity fetishism of pristine nature.

Contradictions of Commodification

Galápagos is special because of its ostensibly pristine landscapes. But in the words of Neil Smith, even the landscapes of these remote, uninhabited islands are "produced in every conceivable sense" (1984, p. 80). To be made into a commodity, tourist experiences must be standardized, regulated, and made predictable (Britton 1991). This makes nature advertise-able and sale-able so that tourists may purchase their vacation based on the promise of lived experiences. From the moment tourists arrive at Baltra airport—or perhaps even since their arrival on the continent in Ecuador—every hour, activity, and view they will experience in the Galápagos has been planned. This is particularly true for cruise passengers, who are whisked by private bus from the airport to their awaitng yacht where for the next 5, 10 or 14 days they will follow a carefully planned route itinerary and daily schedule approved by the national park. Not all the experiences tourists will undergo—the mandatory safety drill on board or the inevitable sea-sickness—will be enjoyable, but they will fade into the background of the experience of life on open water and the access to wild nature it affords.

Figure 6.3 "Pristine" Landscape, from Bartolomé Island

Perhaps the most famous landscape in Galápagos, taken from Bartolomé Island looking west toward Santiago Island. A scene in the movie "Master and Commander" was shot here. Photo/E Hennessy, July 2009

A major component of tourism in the Galápagos is the creation of an ability to witness "pristine" nature. The fetishization of the pristine that is the foundation of nature tourism is produced through carefully scheduled tour experiences: cruise ship itineraries are staggered such that tourists rarely see more than two or three other boats on the water at any particular visitor site. Each group of 16 tourists must have its own naturalist guide—the guides act as essential interpreters and trip leaders who educate, entertain, and keep tourists from getting too close in their wild encounters. The low number of tourists per guide helps to ensure guides' control over tourist behavior and to prevent crowding at visitor sites, lest the illusion of being alone in the wild be spoiled (Honey 2008). Even scientists and park guards who might be working on remote islands are instructed to stay out of sight of visitor sites. Only certain elements of conservation work—most notably the baby tortoises bred at the Park headquarters—are deemed appropriate for visitors' eyes.

The fetishization of the pristine involved in nature tourism is central to Rod Neumann's argument that national parks are the "quintessential landscape of consumption for modern society" (1998, p. 24). The "landscape way of seeing" involves the "removal of all evidence of human labor, the separation of the observer from the land, and the spatial division of production and consumption" (ibid, p. 24). Tourists live in a "bubble" of carefully planned experiences cut off from the surrounding communities and socio-natural relations that make their tours possible (Hennessy and McCleary 2011, Carrier 2010, Graburn 1989). The fetishization of nature makes the relations of production invisible. Geographic displacement of the relations of production from the relations of consumption is a hallmark of the fetishization of pristine nature (Carrier 2010, Castree 2003).[132] For many years, the only way for tourists to see Galápagos was on a

[132] Here I am relying on Carrier (2010) use of fetishization in the realm of conservation. He extends the term, using it more broadly than Marx to be the "ignoring of denial of the background of objects." Carrier is concerned with not

cruise ship. Except for their visit to the Darwin Station to see Lonesome George and, in the early days, have coffee with the station's scientist-director, tourists were systematically kept out of Galapagueño towns during their cruises.

The fetishization of pristine nature involves individuating specific parts of nature—such as Lonesome George—separating them from their ecological context and producing value through symbolic abstraction. Galápagos tourism propaganda separates nature—particularly charismatic species—from its social and ecological contexts (Ospina 2006). As Castree notes, capitalist commodities must be "separated out as discrete ontological entities with their own qualitative specificities" (2003, p. 280). In George's case, conservationists not only removed him from his native island and brought him into captivity, but also popularized his social identity—his qualitative specificities—as a solitary tortoise with a tendency to overeat who was not interested in other tortoises. George's value as a tourist commodity is built on this identity as well as qualitative abstractions about his symbolic value. As the last of his species, George was made to stand for a lost race as well as hundreds of thousands of tortoises from other islands nearly hunted into extinction. The continued emphasis on getting him to reproduce also made him a symbol of the future of the species that spoke to the difficulty of remaking nature once lost. As such, George occupied a liminal space between life and death, the past and the future.

Displaying Lonesome George at the Breeding Center generated multiple forms of value. As a centerpiece of the tourist experience, he helps to generate revenue for businesses that sell tours in Galápagos as well as hotels, restaurants, souvenir shops, and numerous related support industries. He also generates funding for conservation through direct fundraising campaigns that solicit donations from tourists. The experience of seeing Lonesome George and learning about

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only the transmutation of labor power into commodities, but a broader "general tendency to obscure the people and processes, of which labor power is a component, that are part of creating and object and bringing it to market."

his sad fate as the last of his species coupled with the work of rearing baby tortoises and meeting with the scientist in charge of "saving Galápagos" was a powerful close to tourists' stay in the Galápagos—a sure argument for enrolling them as donors in the conservationist project.

But the fetishization of Lonesome George and the "pristine" landscapes of the Galápagos mask the relations of production of the tourist experience. Many tourists are surprised to find out that more than 25,000 people live in the islands today. When I tell people I work in Galápagos, they often ask where I stay—the implication being that I must either camp out or live on board a ship. They are often startled to hear that I rent apartments. Over the past 30 years, as the tourism economy has grown, so has on-island development. When the CDRS was founded, about 2,000 people lived in the islands. Over the past 50 years, as the tourism industry has grown resident populations have developed apace. While the tourism industry is a major pull factor for migrants, the emphasis on pristine nature tourism sets up a structural divide in the industry that limits their ability to prosper. In this case, the spatio-temporal displacement that separates commodity producers and consumers separates "pristine" landscapes from the in-town labor that supports the tourism industry—from food service preparation, to water purification, boat mechanics, hotel staff, and the myriad businesses that support daily life in the islands. It also separates the profits from cruise tourism—which accrue to the big, often foreign-owned businesses that can afford initial capital investments in cruise ships and park operation permits—from Ecuadorians who live on the islands and work in support businesses.[133] In 2007, tourists spent US $419 million in the Galápagos, but only US$62.9 million entered the local economy (Epler 2007). In the previous years, total tour vessel revenue was US$120.5 million; on-island hotel revenue was less than one-tenth of that, US$10.7 million (Epler 2007). One 2000 study reported that only 15.1

[133] The two major lines that have dominated Galápagos tourism are New York-based Linbald Expeditions and Quito-based Metropolitan Touring.

percent of money spent by foreigners stays in the archipelago, compared to 95 percent of money spent by Ecuadorians (Willen and Stewart 2000).

The cost of cruising the islands also sets up social divides in tourism. A 10-day cruise with National Geographic Explorations (run through Linbald Expeditions) in 2013 ranged from $4,990 to $10,450 per person during peak season over the winter holidays.[134] A less luxurious 3-night cruise with G Adventures (a Canadian company) started at $2,149 per person.[135] These prices, and trip advertising, are targeted to Western visitors—norteños or northerners as they are often called in Ecuador. Over the past 10 years, Ecuadorian and South American tourism to Galápagos has increased (Honey 2008). But most of these tourists stay on the islands and take much more affordable day-trips to central islands (these tend to cost around US$100 per day, as of my last visit to the islands in March 2012). Indeed, the entire experience of Galápagos tourism is marketed differently in South America than it is in the United States and Europe. Chatting with a tourist guide and Chilean tourist on George's platform, the guide told me that Norte Americanos knew a lot about Galápagos before they got here and always carried guide books. She said you had to be careful as a guide not to say anything incorrect, because they would catch you and look at you funny. National tourists, she said, were different—they came not so much for Darwinian nature, but for sun and relaxation. On the continent, she said, Galápagos are not advertised as a conservation destination, but as a place for "sol y mar"—sun and sea—tourism. The Chileña agreed, saying in Chile, Galápagos were not advertised for their conservation value. She came because she wanted to see nature and always chooses places for vacation where she can see something new. But many do not do that, she said, they just want to go to the beach and

[134] http://www.nationalgeographicexpeditions.com/expeditions/Galápagos-cruise/detail Accessed Nov. 28, 2013

[135] http://www.gadventures.com/trips/voyage-Galápagos-southern-islands/EV06HB/2014/ Accessed Nov. 28, 2013

don't pay attention. The guide said those tourists are often upset when they do not get as much beach time as they had hoped. Indeed, Galápagos has fewer beaches than continental Ecuador and the climate on the central islands is often cloud-covered for months out of the year.

The different profile of tourists reflects a division between cruise and land-based tourism in the islands. Since I began working in Galápagos in 2007, on-island tour businesses—day trip providers, restaurants, hotels—have multiplied each year. Concern about increased development in town was a central theme of crisis declarations, particular among conservationists who framed town-based growth as more harmful to the environment than increases in cruise-based tourism.

As this section has shown, economic analyses of eco-tourism stress what Martha Honey calls its central paradox—that success often means the degradation of landscapes (2008). Ecotourism is an example of the contradictions of treating natural landscapes as commodities—through direct and indirect consumption, accumulation strategies cause ecological damage that despoils the resource (Castree 2003, O'Connor 1998). But the contradictions that arise through eco-tourism in the Galápagos are not only economic and ecological—they also generate social divides that have been the source of much political conflict in the Galápagos. As I will detail in the following section, tourism development was central to the discourse of crisis in the islands that gained international traction in the mid-2000s and culminated with President Correa's "at risk" designation and UNESCO putting Galápagos on its list of World Heritage Sites 'In Danger' from 2007-2010. The fetishization of the pristine has caused decades of tension in the islands between conservationist desire to protect pure nature and growing towns needed to facilitate the tourism industry. At the center of these debates, as I will discuss in the following section, are standards of social development in the islands and islanders' ability to profit from the tourism industry.

Nature of the Crisis

When UNESCO put the Galápagos on its list of "World Heritage Sites In Danger" in 2007 following President Correa's "at risk" designation, growth in the tourism industry was a central concern. In their analysis of the crisis moment, Galápagos conservationists Graham Watkins and Felipe Cruz identified tourism growth as the principle cause for "drastic economic, social, cultural and ecological" changes in the islands during the previous 15 years (2007). For conservationists, tourism was often framed as the root cause of problems because it increased flows of people, goods, and pests to the historically isolated islands. The problem was less the tourists themselves than the imported food, water and supplies needed to sustain them and growing resident populations that work in tourism and support industries. Tourism acted as a motor for growth—as cultural ecologist William Durham explained,

> "The development of international and domestic tourism has created an economic motor that propels not only one of the fastest-growing economies of the world, but also one of the fastest-growing human populations with high rates of immigration. The human population of Galápagos, in turn, has modified the archipelago's habitats, tempered its harsh ecological conditions in places, and introduced hundreds and hundreds of exotic species" (2008, p. 85).

But tourism was far from the only problem identified in the crisis discourse. The official World Heritage Committee report listed multiple problems in the islands that needed "urgent resolution" extending far beyond direct impacts from the tourism industry (UNESCO 2007, p. 1). Among these problems were "lack of effective governance"; "risk from alien invasive species"; rapid, "haphazard," "unsustainable," and "inequitable" growth of the tourism sector"; inability to control illegal immigration; lack of stability and capacity of National Park and Marine Reserve staff; and a poor education system that "does not incorporate elements of environmental management and heritage preservation, and natural resource development, further delaying the critical need to develop an insular culture focused on sustainable development" (UNESCO 2007, p. 9-10, Hennessy 2010).

These issues came up repeatedly during interviews I conducted with various stakeholders in the islands as part of a team in May 2007 and during the summer of 2008 (Hennessy 2010). What was most evident from in-depth discussions with stakeholders of what was at stake in the crisis was that the crisis was not an easily definable event with a tangible material referent, but was experienced and interpreted very differently by differently situated actors. Several "master narratives" about the nature of the crisis emerged from these discussions—as Lu, Valdivia, and Wolford defined them: "There are too many people; development is the problem; people lack concern for, and education about, the environment; environmental resources are over-harvested; the problem is weak management" (2013, p. 85). But while interviewees tended to agree on these broad definitions of the crisis, they differed considerably on the specificity of issues and how they should be addressed (ibid, Hennessy 2010). For example, while conservationists tended to frame migration issues in terms of neo-Malthusian concerns about increasing population on small, "fragile" islands; resident farmers and business owners spoke about migration problems in terms of the difficulty of finding reliable, hard-working laborers (Lu, Valdivia, and Wolford 2013, Hennessy 2010). Temporary residents on one-year work permits had yet a different perspective—they were frustrated by both laws that locked them into contracts (to get a new job they would have to leave the islands and be brought back in on new papers) and limitations on their ability to bring their families with them to the islands. Similarly, while conservationists voiced concern about the *extent* of development in growing towns, local residents were more concerned about the *quality* of public services—water and sewerage, education, and health care

(Hennessy 2010, Lu, Valdivia, Wolford 2013). Thus while Galápagos stakeholders generally agreed that there was a crisis in the islands, their different lived experiences shaped their understandings of the issues of central concern.

One of the common refrains in these interviews about the crisis was that the problems in the Galápagos stem from the "3 percent" of the islands dedicated to urban and agricultural areas. As the former head of the CDRS explained, there are biological and ecological problems in the islands, but they are all driven by socio-economic and cultural issues (Interview 2007). This interpretation of the crisis as fundamentally one caused by "society" intruding into a space of pristine nature re-inscribes the bifurcation between Nature and Culture that has shaped Galápagos politics since the GNP and CDRS were founded (Hennessy 2010).

As a former head of CDRS told us in the summer of 2008, the Galápagos have been in crisis since the early 1980s—the same issues of over-development in fragile islands, concern about introduced species, and growing tourism have been raised again and again over the past 30 years. The 2007 declarations were not a response to a new event, but a marker of the escalation of decades of tensions between conservation and development in the islands (Grenier 2007, Ospina 2004). A review of the CDRS flagship publication, *Galápagos Research* (formerly *Noticias de Galápagos* [Notices from Galápagos]), demonstrates that conservationists' definition of the key problems facing the Galápagos—concern about the local population's use of resources, introduced species, and control of tourism—have remained broadly consistent since the organization was founded (Brosset 1963, Bowman 1960, Eibl-Eibesfeldt 1960). As the informant explained, the discourse of crisis was central to the way scientists and conservationists framed social and developmental issues in the islands: "It all comes back to crisis management—biologists, not knowing much about human stuff, they used to see everything as a crisis—nonequilibrium. They knew they needed money" so they used the crisis discourse to generate funding for conservation (Interview 2008).

From a conservationist perspective, what is at stake in crisis declarations is the production and continued health of "pristine" wilderness. If the crisis is interpreted as "social development" threatening "pristine nature," then declarations work to draw attention to the need for purification—the enforcement of laws and regulations to limit the in-flow of migrants and their use of resources. The work of the national park has long been structured around performing boundary work—including literally patrolling the boundaries between the park and agricultural zones (when Pepe Villa, one of the first two park guards, arrived in Galápagos, establishing the park boundary on Santa Cruz was one of his first activities—see Chapter III). This work is essential to the production of pristine nature. But the ongoing nature of the crises and the repetition of core conservationist concerns over the past half decade demonstrates that this work is never finished.[136]

The technologies that emerged in response to crisis declarations are designed to give government more control over access to the islands. One key example is the implementation of a transit control system in which residents and visitors are issued scan-able transit control cards. (While I was living in the islands, police would set up check points every couple of months along the major road to look for migrants whose work permits had expired.) But while such solutions provide action items for law enforcement whose results can be quantitatively monitored, they ignore the fundamental contradictions that produced the crisis in the first place—the social

[136] By pointing this out, my argument is not that these technologies should not be used, necessarily. But it is that politics remains a question of "who" rather than a question of "what" to use Annemarie Mol's distinction—the end goal of protecting nature is not questioned, what is at stake in debates is who has access to that nature and who has the authority to decide that access.

stratifications produced through commodifying pristine nature and the different valuations of nature held by differently situated actors.

Galápagos politics are marked by a long-running conflict between island conservation and development (Ospina 2006, Hennessy and McCleary 2011). The emphasis on maintaining pristine island ecosystems—and the powerful influence of scientists working with the CDRS from the organization's founding to the end of the century—led to an implicit policy among conservationists to discourage on-island development (Hennessy and McCleary 2011). This ranged from lack of support for municipal projects—such as water purification plants, improvements to sewerage systems, and proposals to build multiple hospitals in the islands (there is only one today, on Santa Cruz, that is notoriously poorly equipped and under-staffed)[137]—to discussions about buying the islands from Ecuador and removing resident populations from the islands altogether (Interviews).[138] In an interview, a retired CDRS scientist told me that if he had his way, there would not be any people on the islands—but, he said, Ecuador is a democracy, so what could be done? Over the past ten years, these extreme views have slipped in their hold over conservation visions in the islands—in 2005, the Park published a new management plan that made the need to recognize and work with local populations a central goal. Since then, calls to view Galápagos as a "socio-ecological system" (Gonzalez et al. 2008) and to orient science to achieving sustainability (Tapia et al. 2009) have come to the forefront. (Several of the [white, foreign] scientists and conservationists with more extreme views have left or been pushed out of CDRS management since the late 1990s.) As Gonzalez et al wrote in 2008, "There is a clear

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[137] Galápagos is not a place of abject poverty such as exists in mainland Ecuador. Residents repeatedly said in interviews that life in Galápagos was better than on the continent — more tranquilo, less crime, more opportunity. But it is a place of uneven distributions of wealth and of economic and social precarity.

[138] Such a move is not unprecedented in modern Latin America. U.S. millionaire Douglas Tompkins purchased 750,000 acres in Patagonia to create the private Pumalían Park (Waklid 2010, Carey 2009).

need in Galápagos to abandon the historical perspective of the separation of humans from nature, which only exacerbates conflicts between conservation and development." Instead of conservation versus development, it should be "conservation for development" (2008, p. 17). While this emerging recognition of Galápagos as a hybrid landscape reflects a new approach to conservation, it does not always address nuanced histories of conflict among the various sectors that constitute Galápagos "society."

As the multiple interpretations of crisis declarations make clear, Galápagos "society" is far from a homogenous unit working on "nature," but includes numerous social, political, and class divisions— among them fractures and alliances between conservationists and local residents, scientists and politicians, Galapagueño residents and outsiders, old and new migrants, those who work in lucrative tourism jobs versus support industry jobs (Quiroga 2009, Ospina and Facloní 2007). Each of these populations has varied economic interests as well as particular understandings of nature based on their unique lived experiences. Galápagos historian Pablo Ospina gives the endemic Opuntia cacti as an example: to someone from the islands, the Opuntia are everywhere and serve no real purpose, but for a botanist, the Opuntia are fascinating because they are a species endemic to Galápagos that grow into much taller trees than to other Opuntias elsewhere (2004). Nature has a different use value for different populations. Ospina identifies three main uses of nature that inspire conflicts: the scientific, the tourist, and the "campesino" or local (2004). But as varied responses to the crisis declarations show, even these three categories are too broad to fully explain the situated practices through which ideas about nature and its value are formed. Neither understandings of the crisis nor individual actors' understanding of nature map directly to broad sectoral categorizations, but instead emerge from the contradictory patterns of lived experiences of place (Valdivia, Wolford, and Lu 2013).

Tensions of Iconism

Attention to the islands' iconic species can illuminate the frictions that arise as these contradictory understandings of nature meet (Thompson 2004). The giant tortoises have often become an object of contestation in political conflicts in the islands. Since the park and CDRS were founded, conservationists have sought to rework local people's relationships with nature—the giant tortoises were one of the chief vehicles for doing that, both for the sake of the animals who had commonly been used as food in the islands for centuries, as well as for the development of a "conservation ethic." For the most part, Galápagos residents have adopted the figure of the tortoise as a symbol of Galápagos—tortoises frequently appear in logos for tourism businesses, but can also be seen in areas of town not commonly traversed by tourists in murals on school walls and in logos for internet cafes and other local businesses. When I asked one municipal employee in Santa Cruz how he thought residents generally viewed the tortoises, he exclaimed "como oro!" [Like gold!] As one conservationist explained, they are a cash cow—a symbol of tourism and its potential, if not necessarily the main reason tourists come to visit the islands.

But not all island residents look positively on this cash cow—particularly island fisher populations, which through the 1990s and early 2000s had tense relationships with conservationists that often erupted into strikes and acts of violence. As one fisher told a group of students, "Lonesome George here, Lonesome George there, that is the best business that the conservationists have invented!" (quoted in Quiroga 2009). Over the past 20 years, the tortoises have often become targets of political protests. In 1994, when conflict between fishers and conservationists was at a peak, Park guards found 73 tortoises slaughtered, many of them in southern Isabela Island—nearly double the number that had been found over the previous 15 years (Cayot and Lewis 1994).[139] Conservationists widely suspected fishers were behind the slaughter—a symbolic response to escalating to tensions over booms in commercial fishing of sea cucumbers in the early 1990s. From 1995-2004, conservationists found 190 slaughtered tortoises—all but one of them on Isabela Island and many in places frequented by fishers (Marquez et al. 2007). Many of the tortoises were apparently used for food, but park wardens reported finding others whose necks had been slit and left, sometimes in the middle of a trail so they would be found.[140] With each of these incidents, there has been speculation over the source and meaning of the actions: some describe them as hostile responses by fishers to restrictive park regulations, while others attribute them to park officials themselves, suggesting that the park will kill its own animals to get more funding for conservation.

In 2000, fishermen directly challenged the Park's presence in Isabela by setting the director's house on fire, then walking down the street to vandalize the park office, where they broke windows and destroyed computers. Tortoises too became a target in this protest—the fishers took ten tortoises from the breeding center on Isabela and destroyed tortoise egg incubators. They were angry over park quotas on the year's lobster fishery, but tensions mounted with the support of the islands' governor and some mayors who later opposed the main Park director's calls for fishers to be arrested—they never were (Bassett 2009). In 2004, fishing conflicts over the right to use long-line methods to catch sharks erupted into strikes. In February of that year, international headlines claimed that "Galápagos tortoises held hostage" as fishers

[139] Tortoises are not the only animals found slaughtered in what conservationists interpret as acts of protect. On January 29, 2008, Park rangers reported finding 53 dead sea lions on Pinta island in the archipelago. Sea lion killings are not uncommon—their penises are sold to Asian markets, but these had had their skulls crushed, apparently indicating an act of vengeance. It is possible that fishers were defending themselves and their catch from aggressive male sea lions. http://news.bbc.co.uk/2/hi/americas/7214860.stm (Accessed December 10, 2013).

[140] On September 10, 2004, park guards encountered an encampment of fishers cooking tortoise meat in a pot (Marquez et al. 2007). When tortoises are killed for food, their plastrons (under shells) are usually slit or removed. Park wardens say the state of the dead body is an obvious indicator of how a tortoise died.

took over Park and CDRS headquarters for several days, where the breeding center and pens—including Lonesome George's—are located.[141] In September, it was national park guards who went on strike, closing the park to its director who was seen as allying with the fishers against the interests of the park. That year of unrest ended with the ousting of that park director. While these sensational acts generate a lot of publicity, they are often also misconstrued. A fisher I interviewed in 2012 who had been part of the strikes as a union leader, said the oft-repeated charge that the fishers had taken Lonesome George hostage was false, that they never intended any harm to the tortoises, but had no other way of being taken seriously than to strike.[142] Fishers target tortoises because perceived threats to the iconic species quickly get conservationist attention.

In a focus group with Isabela fishers in 2007, an incident that had occurred more than 10 years earlier came up in interviews in the midst of discussion of the state crisis declaration. Fishers complained about the resources spent to protect giant tortoises, citing the injustice of conservationists' rush to project tortoises in times of crisis. In 1994, during a wildfire on Isabela (thought to be caused by a runaway campfire), several tortoises were airlifted to safety and one injured tortoise was flown to Florida to have his leg amputated (Interview May 20, 2007). (The injury was caused not directly by the fire, but because the tortoise struggled to escape after a park guard tied his back leg so that he could be kept safe from the fire.)[143] For the fishers, this incident was a classic display of the park's greater concern for wildlife than for the wellbeing of human populations on the islands. (The fire was put out before it got close to town, so the human population had not been under direct threat.)

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[141] http://news.bbc.co.uk/2/hi/americas/3491658.stm (Accessed December 10, 2013)

[142] Interview March 5, 2012

[143] L. Cayot to E. Jacobson correspondence, 13 June 1994. L. Cayot to S. Cameron, 27 June 1994. CDRS Archives.

In contrast to populations who see the tortoises as an important economic resource for development, fishers—who see their livelihoods more often constrained by conservation than aided by it—use the symbolism of the tortoises to contest the hegemony of an alliance among scientists, conservationists and tourism industry. From the beginning of the national park and CDRS, tortoises have been central to conservationists relationship with the local population. In the early 1960s, CDRS scientists collected tortoises kept by residents on Santa Cruz and other islands in an act that demonstrated that they were now to be in charge of native species. Tortoises were no longer to be kept as pets or used for food, but were brought to live in captivity at the CDRS headquarters. (The tortoises lived for a brief period on Santa Fe Island, where one of the first CDRS directors put them for lack of a large enough holding pen.) Poaching among residents on Santa Cruz ended relatively rapidly—my informants repeatedly told me that local residents had long since stopped relying on tortoise meat on the island. (The native population near the human settlement on the other major populated island, San Cristobal, had already gone extinct, so poaching was not an issue by the 1960s.) But poaching on Isabela Island aside from the fishers' strikes—with a much smaller resident population that until very recently had much less contact with both the Park service and tourism—has remained an issue. Concerns about poaching have long prompted calls for increased Park presence and monitoring on Isabela. When I first pitched my project in 2009 to the social scientist at the CDRS (the institution's first on permanent staff), he was excited about the potential for me to do an ethnography of people living in Isabela to discover why they were still poaching tortoises so that conservationists could confront them in an open "tableau" setting. I demurred, explaining this was not the focus I wanted for my project, and consequently spent little time in Isabela over the next several years so as not to become involved in proposed CDRS/GNP surveillance efforts.

When I did interview the director of the GNP office in Isabela in October 2011, he reported that although poaching had not ceased, it was no longer a major political concern. Guards had found five slaughtered tortoises that year—since 2005, the number found ranged between 3 and 11 each year. I asked whether he thought killing tortoises was a political statement—No, he said, "I think that before it was, the tortoises were sacrificed for revenge against the institution, but now it's not like that." He said a black market existed on the island for tortoise meat where a 25-30 year old tortoise could be sold for about $65. He attributed this to a tradition from the time when residents' ancestors had come to Galápagos before the Park was created. Some Galápagos folklore holds that eating tortoises will help you to live as long as they do, although no one I talked to told me this as if they believed it (also, see Constantino 2007 on local cultural significance of tortoises in Isabela). As shown in the figure below, the sentiment is used in advertisements for a local dairy. For the park director, the continued poaching of tortoises was troubling because older people had not come to understand that killing a tortoise was not permitted. He said the guards were trying to discourage people from buying tortoise meat: As he told me, "they think they have to kill the turtle and that eating turtles will do them good…they think the resource is worth more dead than alive, and it is this that we are trying to change."[144]

[144] Interview October 17, 2011

Figure 6.4 "Warning: He who consumes Kastdalen dairy products will live longer than Lonesome George."

On the back of a delivery truck, Bellavista, Santa Cruz, Photo/E Hennessy, October 2011

The experience of Isabela points to the varied nature of tortoise encounters in the Galápagos among differently situated actors. The fishers' contestation of the animals' symbolism has grabbed headlines, but many other Galápagos residents have a very different relationship with the tortoises. For residents who do not work as tour guides, or who do not travel the islands as fishers do, the islands' famed nature is often divorced from their daily lives. In the largest town, Puerto Ayora, on Santa Cruz Island, where some 20,000 people live, there is not much of the famed Galápagos nature on display. It is far easier to find a poster, trinket or restaurant TV showing blue-footed boobies or penguins than it is to see the real thing. In town, the waterfront is fully developed with tourist and cargo docks, the Capitania [Navy port captain], the police headquarters, a Seventh Day Adventist school, and private residences. Darwin Avenue, along the waterfront in Puerto Ayora, is tourism central: hotels, souvenir shops, restaurants and bars. But this changes if you walk a few blocks up into town—the Darwin statutes and expensive tourist restaurants and hotels disappear, replaced with schools, family homes, tiendas, and internet cafes. A fishermen's dock, where pelicans and sea lions circle for the chance to eat the remnants of cleaned fish is the most dynamic site of human-animal encounters in town, a common gathering place for locals and a popular tourist attraction. The town's main beach, Tortuga Bay, inside the park boundaries, is a 2.5-kilometer walk from the western edge of town. It is popular with locals and tourists alike—but it is a place that most residents only have time to visit on the weekends or during early-morning runs. Many children in Galápagos—particularly on Santa Cruz Island where most of the waterfront in town is not open to the public—grow up without any contact with the nature the islands are so famous for. Unless their families have land in the highlands, many grow up without ever seeing tortoise in the wild, even though some 5,000 are estimated to live on the island. [145]

[145] Steve Blake, an ecologist I shadowed in the islands, worked with a local school for two years while he lived on the islands to involve students in his tortoise monitoring projects. His project was unique in its focus on getting young students out into "the field" to participate in science. Despite the constant influx of visiting international scientists and local science staff at the CDRS, the quality of science education in most local schools is very poor. (CDRS has run programs sending scientists into local classrooms for years, and offers more extensive training programs for high school and college students.)

Figure 6.5 Multispecies Encounters at the Fishermen's Dock, Puerto Ayora, Santa Cruz

Photo/ E Hennessy, March 2012

The symbolism of the tortoises extends beyond a representation of pristine nature. Analysis of residents' daily and exceptional experiences of tortoises (or lack thereof) sheds light on the fractures among local resident populations. As different understandings and valuations of nature come into conflict, tortoises have become contested symbols of the hegemony of conservationist control in the islands. Differently situated people's lived experiences generate multiple contradictory understandings of nature that cohere and collide over this iconic species.

Conclusion

Ecotourism is widely critiqued for setting up power imbalances between locals and foreign visitors. Looking closely at the relationship between ecotourism and declarations of crisis in the Galápagos reveals the fractures the commodification of pristine nature creates within island communities as well. Encounters with "wild nature" are at the center of Galápagos ecotourism. As epitomized by the conservation icon Lonesome George, these encounters are at the center of an alliance between tourism and conservation. But the commodification of pristine nature produces ecological, economic, political, and social divides in the islands. Analyzing the different interpretations of Lonesome George among tourists and differently situated island residents demonstrates that through encounters animals do not "speak" for themselves, but are interpreted differently based on perceptions development through people's past lived experiences. Tortoise encounters are multiple and contested. In this chapter, I have been concerned to show the contradictions that emerge from the transmutation of nonhuman labor into commodities through charismatic encounters.

In analyzing nonhuman charisma and the role of animals as conservation icons, we need to look outside the boundaries of moments of lived tourist encounters and place these moments in the relations of production that make them possible. Doing so complicates the ethics of "response-ability" to conservation icons as they are framed in conservationist terms through interpretation signs, ad campaigns, and tour guide spiels. Lonesome George is framed by conservationists to generate sympathy, respect and even a sense of culpability for the fate of nonhuman world. He is a charismatic subject who works to generate political and financial support for conservation. In this light, his charisma creates an emotional affect in "response-able" tourists. But what of an ethical response to the broader material realities of ecotourism in the Galápagos? Increasing consumer environmental consciousness has spurred many cruise companies to trumpet their environmentally friendly practices. Some particularly aware tourists voice concern about the carbon footprints they create through long international flights.

But this sense of responsibility in Galápagos tourism seldom extends past the boundaries of the tourist experience. For many tourists, the pristine ecotourism "bubble" bursts when they learn about development issues in the islands. Several tourists—and potential tourists—I have spoken with interpret this as a paradox—should I go or not if tourism generates money for conservation but simultaneously generates increasing development? But this interpretation reflects the power of hegemonic imaginations of the islands as pristine. Critically analyzing how the ecotourism industry has produced such imaginations leads to a different ethical issue for the responsible tourist. Recognizing that the commodification of the pristine produces social and economic stratifications among island residents is a more important focus for tourists' ethical concerns. Lonesome George should represent not a declensionist narrative about man's destruction of the natural world, but the messy contradictions that emerge through the commodification of nature.

CHAPTER VII: CONCLUSION

The crisis declarations that were issued as I began this research in 2007 provoked considerable debate in the Galápagos about the future of the islands. Although the UNESCO "In Danger" designation was lifted in 2010, these debates continue today, centering on a new vision of Galápagos not as a site of pristine nature, but as a site of sustainable development and "harmony between the natural and social worlds" as one NGO banner put it. These are important conversations which I suspect will never be fully resolved as they reflect differently situated actors' lived experiences, conceptions of nature, and divergent ideas about the meaning of conservation and sustainability. They are difficult conversations because they emerge from and invoke long histories. It is my hope that my work will be considered as part of these debates in an effort to reflect on how histories science, conservation and development in the islands have shaped contemporary politics.

This dissertation has outlined a historical perspective on this crisis moment that situates the origins of the crisis not in the 1970s when tourism development began to take off, but centuries earlier. Instead of the traditional conservationist framing in which basically globalization has caused the crisis, I site the roots of the crisis in a moment in the mid-twentieth century when the Galápagos National Park and Charles Darwin Research Station were founded by networks of American and European naturalists working with UNESCO. Tracing networks of animals, scientists and conservationists in and out of the Galápagos is important because they were instrumental in reframing a place that had long been on the margins of Latin American history and making it into one of the best known environments in South America today and a "golden egg" in the Ecuadorian economy.

Tracking tortoise histories helps us see how histories of science, empire, conservation and tourism are enfolded in the lives of iconic endangered species. In many ways, the Galápagos is a conservation success story—the islands retain 95 percent of their endemic biodiversity, tourism is well-controlled, and tortoise breeding efforts are among the most successful rewilding projects in the world. But while scientists and conservationists have figured out how to save tortoises, they have not figured out how to save Galápagos. As they have proceeded to "conserve evolution" in the islands, the crisis has been brewing around them. As numbers of baby tortoises bred each year has risen, so has the number of tourists and the development associated with them. This should not be a surprise: it is precisely the mandate on which the park and research station were founded.

Geographically, the crisis cannot be understood as contained in a remote archipelago, but has been produced through world historical networks of science, conservation, and development. By founding the station, these scientists reframed what had been more or less an economic wasteland into a "pristine," Darwinian paradise that would support a lucrative tourism industry. The naturalists who campaigned to convince the Ecuadorian government to give them authority over the islands used Darwin's name to make a territorial claim. This was a continuation of a history of scientific imperialism based on the old maxim that was used to justify colonial governance claims—that scientific knowledge provides the most rational use of resources. In this case, the most rational use of resources meant "conserving evolution" for the continued benefit of natural science and as a celebration of Darwin's achievement.

Tracing the biopolitical relations of conservation through tortoise breeding programs and eradication efforts demonstrates that conservation is not a matter of protecting pre-existing natures, but is productive of desired natures. Celebrations of Darwinian nature in the islands are not only about protecting landscapes and species—even perhaps the same animals—that Darwin saw. They are also productive of evolutionary landscapes as conservationists attempt to conserve evolutionary processes on remote islands. The science of evolution may have emerged in part from this island laboratory, but it has also recreated the landscapes to adhere to this particular vision of nature. The science of evolution has become embedded in island landscapes through processes of fieldwork and conservation.

Conservation also depends on and produces particular human subjects with appropriate—or inappropriate—knowledge and skills to protect prized species. The inequalities of knowledge and appropriate ways of relating to nature are reflected in current conservationist discourse aiming to instill a "conservation ethic" among local populations, to teach them to love and care for nature in the "correct" way. But these claims about what conservation entails and how it should be done are at the center of current political debates. Island residents' experiences of nature are very diverse and have in part been structured by the tourism industry and its focus on encounters with "pristine" nature. Nesting bird colonies and whale sharks are not the nature most residents encounter on a regular basis—their experience with Galápagos nature is more often collection of *garua* rains, *cedrela* (cedar) forestry, tuna fishing, or trying to control invasive *mora* (blackberry) on farms. These inequalities are reinforced by a tourism industry that fetishizes endemic species and structurally excludes most local residents from profitable participation. Conserving and commodifying evolution has also become embedded in the islands' socio-economic landscapes and political struggles.

By investigating tensions between science, conservation, and development that are producing crisis in the islands, I contribute to emerging work on how we make sense of recent diagnoses of an "Anthropocene" era. In particular, I push the declensionist narratives that have remained quite strong in Latin American environmental historiography. My work does not tell a story of conservationists stepping in to protect nature from the ravages of colonial capitalism, but rather a more complicated tale in which conservationists made a neo-imperial claim to nature that has brought the islands more fully inside flows of global capital. What my work suggests is that this crisis moment is not just a crisis of threatened species, but a much broader crisis of the rationality of Western science and conservation and their alignment with world capitalism.

By engaging with evolutionary science, the project also reflects on evolution as an analytic for understanding the relationships between nature and culture. Several authors have recently discussed the "co-evolution" of nature and society (Russell 2011, Helmreich 2009, Haraway 2008). My work extends these discussions by engaging with conservation and eco-tourism, but also problematizes the notion of any kind of simple co-evolutionary relationship. Much of the co-evolution literature relies on concepts of "symbiogenesis" or mutual becoming to explore asymmetrical but close relationships with companion species. After a century of popular interpretations of evolution as a struggle of the fittest, focus on "mutual aid" (Kropotkin 2009[1902]) is a refreshing change. But neither of these frameworks fully account for the diversity of co-evolutionary relationships among tortoises, environments, and human societies in the Galápagos. While tortoise keepers have shaped the future evolution of the species through care and breeding, the boundaries of the co-evolutionary relationship do not end at the walls of the breeding center. The relationship has been shaped through centuries of scientific experimentation, zoo breeding, tortoise collecting, and tortoise predation. Today, tortoise breeding is also central to tourism—the industry, if not the tourists themselves, could be said to have co-evolved with the breeding program. But if that is so, then the structural inequalities in local economies produced through the commodification of pristine nature have also co-evolved with the breeding program. It may be a false extension to consider these things evolutionary changes—false in that I am using evolution as mere metaphor if I am not referring to change in a species' traits over time—but I would argue the broader contexts that shape evolutionary change are part of the process itself, not external factors that can be managed separately. This includes biological and ecological processes, social histories, and the development of scientific knowledge.

This is the central insight of a critical geographic perspective of evolution: to understand nature-culture relations, we must open analysis to the variety of factors that influence how particular nature-society relationships come together and how others do not. If evolution is the "elaboration of difference" (Grosz 2004), we must find ways to understand not only how it is produced through articulations of difference, but also how it produces new differences—not only in the traits and genomes of species, but distributed across the worlds of which these species are part. Building from philosophies of biology that frame evolution as articulations among genes, organisms and environments, a critical geographic perspective also takes into account how power-laden relationships of modern capitalism, imperial exploration, the development of scientific knowledge, and sustainable development articulate with organisms, genes and environments. Rather than a reductionist or causal interpretation of evolution, a critical geographic perspective recognizes the role of chance as well as the extended, political networks through which nature-society relationships are shaped. As new technologies—such as the phylogenetics discussed here or the possibility to engineer species genomes—open new avenues for conservation and extend human ability to intervene in shaping both human and nonhuman life, a critical geographic perspective on how we are reshaping evolution becomes increasingly necessary. Engagements with the natural world always reflect cultural priorities and are always historically and biologically overdetermined. A critical geographic perspective on evolution offers analytical tools for parsing articulations among scientific knowledge, species and the political construction of socio-natural landscapes.

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